ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS AFFILIATED COLLEGES
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

   I. Find employment in Core Electrical and Electronics Engineering and service sectors.
   II. Get elevated to technical lead position and lead the organization competitively.
   III. Enter into higher studies leading to post-graduate and research degrees.
   Become consultant and provide solutions to the practical problems of core organization.
   IV. Become an entrepreneur and be part of electrical and electronics product and service industries.

2. PROGRAMME OUTCOMES (POs):

   After going through the four years of study, our Electrical and Electronics Engineering Graduates will exhibit ability to:

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<tr>
<th>PO#</th>
<th>Graduate Attribute</th>
<th>Programme Outcome</th>
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<tr>
<td>1</td>
<td>Engineering knowledge</td>
<td>Apply knowledge of mathematics, basic science and engineering science.</td>
</tr>
<tr>
<td>2</td>
<td>Problem analysis</td>
<td>Identify, formulate and solve engineering problems.</td>
</tr>
<tr>
<td>3</td>
<td>Design/development of solutions</td>
<td>Design an electrical system or process to improve its performance, satisfying its constraints.</td>
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<tr>
<td>4</td>
<td>Conduct investigations of complex problems</td>
<td>Conduct experiments in electrical and electronics systems and interpret the data.</td>
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<tr>
<td>5</td>
<td>Modern tool usage</td>
<td>Apply various tools and techniques to improve the efficiency of the system.</td>
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<tr>
<td>6</td>
<td>The Engineer and society</td>
<td>Conduct themselves to uphold the professional and social obligations.</td>
</tr>
<tr>
<td>7</td>
<td>Environment and sustainability</td>
<td>Design the system with environment consciousness and sustainable development.</td>
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<tr>
<td>8</td>
<td>Ethics</td>
<td>Interacting industry, business and society in a professional and ethical manner.</td>
</tr>
<tr>
<td>9</td>
<td>Individual and team work</td>
<td>Function in a multidisciplinary team.</td>
</tr>
<tr>
<td>10</td>
<td>Communication</td>
<td>Proficiency in oral and written Communication.</td>
</tr>
<tr>
<td>11</td>
<td>Project management and finance</td>
<td>Implement Cost effective and improved system.</td>
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<tr>
<td>12</td>
<td>Life-long learning</td>
<td>Continue professional development and learning as a life-long activity.</td>
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3. PROGRAM SPECIFIC OUTCOMES (PSOs):

On completion of Electrical and Electronics Engineering program, the student will have the following Program Specific Outcomes.

1. **Foundation of Electrical Engineering**: Ability to understand the principles and working of electrical components, circuits, systems and control that are forming a part of power generation, transmission, distribution, utilization, conservation and energy saving. Students can assess the power management, auditing, crisis and energy saving aspects.

2. **Foundation of Mathematical Concepts**: Ability to apply mathematical methodologies to solve problems related with electrical engineering using appropriate engineering tools and algorithms.

3. **Computing and Research Ability**: Ability to use knowledge in various domains to identify research gaps and hence to provide solution which leads to new ideas and innovations.
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1-low, 2-medium, 3-high, '-' no correlation
### ANNA UNIVERSITY, CHENNAI
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REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM
B.E. ELECTRICAL AND ELECTRONICS ENGINEERING
CURRICULUM AND SYLLABI FOR SEMESTERS I TO VIII

#### SEMESTER – I

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*Skill Based Course

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# NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

$ Skill Based Course
# SEMESTER III

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$ Skill Based Course

# SEMESTER IV

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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.
### SEMESTER V

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

### SEMESTER VI

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

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

*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).

### TOTAL CREDITS: 167

### 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: 167
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*Mandatory courses are offered as Non-Credit courses

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*Mandatory courses are offered as Non-Credit courses

### ELECTIVE - MANAGEMENT COURSES

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# Professional Elective Courses: Verticals

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<td>Under Ground Cable Engineering</td>
<td>Analysis of Electrical Machines</td>
<td>Embedded C-Programming</td>
<td>Design of Motor and Power Converters for Electric Vehicles</td>
<td>Computer Control of Processes</td>
<td>Hybrid Energy Technology</td>
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<td>HVDC and FACTS</td>
<td>Electrical Drives</td>
<td>Embedded Control for Electric Drives</td>
<td>Design of Electric Vehicle Charging System</td>
<td>Model Based Control</td>
<td>Grid integrating Techniques and Challenges</td>
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<td>Energy Management and Auditing</td>
<td>SMPS and UPS</td>
<td>Smart System Automation</td>
<td>Testing of Electric Vehicles</td>
<td>Non Linear Control</td>
<td>Sustainable and Environmental Friendly HV Insulation System</td>
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<td>Smart Grids</td>
<td>Control of Power Electronics Circuits</td>
<td>VLSI Design</td>
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**Registration of Professional Elective Courses from Verticals:**

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

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**VERTICAL VI - DIVERSIFIED COURSES**

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

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

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8. Mandatory Course (Non credit)
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>
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<th>Vertical I</th>
<th>Vertical II</th>
<th>Vertical III</th>
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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)

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IP3151 INDUCTION PROGRAMME

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

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

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

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

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

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

(i) Physical Activity

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

(ii) Creative Arts

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

(iii) Universal Human Values

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

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

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

(vii) Visits to Local Area

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

(viii) Familiarization to Dept./Branch & Innovations

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.

TOTAL : 45 PERIODS

LEARNING OUTCOMES:
At the end of the course, learners will be able
CO1: To use appropriate words in a professional context
CO2: To gain understanding of basic 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)
2. English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

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

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COURSE OBJECTIVES:

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

UNIT I MATRICES 9 + 3

UNIT II DIFFERENTIAL CALCULUS 9 + 3

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9 + 3

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

UNIT V MULTIPLE INTEGRALS 9 + 3

TOTAL : 60 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to
CO1: Use the matrix algebra methods for solving practical problems.
CO2: Apply differential calculus tools in solving various application problems.
CO3: Able to use differential calculus ideas on several variable functions.
CO4: Apply different methods of integration in solving practical problems.
CO5: Apply multiple integral ideas in solving areas, volumes and other practical problems.
TEXT BOOKS:
3. James Stewart, "Calculus : Early Transcendentals ", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8 ].

REFERENCES:

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COURSE OBJECTIVES:

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

UNIT I   MECHANICS                                              9

UNIT II              ELECTROMAGNETIC WAVES                                                            9
The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS                                             9

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

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

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:

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

UNIT I  WATER AND ITS TREATMENT

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

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

UNIT IV  FUELS AND COMBUSTION

UNIT V  ENERGY SOURCES AND STORAGE DEVICES
Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-
battery; **Electric vehicles-working principles; Fuel cells:** $\text{H}_2\text{-O}_2$ fuel cell, microbial fuel cell; **Supercapacitors:** Storage principle, types and examples.

**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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**TOTAL:** 45 PERIODS
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, a nd list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

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

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

UNIT V  FILES, MODULES, PACKAGES  
Files and 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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UNIT I LANGUAGE AND LITERATURE

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

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

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

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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. 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)
TEXT-CUM-REFERENCE BOOKS

1. Social Life of Tamils (Dr. K.K. Pillay) – A joint publication of TNTB & ESC and RMRL – (in print)
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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)
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)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)
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/

MAPPING OF COs WITH POs AND PSOs

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PHYSICS LABORATORY : (Any Seven Experiments)

COURSE OBJECTIVES:

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

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

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

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

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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:

MAPPING OF COs WITH POs AND PSOs

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GE3172 ENGLISH LABORATORY L T P C
0 0 2 1

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

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

UNIT IV    CLASSIFICATION AND RECOMMENDATIONS

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

UNIT V    EXPRESSION

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

TOTAL : 30 PERIODS

LEARNING OUTCOMES:
At the end of the course, learners will be able

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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COURSE OBJECTIVES:

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

UNIT I MAKING COMPARISONS

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

UNIT II EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING

Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds

UNIT III PROBLEM SOLVING

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

UNIT IV REPORTING OF EVENTS AND RESEARCH


UNIT V THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY

Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.

COURSE OUTCOMES:

At the end of the course, learners will be able

CO1: To compare and contrast products and ideas in technical texts.
CO2: To identify and report cause and effects in events, industrial processes through technical texts
CO3: To analyse problems in order to arrive at feasible solutions and communicate them in the written format.
CO4: To present their ideas and opinions in a planned and logical manner
CO5: To draft effective resumes in the context of job search.

TEXT BOOKS :

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

REFERENCE BOOKS:

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

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**MA3251**  
STATISTICS AND NUMERICAL METHODS  
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**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:

REFERENCES:

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PH3202 PHYSICS FOR ELECTRICAL ENGINEERING

COURSE OBJECTIVES:

- To make the students to understand the basics of dielectric materials and insulation.
- 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 DIELECTRIC MATERIALS AND INSULATION


UNIT II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS

UNIT III SEMICONDUCTORS AND TRANSPORT PHYSICS  9

UNIT IV OPTICAL PROPERTIES OF MATERIALS  9

UNIT V NANO DEVICES  9

TOTAL: 45 PERIODS

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

CO1: know basics of dielectric materials and insulation.
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:

REFERENCES:
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COURSE OBJECTIVES:

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

UNIT I   PART A: OVERVIEW OF CIVIL ENGINEERING

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

UNIT I   PART B: OVERVIEW OF MECHANICAL ENGINEERING


UNIT II   SURVEYING AND CIVIL ENGINEERING MATERIALS


UNIT III   BUILDING COMPONENTS AND INFRASTRUCTURE


UNIT IV   INTERNAL COMBUSTION ENGINES AND POWER PLANTS

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

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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GE3251 ENGINEERING GRAPHICS

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Drawing engineering curves.
2. Drawing freehand sketch of simple objects.
3. Drawing orthographic projection of solids and section of solids.
4. Drawing development of solids
5. Drawing isometric and perspective projections of simple solids.
CONCEPTS AND CONVENTIONS (Not for Examination)
Importance of graphics in engineering applications — Use of drafting instruments — BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT I PLANE CURVES 6+12
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12
Orthographic projection- principles-Principal planes-First angle projection—projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS AND FREEHAND SKETCHING 6+12
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects.
Practicing three dimensional modeling of simple objects by CAD Software(Not for examination)

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6 +12
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.
Practicing three dimensional modeling of simple objects by CAD Software(Not for examination)

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12
Principles of isometric projection — isometric scale —Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.
Practicing three dimensional modeling of isometric projection of simple objects by CAD Software(Not for examination)

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

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

TEXT 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.

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# NCC Credit Course Level 1*

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## PERSONALITY DEVELOPMENT

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## LEADERSHIP

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## SOCIAL SERVICE AND COMMUNITY DEVELOPMENT

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

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TOTAL : 30 PERIODS
NCC Credit Course Level 1*

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

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TOTAL : 30 PERIODS
GE3252 TAMILS AND TECHNOLOGY LT P C
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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 worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY

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

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. சம்பந்த சமவுகை - மாலிகை மூலமாக - இலங்கை, பிசார்டா (சொகுற்றில்: சொகுற்றில் மலையடை மலையடை காலமானின் காலத்திலுள்ள குற்றில் குற்றில்).
2. காலக்குறிக்குள் சுனை - குமாரியம் பிள், நந்தியம். (சொகுற்றில் பிள்).
3. சுனை - குமாரியம் காலக்குறிக்குள் குற்றிலும் குற்றிலும் குற்றிலும் குற்றிலின் (சொகுற்றிலின் குற்றிலின் குற்றிலின்)
4. பிள் - பிள் குற்றிலும் குற்றிலும். (சொகுற்றிலின் குற்றிலின் குற்றிலின்)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
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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

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

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

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

PART II ELECTRICAL ENGINEERING PRACTICES

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

PART III MECHANICAL ENGINEERING PRACTICES

WELDING WORK:
- b) Practicing gas welding.

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

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

SHEET METAL WORK:
- a) Making of a square tray

FOUNDRY WORK:
- a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES

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

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

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

TOTAL : 60 PERIODS

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

CO1: Draw pipeline 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.
MAPPING OF COs WITH POs AND PSOs

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EE3271                        ELECTRIC CIRCUITS LABORATORY                     L    T    P    C
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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

**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.

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

MAPPING OF COs WITH POs AND PSOs

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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.
COURSE OBJECTIVES:
- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two-dimensional random variables.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To acquaint the students with Differential Equations which are significantly used in engineering problems.

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

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

UNIT III  ANALYTIC FUNCTIONS  9 + 3
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c, cz, \frac{1}{z}, z^2$ - Bilinear transformation.

UNIT IV  COMPLEX INTEGRATION  9 + 3
Line integral - Cauchy’s integral theorem – Cauchy’s integral formula – Taylor’s and Laurent’s series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Applications of circular contour and semicircular contour (with poles NOT on real axis).

UNIT V  ORDINARY DIFFERENTIAL EQUATIONS  9 + 3

COURSE OUTCOMES:
Upon successful completion of the course, students will be able to:
CO1: Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
CO2: Understand the basic concepts of one and two-dimensional random variables and apply in engineering applications.
CO3: To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.

TOTAL: 60 PERIODS
CO4: To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.

CO5: To acquaint the students with Differential Equations which are significantly used in engineering problems.

TEXT BOOKS

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COURSE OBJECTIVES:
- To introduce the basic mathematical concepts related to electromagnetic vector fields
- To impart knowledge on the concepts of:
  - Electrostatic fields, electric potential, energy density and their applications.
  - Magnetostatic fields, magnetic flux density, vector potential and its applications.
  - Different methods of emf generation and Maxwell’s equations
  - Electromagnetic waves and characterizing parameters

UNIT I  ELECTROSTATICS – I  12
Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields – Gradient, Divergence, Curl – theorems and applications - Coulomb’s Law – Electric field intensity – Field due to discrete and continuous charges – Gauss’s law and applications.

UNIT II  ELECTROSTATICS – II  12
Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization – Dielectric strength – Electric field in multiple dielectrics – Boundary conditions, Poisson’s and Laplace’s equations, Capacitance, Energy density, Applications.

UNIT III  MAGNETOSTATICS  12
Lorentz force, magnetic field intensity (H) – Biot–Savart’s Law - Ampere’s Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media – Boundary conditions, scalar and vector potential, Poisson’s Equation, Magnetic force, Torque, Inductance, Energy density, Applications.

UNIT IV  ELECTRODYNAMIC FIELDS  12

UNIT V  ELECTROMAGNETIC WAVES  12
Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector – Plane wave reflection and refraction.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon the successful completion of the course, students will be able to:
CO1: Visualize and explain Gradient, Divergence, and Curl operations on electromagnetic vector fields and identify the electromagnetic sources and their effects.
CO2: Compute and analyse electrostatic fields, electric potential, energy density along with their applications.
CO3: Compute and analyse magneto static fields, magnetic flux density, vector potential along with their applications.
CO4: Explain different methods of emf generation and Maxwell’s equations
CO5: Explain the concept of electromagnetic waves and characterizing parameters

TEXT BOOKS:

REFERENCES

EE3302 DIGITAL LOGIC CIRCUITS

COURSE OBJECTIVES:
- To introduce the fundamentals of combinational and sequential digital circuits.
• To study various number systems and to simplify the mathematical expressions using Boolean functions word problems
• To study implementation of combinational circuits using Gates’ and MSI Devices.
• To study the design of various synchronous and asynchronous circuits
• To introduce digital simulation techniques for development of application oriented logic circuit

UNIT I  NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES  
Number system, error detection, corrections & codes conversions, Boolean algebra: De-Morgan’s theorem, switching functions and minimization using K-maps & Quine McCluskey method - Digital Logic Families - comparison of RTL, DTL, TTL, ECL and MOS families - operation, characteristics of digital logic family.

UNIT II  COMBINATIONAL CIRCUITS  
Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps - simplification and implementation of combinational logic – multiplexers and de multiplexers - code converters, adders, substractors, Encoders and Decoders.

UNIT III  SYNCHRONOUS SEQUENTIAL CIRCUITS  
Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Mealy models- Counters, state diagram; state reduction; state assignment.

UNIT IV  ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY  
Asynchronous sequential logic Circuits-Transition stability, flow stability-race conditions, hazards & errors in digital circuits; analysis of asynchronous sequential logic circuits-introduction to Programmability Logic Devices: PROM – PLA –PAL, CPLD-FPGA.

UNIT V  VHDL  

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon the successful completion of the course, students will be able to:
CO1: Explain various number systems and characteristics of digital logic families
CO2: Apply K-maps and Quine McCluskey methods to simplify the given Boolean expressions
CO3: Explain the implementation of combinational circuit such as multiplexers and de multiplexers - code converters, adders, substractors, Encoders and Decoders
CO4: Design various synchronous and asynchronous circuits using Flip Flots
CO5: Explain asynchronous sequential circuits and programmable logic devices
CO6: Use VHDL for simulating and testing RTL, combinatorial and sequential circuits

TEXTBOOKS:

REFERENCES:

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EC3301 ELECTRON DEVICES AND CIRCUITS L T P C 3 0 0 3

COURSE OBJECTIVES:
- To understand the structure of basic electronic devices.
- To be exposed to active and passive circuit elements.
- To familiarize the operation and applications of transistor like BJT and FET.
- To explore the characteristics of amplifier gain and frequency response.
- To learn the required functionality of positive and negative feedback systems.

UNIT I PN JUNCTION DEVICES 9

UNIT II TRANSISTORS AND THYRISTORS 9
BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT - Structure and characteristics.

UNIT III AMPLIFIERS
BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER
BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS

TOTAL: 45 PERIODS

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

CO1: Explain the structure and operation of PN junction devices (diode, Zener diode, LED and Laser diode)

CO2: Design clipper, clamper, half wave and full wave rectifier, regulator circuits using PN junction diodes

CO3: Analyze the structure and characteristics BJT, FET, MOSFET, UJT, Thyristor and IGBT

CO4: Analyze the performance of various configurations of BJT and MOSFET based amplifier

CO5: Explain the characteristics of MOS based cascade and differential amplifier

CO6: Explain the operation of various feedback amplifiers and oscillators

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EE3303 ELECTRICAL MACHINES - I  L  T  P  C
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COURSE OBJECTIVES:
- To understand the concept of electromechanical energy conversion system.
- To identify the appropriate machine for a given application based on its characteristics.
- To identify the appropriate test to determine the performance parameters of a given machine.
- To familiarize with the procedure for parallel operation of generators and transformers.
- To deliberate the working of auto transformer and three phase transformers.

UNIT I  ELECTROMECHANICAL ENERGY CONVERSION  9
Fundamentals of Magnetic circuits- Statically and dynamically induced EMF - Principle of electromechanical energy conversion forces and torque in magnetic field systems- energy balance in magnetic circuits- magnetic force- co-energy in singly excited and multi excited magnetic field system mmf of distributed windings – Winding Inductances-, magnetic fields in rotating machines- magnetic saturation and leakage fluxes. Introduction to Indian Standard Specifications (ISS) - Role and significance in testing.

UNIT II  DC GENERATORS  9
Principle of operation, constructional details, armature windings and its types, EMF equation, wave shape of induced emf, armature reaction, demagnetizing and cross magnetizing Ampere turns, compensating winding, commutation, methods of improving commutation, interpoles, OCC and load characteristics of different types of DC Generators. Parallel operation of DC Generators, equalizing connections- applications of DC Generators.
UNIT III  DC MOTORS
Principle of operation, significance of back emf, torque equations and power developed by armature, speed control of DC motors, starting methods of DC motors, load characteristics of DC motors, losses and efficiency in DC machine, condition for maximum efficiency. Testing of DC Machines: Brake test, Swinburne’s test, Hopkinson's test, Field test, Retardation test, Separation of core losses-applications of DC motors.

UNIT IV  SINGLE PHASE TRANSFORMER
Construction and principle of operation, equivalent circuit, phasor diagrams, testing - polarity test, open circuit and short circuit tests, voltage regulation, losses and efficiency, all day efficiency, back-to-back test, separation of core losses, parallel operation of single-phase transformers, applications of single-phase transformer.

UNIT V  AUTOTRANSFORMER AND THREE PHASE TRANSFORMER
Construction and working of auto transformer, comparison with two winding transformers, applications of autotransformer. Three Phase Transformer- Construction, types of connections and their comparative features, Scott connection, applications of Scott connection.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

COURSE OUTCOMES:
At the end of the course students will be able to:
CO1: Apply the laws governing the electromechanical energy conversion for singly and multiple excited systems.
CO2: Explain the construction and working principle of DC machines.
CO3: Interpret various characteristics of DC machines.
CO4: Compute various performance parameters of the machine, by conducting suitable tests.
CO5: Draw the equivalent circuit of transformer and predetermine the efficiency and regulation.
CO6: Describe the working principle of auto transformer, three phase transformer with different types of connections.

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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)  

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

UNIT III   LINEAR DATA STRUCTURES (8+1 SKILL)  

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)  
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

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PRESS THROUGH KNOWLEDGE
COURSE OBJECTIVES:
- To enable the students to understand the behavior of semiconductor device based on experimentation.
- Be exposed to active and passive circuit elements.
- Familiarize the operation and characteristics of transistor like BJT and FET.
- Explore the characteristics of amplifier gain and frequency response.
- Learn the required functionality of positive and negative feedback systems.

LIST OF EXPERIMENTS
1. Characteristics of Semiconductor diode, Zener diode, photo diode, and photo transistor,
2. Characteristics of NPN Transistor under common emitter, common collector and common base configurations
3. Characteristics of JFET and draw the equivalent circuit
4. Characteristics of UJT and generation of saw tooth waveforms
5. Design and frequency response characteristics of a Common Emitter amplifier
6. Characteristics of light activated relay circuit
7. Design and testing of RC phase shift and LC oscillators
8. Characteristics of Single Phase half-wave and full wave rectifiers with inductive and capacitive filters
10. Measurement of frequency and phase angle using CRO
11. Realization of passive filters

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:
CO1: Analyze the characteristics of PN, Zener diode and BJT in CE, CC, CB configurations experimentally
CO2: Analyze the characteristics of JFET and UJT experimentally
CO3: Analyze frequency response characteristics of a Common Emitter amplifier experimentally
CO4: Analyze the characteristics of RC phase shift and LC oscillators experimentally
CO5: Analyze the characteristics of half-wave and full-wave rectifier with and without filters experimentally
CO6: Analyze the characteristics of FET based differential amplifier experimentally
CO7: Calculate the frequency and phase angle using CRO experimentally
CO8: Analyze the frequency response characteristics of passive filters experimentally

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COURSE OBJECTIVES:
- To expose the students to determine the characteristics of DC machines and transformers by performing experiments on these machines.
- To provide hands on experience to evaluate the performance parameters of DC machines and transformer by conducting suitable tests.

LIST OF EXPERIMENTS:
1. Open circuit and load characteristics of DC shunt generator- calculation of critical resistance and critical speed.
2. Load characteristics of DC compound generator with differential and cumulative connections.
3. Load test on DC shunt motor.
4. Load test on DC compound motor.
5. Load test on DC series motor.
6. Swinburne’s test and speed control of DC shunt motor.
8. Load test on single-phase transformer and three phase transformers.
9. Open circuit and short circuit tests on single phase transformer.
10. Sumner’s test on single phase transformers.
12. Study of starters and 3-phase transformers connections.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course students will be able to:
CO1: Construct the circuit with appropriate connections for the given DC machine/transformer.
CO2: Experimentally determine the characteristics of different types of DC machines.
CO3: Demonstrate the speed control techniques for a DC motor for industrial applications.
CO4: Identify suitable methods for testing of transformer and DC machines.
CO5: Predetermine the performance parameters of transformers and DC motor.
CO6: Understand DC motor starters and 3-phase transformer connections.

MAPPING OF COs WITH POs AND PSOs
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

MAPPING OF COs WITH POs AND PSOs

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GE3361 PROFESSIONAL DEVELOPMENT

COURSE OBJECTIVES:

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

MS WORD: 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.

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

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

UNIT I ENVIRONMENT AND BIODIVERSITY  6

UNIT II ENVIRONMENTAL POLLUTION  6

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

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

COURSE 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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EE3401 TRANSMISSION AND DISTRIBUTION

COURSE OBJECTIVES:

- To impart knowledge about the configuration of the electrical power systems.
- To study the line parameters and interference with neighboring circuits.
To understand the mechanical design and performance analysis of transmission lines.
To learn about different insulators and underground cables.
To understand and analyze the distribution system.

UNIT I  TRANSMISSION LINE PARAMETERS
Structure of electric power system - Parameters of single and three phase transmission lines with single and double circuits - Resistance, inductance, and capacitance of solid, stranded, and bundled conductors - Typical configuration, conductor types - Symmetrical and unsymmetrical spacing and transposition – application of self and mutual GMD; skin and proximity effects - Effects of earth on the capacitance of the transmission line - interference with neighboring communication circuits.

UNIT II  MODELLING AND PERFORMANCE OF TRANSMISSION LINES
Performance of Transmission lines – short line, medium line and long line – equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance – transmission efficiency and voltage regulation, real and reactive power flow in lines – Power Circle diagrams – Ferranti effect – Formation of Corona – Critical Voltages – Effect on line Performance.

UNIT III  SAG CALCULATION AND LINE SUPPORTS
Mechanical design of overhead lines – Line Supports – Types of towers – Tension and Sag Calculation for different weather conditions – Methods of grounding - Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators.

UNIT IV  UNDERGROUND CABLES

UNIT V  DISTRIBUTION SYSTEMS

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCE BOOKS:
6. V.K.Mehta, Rohit Mehta, ‘Principles of power system’, S. Chand & Company Ltd, New Delhi,
2013

COURSE OUTCOMES
On the successful completion of the course, students will be able to:
CO1: Understand the structure of power system, computation of transmission line parameters for different configurations.
CO2: Model the transmission lines to determine the line performance and to understand the impact of Ferranti effect and corona on line performance.
CO3: Do Mechanical design of transmission lines, grounding and to understand about the insulators in transmission system.
CO4: Design the underground cables and understand the performance analysis of underground cable.
CO5: Understand the modelling, performance analysis and modern trends in distribution system.

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EE3402 LINEAR INTEGRATED CIRCUITS

COURSE OBJECTIVES:
To impart knowledge on the following topics
- Signal analysis using Op-amp based circuits.
- Applications of Op-amp.
- Functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
- IC fabrication procedure.

UNIT I IC FABRICATION
IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realisation of monolithic ICs and packaging. Fabrication of diodes, capacitance,
resistance, FETs and PV Cell.

UNIT II  CHARACTERISTICS OF OPAMP
Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP-AMP; Voltage-shunt feedback and inverting amplifier - Voltage series feedback: and Non-Inverting Amplifier - Basic applications of op-amp –, summer, differentiator and Integrator-V/I & I/V converters.

UNIT III  APPLICATIONS OF OPAMP
Instrumentation amplifier and its applications for transducer Bridge, Log and Antilog Amplifiers- Analog multiplier & Divider, first and second order active filters, comparators, multi vibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R-2R ladder and weighted resistor types), A/D converters using OP-AMPS.

UNIT IV  SPECIAL ICs
Functional block, characteristics of 555 Timer and its PWM application - IC-566 voltage controlled oscillator IC; 565-phase locked loop IC, AD633 Analog multiplier ICs.

UNIT V  APPLICATION ICs
AD623 Instrumentation Amplifier and its application as load cell weight measurement - IC voltage regulators –LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM317, 723 Variability voltage regulators, switching regulator- SMPS - ICL 8038 function generator IC.

TOTAL :45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:
CO1   Explain monolithic IC fabrication process
CO2   Explain the fabrication of diodes, capacitance, resistance, FETs and PV Cell.
CO3  Analyze the characteristics and basic applications (inverting/non-inverting amplifier, summer, differentiator, integrator, V/I and I/V converter) of Op-Amp
CO4   Explain circuit and applications of op-amp based instrumentation amplifier, log/antilog amplifier, analog multiplier /divider, active filters, comparators, waveform generators, A/D and D/A converters
CO5    Explain Functional blocks, characteristics and applications of Timer, PLL, analog multiplier ICs.
CO6   Explain the applications of ICs in Instrumentation amplifier, fixed and variable voltage regulator, SMPS and function generator

TEXT BOOKS:

REFERENCES
5. Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', McGraw Hill,
MAPPING OF COs WITH POs AND PSOs

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EE3403 MEASUREMENTS AND INSTRUMENTATION LT P C 3 0 0 3

COURSE OBJECTIVES
- To educate the fundamental concepts and characteristics of measurement and errors
- To impart the knowledge on the functional aspects of measuring instruments
- To infer the importance of various bridge circuits used with measuring instruments.
- To educate the fundamental working of sensors and transducers and their applications
- To summarize the overall measurement and instrumentation with the knowledge on digital instrumentation principles.

UNIT I CONCEPTS OF MEASUREMENTS
Instruments: classification, applications – Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement - Statistical evaluation of measurement data.

UNIT II MEASUREMENT OF PARAMETERS IN ELECTRICAL SYSTEMS

UNIT III AC/DC BRIDGES AND INSTRUMENTATION AMPLIFIERS

UNIT IV TRANSUDCERS FOR MEASUREMENT OF NON- ELECTRICAL PARAMETERS

UNIT V DIGITAL INSTRUMENTATION
COURSE OUTCOMES:
Upon successful completion of the course, the students should have the:
CO1: Ability to understand the fundamental art of measurement in engineering.
CO2: Ability to understand the structural elements of various instruments.
CO3: Ability to understand the importance of bridge circuits.
CO4: Ability to understand about various transducers and their characteristics by experiments.
CO5: Ability to understand the concept of digital instrumentation and virtual instrumentation by experiments.

TEXT BOOKS:

REFERENCES:

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EE3404 MICROPROCESSOR AND MICROCONTROLLER LT P C 3 0 0 3

COURSE OBJECTIVES:
- To study the addressing modes & instruction set of 8085 &8051
- To develop skills in simple program writing in assembly languages
- To introduce commonly used peripheral/interfacing ICs.
- To study and understand typical applications of micro-processors.
- To study and understand the typical applications of micro-controllers

UNIT I INTRODUCTION TO 8085 ARCHITECTURE 9

UNIT II 8085 INSTRUCTION SET AND PROGRAMMING 9
Instruction format and addressing modes — Assembly language format — Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing - Look up table - Subroutine instructions, stack.

UNIT III INTERFACING BASICS AND ICS 9
Study of Architecture and programming of ICs: 8255 PPI, 8259PIC, 8251USART, 8279 Keyboard display controller and 8254 Timer/Counter – Interfacing with 8085 -A/D and D/A converter interfacing.

UNIT IV INTRODUCTION TO 8051 MICROCONTROLLER 9

UNIT V INTRODUCTION TO RISC BASED ARCHITECTURE 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students should have the:
CO1: Ability to write assembly language program for microprocessor and microcontroller
CO2: Ability to design and implement interfacing of peripheral with microprocessor and microcontroller
CO3: Ability to analyze, comprehend, design and simulate microprocessor based systems used for control and monitoring.
CO4: Ability to analyze, comprehend, design and simulate microcontroller based systems used for control and monitoring.
CO5: Ability to understand and appreciate advanced architecture evolving microprocessor field

TEXTBOOKS:

REFERENCES:
MAPPING OF COs WITH POs AND PSOs

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EE3405 ELECTRICAL MACHINES - II LT P C 3 0 0 3

COURSE OBJECTIVES:

To impart knowledge on the following Topics
- Construction and performance of salient and non - salient type synchronous generators.
- Principle of operation and performance of synchronous motor.
- Construction, principle of operation and performance of induction machines.
- Starting and speed control of three-phase induction motors.
- Construction, principle of operation and performance of single phase induction motors and special machines.

UNIT I  SYNCHRONOUS GENERATOR 9

UNIT II  SYNCHRONOUS MOTOR 9

UNIT III  THREE PHASE INDUCTION MOTOR 9

UNIT IV  STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 9
UNIT V  SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES


TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon the successful completion of the course, students will have the:

CO1: Ability to understand the construction and working principle of Synchronous generator
CO2: Ability to understand the construction and working principle of Synchronous Motor
CO3: Ability to understand the construction and working principle of Three Phase Induction Motor
CO4: Acquire knowledge about the starting and speed control of induction motors.
CO5: To gain knowledge about the basic principles and working of Single phase induction motors and Special Electrical Machines.

TEXT BOOKS:

REFERENCES

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## PERSONALITY DEVELOPMENT

- **PD 3**  
  Group Discussion: Change your mindset, Time Management, Social Skills  
  **6**

- **PD 5**  
  Public Speaking  
  **3**

## LEADERSHIP

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

## DISASTER MANAGEMENT

- **DM 1**  
  Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation  
  **3**

- **DM 2**  
  Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters  
  **9**

- **DM 3**  
  Fire Service & Fire Fighting  
  **1**

## ENVIRONMENTAL AWARENESS & CONSERVATION

- **EA 1**  
  Environmental Awareness and Conservation  
  **3**

## GENERAL AWARENESS

- **GA 1**  
  General Knowledge  
  **4**

## ARMED FORCES

- **AF 1**  
  Armed Forces, Army, CAPF, Police  
  **6**

## ADVENTURE

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

## BORDER & COASTAL AREAS

- **BCA 1**  
  History, Geography & Topography of Border/Coastal areas  
  **2**

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**TOTAL: 45 PERIODS**
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**TOTAL : 45 PERIODS**
COURSE OBJECTIVES:
- To expose the students to the operation of synchronous machines and induction motors and give them experimental skill.

LIST OF EXPERIMENTS
1. Regulation of three phase alternator by EMF and MMF methods.
2. Regulation of three phase alternator by ZPF and ASA methods.
3. Regulation of three phase salient pole alternator by slip test.
4. Measurements of negative sequence and zero sequence impedance of alternators.
5. V and Inverted V curves of Three Phase Synchronous Motor.
7. No load and blocked rotor tests on three-phase induction motor (Determination of equivalent circuit parameters).
10. No load and blocked rotor test on single-phase induction motor.
11. Study of Induction Motor Starters

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student should have the:
CO1: Ability to understand and analyze EMF and MMF methods
CO2: Ability to analyze the characteristics of V and Inverted V curves
CO3: Acquire hands on experience of conducting various tests on alternators and obtaining their performance indices using standard analytical as well as graphical methods. to understand the importance of Synchronous machines
CO4: Acquire hands on experience of conducting various tests on induction motors and obtaining their performance indices using standard analytical as well as graphical methods. to understand the importance of single and three phase Induction motors
CO5: Ability to acquire knowledge on separation of losses

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COURSE OBJECTIVES:
- To learn design, testing and characterizing of circuit behavior with combinational logic gate ICs.
- To learn design, testing and characterizing of circuit behavior with register/counter and sequential logic ICs.
- To learn design, testing and characterizing of circuit behavior with OPAMP ICs.
- To learn design, testing and characterizing of circuit behavior with analog ICs like 555 timer VCO and regulators.
- To learn design, testing and characterizing of circuit behavior with digital ICs like decoders, multiplexers.

LIST OF EXPERIMENTS
1. Implementation of Boolean Functions, Adder and Subtractor circuits.
2. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa.
3. Parity generator and parity checking.
4. Encoders and Decoders.
5. Counters: Design and implementation of 3-bit modulo counters as synchronous and asynchronous types using FF IC's and specific counter IC.
6. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.
7. Study of multiplexer and de multiplexer
8. Timer IC application: Study of NE/SE 555 timer in Astability, Monostability operation.
10. Voltage to frequency characteristics of NE/SE 566 IC.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student should have the:
CO1: Ability to understand and implement Boolean Functions.
CO2: Ability to understand the importance of code conversion
CO3: Ability to Design and implement circuits with digital ICs like decoders, multiplexers, register.
CO4: Ability to acquire knowledge on Application of Op-Ampl
CO5: Ability to Design and implement counters using analog ICs like timers, VCOs and digital ICs like Flip-flops and counters.

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COURSE OBJECTIVES:

- To perform simple arithmetic operations using assembly language program and study the addressing modes & instruction set of 8085 & 8051
- To develop skills in simple program writing in assembly languages
- To write an assembly language program to convert Analog input to Digital output and Digital input to Analog output.
- To perform interfacing experiments with µP8085
- To perform interfacing experiments with µC8051.

PROGRAMMING EXERCISES / EXPERIMENTS WITH µP8085:

1. Simple arithmetic operations: Multi precision addition / subtraction /multiplication / division.
5. Displaying a moving/ rolling message in the student trainer kit’s output device.

PROGRAMMING EXERCISES / EXPERIMENTS WITH µC8051:

10. Displaying a moving/ rolling message in the student trainer kit’s output device.
11. Programming PIC architecture with software tools.

COURSE OUTCOMES:

After studying the above subject, students should have the:

CO1: Ability to write assembly language program for microprocessor.
CO2: Ability to write assembly language program for microcontroller
CO3: Ability to design and implement interfacing of peripheral with microprocessor and microcontroller
CO4: Ability to analyze, comprehend, design and simulate microprocessor based systems used for control and monitoring.
CO5: Ability to analyze, comprehend, design and simulate microcontroller based systems used for control and monitoring.

TOTAL: 45 PERIODS
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### COURSE OBJECTIVES:

- Impact knowledge on need for operational studies and to model the power system under steady state operating condition.
- To understand and apply iterative techniques for power flow analysis.
- To model of carry out short circuit studies for power system during symmetrical fault.
- To study about the various methods for analyzing power system stability.

### UNIT I  POWER SYSTEM


### UNIT II  POWER FLOW ANALYSIS


### UNIT III  SYMMETRICAL FAULT ANALYSIS

- Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin’s theorem - Bus Impedance matrix building algorithm (without mutual coupling) - Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level - Current limiting reactors.

### UNIT IV  UNSYMMETRICAL FAULT ANALYSIS

- Symmetrical components - Sequence impedances - Sequence networks - Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - unsymmetrical fault occurring at any point in a power system.
UNIT V  STABILITY ANALYSIS

COURSE OUTCOMES:
Upon the successful completion of the course, students should have the:
CO1: Ability to model the power system under steady state operating condition.
CO2: Ability to carry out power flow analysis using.
CO3: Ability to infer the significance of short circuit studies in designing circuit breakers.
CO4: Ability to analyze the state of the power system for various unsymmetrical faults.
CO5: Ability to analyze the stability of power system using different methods.

TEXT BOOKS:

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COURSE OBJECTIVES:
- To understand the various applications of power electronic devices for conversion, control and conditioning of the electrical power and to get an overview of different types of power semiconductor devices and their dynamic characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers.
- To study the operation, switching techniques and basic topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and various configurations of AC voltage controller.

UNIT I  SWITCHING POWER SUPPLIES  9
MOSFET dynamic behavior - driver and snubber circuits - low power high switching frequency switching Power supplies, buck, boost, buck-boost converters – Isolated topologies – resonant converters - switching loss calculations and thermal design.

UNIT II  INVERTERS  9
IGBT: Static and dynamic behavior - single phase half bridge and full bridge inverters - VSI :(1phase and three phase inverters square wave operation) - Voltage control of inverters single, multi pulse, sinusoidal, space vector modulation techniques– various harmonic elimination techniques-CSI

UNIT III  UNCONTROLLED RECTIFIERS  9

UNIT IV  CONTROLLED RECTIFIERS  9
SCR-Two transistor analogy based turn- ON – turn ON losses – thermal protection – controlled converters (1 pulse, 2 pulse, 3 pulse, 6 pulse) - displacement factor – ripple and harmonic factor - power factor mitigation, performance parameters – effect of source inductance - inverter angle limit.

UNIT V  AC PHASE CONTROLLERS  9
TRIAC triggering concept with positive and negative gate pulse triggering, TRIAC based phase controllers - various configurations for SCR based single and three phase controllers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon the successful completion of the course, students will be able to:
CO1: Understand the operation of semiconductor devices and dynamic characteristics and to design &analyze the low power SMPS
CO2: Analyze the various uncontrolled rectifiers and design suitable filter circuits
CO3: Analyze the operation of the n-pulse converters and evaluate the performance parameters
CO4: Understand various PWM techniques and apply voltage control and harmonic elimination methods to inverter circuits.
CO5: Understand the operation of AC voltage controllers and its applications.
TEXT BOOKS:

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EE3503 CONTROL SYSTEMS LT P C 3 0 0 3

COURSE OBJECTIVES:
- To make the students to familiarize with various representations of systems.
- To make the students to analyze the stability of linear systems in the time domain and frequency domain.
- To make the students to analyze the stability of linear systems in the frequency domain.
- To make the students to design compensator based on the time and frequency domain specifications.
- To develop linear models: mainly state variable model and Transfer function model

UNIT I MODELING OF LINEAR TIME INVARIANT SYSTEM (LTIV) 9
Control system: Open loop and Closed loop – Feedback control system characteristics – First principle modeling: Mechanical, Electrical and Electromechanical systems – Transfer function representations: Block diagram and Signal flow graph.

UNIT II TIME DOMAIN ANALYSIS 9
UNIT III FREQUENCY DOMAIN ANALYSIS

UNIT IV STATE VARIABLE ANALYSIS

UNIT V DESIGN OF FEED BACK CONTROL SYSTEM

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon the successful completion of the course, students will be able to:
CO1: Represent simple systems in transfer function and state variable forms.
CO2: Analyze simple systems in time domain.
CO3: Analyze simple systems in frequency domain.
CO4: Infer the stability of systems in time and frequency domain.
CO5: Interpret characteristics of the system and find out solution for simple control problems.

TEXT BOOKS:

REFERENCES:

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COURSE OBJECTIVES:
- To study the VI characteristics of SCR, TRIAC, MOSFET and IGBT.
- To analyze the performance of semi converter, full converter, step up, step down choppers by simulation and experimentation.
- To study the behavior of voltage waveforms of PWM inverter applying various modulation techniques.
- To design and analyze the performance of SMPS.
- To study the performance of AC voltage controller by simulation and Experimentation.

LIST OF EXPERIMENTS:
1. Characteristics of SCR and TRIAC.
2. Characteristics of MOSFET and IGBT.
3. AC to DC half controlled converter.
4. AC to DC fully controlled converter.
5. Step down and step up MOSFET based choppers.
6. IGBT based single phase PWM inverter.
7. IGBT based three phase PWM inverter.
8. AC Voltage controller.
9. Switched mode power converter.
10. Simulation of PE circuits (1Φ & 3Φ semi converter, 1Φ & 3Φ full converter, dc-dc converters, ac voltage controllers).

TOTAL :45 PERIODS

COURSE OUTCOMES:
Upon the successful completion of the course, students will be able to:
CO1: Determine the characteristics of SCR, IGBT, TRIAC, MOSFET and IGBT
CO2: Find the transfer characteristics of full converter, semi converter, step up and step down choppers by simulation experimentation.
CO3: Analyze the voltage waveforms for PWM inverter using various modulation techniques.
CO4: Design and experimentally verify the performance of basic DC/DC converter topologies used for SMPS.
CO5: Understand the performance of AC voltage controllers by simulation and experimentation

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COURSE OBJECTIVES:

- To make the students familiarize with various representations of systems.
- To make the students analyze the stability of linear systems in the time domain and frequency domain.
- To make the students design compensator based on the time and frequency domain Specifications.
- To develop linear models mainly state variable model and transfer function model.
- To make the students to design a complete closed loop control system for the physical systems.

LIST OF EXPERIMENTS:

1. Analog (op amp based) simulation of linear differential equations.
3. Real time simulation of differential equations.
4. Mathematical modeling and simulation of physical systems in at least two fields.
   - Mechanical
   - Electrical
   - Chemical process
5. System Identification through process reaction curve.
7. Root Locus based analysis in simulation platform.
8. Determination of transfer function of a physical system using frequency response and Bode’s asymptotes.
11. Discretization of continuous system and effect of sampling.
12. Test of controllability and observability in continuous and discrete domain in simulation platform.
14. Mini Project 1: Simulation of complete closed loop control systems including sensor and actuator dynamics.
15. Mini Project 2: Demonstration of a closed loop system in hardware.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will demonstrate the ability

CO1: To model and analyze simple physical systems and simulate the performance in analog and digital platform.

CO2: To design and implement simple controllers in standard forms.

CO3: To design compensators based on time and frequency domain specifications.

CO4: To design a complete closed control loop and evaluate its performance for simple physical systems.

CO5: To analyze the stability of a physical system in both continuous and discrete domains.
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COURSE OBJECTIVES:
- To understand the significance of protection, protection schemes and role of earthing.
- To study the characteristics, functions and application areas of various relays.
- To acquire practical knowledge about common faults in power system apparatus and applying suitable protective schemes.
- To understand the functioning of static relays and Numerical protection concepts.
- To understand the problems associated with circuit breaking and to discuss about various circuit breakers.

UNIT I PROTECTION SCHEMES
Significance and need for protective schemes – nature and causes of faults – types of faults
Effects of faults - Zones of protection and essential qualities of protection – Types of Protection schemes - Power system Grounding and Methods of Grounding.

UNIT II BASICS OF RELAYS
Operating principles of relays –Universal torque equation - R-X diagram –Electromagnetic Relays – Over current, Directional and non-directional, Distance, Differential, Negative sequence and Under frequency relays.

UNIT III OVERVIEW OF EQUIPMENT PROTECTION
Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line.

UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION
Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Over current protection, transformer differential protection, and distance protection of transmission lines.

UNIT V CIRCUIT BREAKERS

COURSE OUTCOMES:
Upon the successful completion of the course, students will have the ability to:
- CO1: Understand and select proper protective scheme and type of earthing.
- CO2: Explain the operating principles of various relays.
- CO3: Suggest suitable protective scheme for the protection of various power system apparatus.
- CO4: Analyze the importance of static relays and numerical relays in power system protection.
- CO5: Summarize the merits and demerits and application areas of various circuit breakers.

TOTAL : 45 PERIODS
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TEXT BOOKS:

REFERENCES
COURSE OBJECTIVES:

To impart knowledge on,

- The significance of power system operation and control.
- Real power– frequency interaction and design of power– frequency controller.
- Reactive power– voltage interaction and the compensators for maintaining the voltage profile.
- The generation scheduling and economic operation of power system.
- SCADA and its application for real time operation and control of power systems.

UNIT I INTRODUCTION

Power scenario in Indian grid – National and Regional load dispatching centres – Requirements of good power system – Necessity of voltage and frequency regulation – real power vs frequency and reactive power vs voltage control loops - System load variation, load curves – Load forecasting – Computational methods in load forecasting – Load shedding and Islanding – deregulation - Basics of electrical energy tariff.

UNIT II REAL POWER FREQUENCY CONTROL

Basics of speed governing mechanisms and modelling – Speed regulation of two generators in parallel Load Frequency Control (LFC) of single area system – Static and dynamic analysis – LFC of two area system – Tie line modelling – Block diagram representation of two area system – Static and dynamic analysis – Tie line with frequency bias control – State variable model – Integration of economic dispatch control with LFC.

UNIT III REACTIVE POWER – VOLTAGE CONTROL

Generation and absorption of reactive power – Basics of reactive power control – Automatic Voltage Regulator (AVR) – Brushless AC excitation system – Block diagram representation of AVR loop static and dynamic analysis – Stability compensation – Voltage drop in transmission line – Methods of reactive power injection – Tap changing transformer, SVC and STATCOM for voltage control.

UNIT IV ECONOMIC OPERATION OF POWER SYSTEM


UNIT V COMPUTER AIDED CONTROL OF POWER SYSTEM

Need of computer control of power system – Concept of energy control centers and functions – PMU system monitoring, Data acquisition and controls – System hardware configurations – SCADA and EMS functions – State estimation – Measurements and errors – Weighted least square estimation – Various operating states – State transition diagram.

TOTAL: 45 PERIODS
**COURSE OUTCOMES:**

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

CO1: Understand the day – to – day operation of power system.

CO2: Model and analyse the control actions that are implemented to meet the minute-to-minute variation of system real power demand.

CO3: Model and analyze the compensators for reactive power control and various devices used for voltage control.

CO4: Prepare day ahead and real time economic generation scheduling.

CO5: Understand the necessity of computer control of power systems.

**TEXTBOOKS:**


**REFERENCE BOOKS:**


**MAPPING OF COs WITH POs AND PSOs**

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**BORDER & COASTAL AREAS**

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**COMMUNICATION**

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**INFANTRY**

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**MILITARY HISTORY**

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<td>Study of Battles - Indo Pak War 1965, 1971 &amp; Kargil</td>
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**TOTAL: 45 PERIODS**
### 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 |

### NAVAL ORIENTATION

| NO 3 | Modes of Entry - IN, ICG, Merchant Navy | 3 |
| AF 2 | Naval Expeditions & Campaigns | 3 |

### NAVAL COMMUNICATION

| NC 1 | Introduction to Naval Communications | 1 |
| NC 2 | Semaphore | 1 |

### NAVIGATION

| N 1 | Navigation of Ship - Basic Requirements | 1 |
| N 2 | Chart Work | 1 |

### SEAMANSHIP

| MH 1 | Introduction to Anchor Work | 2 |
| MH 2 | Rigging Capsule | 6 |
| MH 3 | Boatwork - Parts of Boat | 2 |
| MH 4 | Boat Pulling Instructions | 2 |
| MH 5 | Whaler Sailing Instructions | 3 |

### FIRE FIGHTING FLOODING & DAMAGE CONTROL

| FFDC 1 | Fire Fighting | 2 |
| FFDC 2 | Damage Control | 2 |

### SHIP MODELLING

| SM | Ship Modelling Capsule | 3 |

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

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

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

### AIRMANSHP
- **A 1**: Airmanship

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

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

### GENERAL SERVICE KNOWLEDGE
- **GSK 4**: Latest Trends & Acquisitions

### AIR CAMPAIGNS
- **AC 1**: Air Campaigns

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

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

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

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**TOTAL : 45 PERIODS**
COURSE OBJECTIVES:
1. To provide a better understanding of modelling of transmission lines in impedance and admittance forms.
2. To apply iterative techniques for power flow analysis and to carry out short circuit and stability studies on power system.
3. To analyze the load – frequency and voltage controls.
4. To analyze optimal dispatch of generators and perform state estimation.
5. To understand the operation of relays, characteristics, and applications.

LIST OF EXPERIMENTS:
2. Formation of Bus Admittance and Impedance Matrices.
5. Symmetric and Unsymmetrical Fault Analysis.
6. Transient Stability Analysis of SMIB System.
12. Testing of CT, PT, and Insulator string.
13. Relay Coordination in Radial Feeder Protection Scheme.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On the successful completion of the laboratory, students will be able to:
CO1: Model and analyze the performance of the transmission lines.
CO2: Perform power flow, short circuit, and stability analysis for any power system network.
CO3: Understand, design, and analyze the load frequency control mechanism.
CO4: Perform optimal scheduling of generators and compute the state of the power system.
CO5: Understand, analyze, and apply the relays for power system protection.
MAPPPING OF COs WITH POs AND PSOs

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EE3701  HIGH VOLTAGE ENGINEERING  L T P C  3 0 0 3

COURSE OBJECTIVES:
- Various types of over voltages in power system and protection methods.
- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination.

UNIT I  OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS  9
Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages – Reflection and Refraction of Travelling waves- protection against over voltages_ Insulation Coordination.

UNIT II  DIELECTRIC BREAKDOWN  9
Properties of Dielectric materials - Gaseous breakdown in uniform and non-uniform fields –Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics- Applications of insulating materials in electrical equipment.

UNIT III  GENERATION AND MEASUREMENTS OF HIGH VOLTAGES AND HIGH CURRENTS  9

UNIT IV  HIGH VOLTAGE TESTING & INSULATION COORDINATION  9
High voltage testing of electrical power apparatus- International and Indian standards – Power
frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers - Insulation Coordination.

UNIT V APPLICATION IN INDUSTRY

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon the successful completion of the course, students will be able to:
CO1: Explain various overvoltage’s and its effects on power systems.
CO2: Understand the breakdown phenomena in different medium under uniform and non-uniform fields.
CO3: Explain the methodsof generating and measuring High DC, AC, Impulse voltage and currents.
CO4: Suggest and Conduct suitable HV testing of Electrical power apparatus as per Standards
CO5: Explain the Industrial Applications of Electrostatic Fields.

TEXT BOOKS

REFERENCES

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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  6

Reading Text: Excerpts from John Stuart Mills’ *On Liberty*

UNIT II  SECULAR VALUES  6
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  6

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

UNIT IV  SOCIAL ETHICS  6
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  6
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.

EE3811 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 any power component/circuit/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, interprete, 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 power components, protection, highvoltage, electronics, process automation, power electronics and drives 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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### VERTICAL I: POWER ENGINEERING

#### EE3001 UTILIZATION AND CONSERVATION OF ELECTRICAL ENERGY

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#### COURSE OBJECTIVES:
- To know various electric drives and traction motors with applications
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To know the conversion of solar and wind energies into electrical energy for different applications.
- To study the domestic utilization of electrical energy.

#### UNIT I ELECTRIC DRIVES AND TRACTION (7+2 Skill) 9

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services traction generator set, traction motors, power transformers - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.

#### UNIT II ILLUMINATION (7+2 Skill) 9

Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED
UNIT III HEATING AND WELDING (7+2 Skill) 9

Unit IV ENERGY CONSERVATION AND ITS IMPORTANCE (7+2 Skill) 9

UNIT V DOMESTIC UTILIZATION OF ELECTRICAL ENERGY (7+2 Skill) 9
House wiring - working principle of air conditioning system, Induction based appliances, Online an OFF line UPS, Batteries - Power quality aspects – nonlinear and domestic loads – Earthing system for Domestic, Industrial and Substation.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation/Quiz/Surprise Test/Solving Problems) 10
1. Choosing electrical motors for drives and traction applications.
2. A general design procedure for lighting schemes.
3. Design of heating element and study of welding methods.
4. Practical case studies of energy conservation.
5. Power requirement for different domestic appliances.

COURSE OUTCOMES:
At the end of the course, students should have the:
CO1 Ability to choose suitable electric drives for different applications
CO2 Ability to design the illumination systems for energy saving
CO3 Ability to demonstrate the utilization of electrical energy for heating and welding purposes
CO4 Ability to know the effective usage of solar and wind energies for electrical applications
CO5 Ability to do electric connection for any domestic appliance like refrigerator, battery charging circuit for a specific household application.
CO6 To illustrate the need for energy conservation and to simulate three phase power control.

TEXT BOOKS:

REFERENCES:
New Delhi-2004.


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**EE3002**

UNDERGROUND CABLE ENGINEERING

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**COURSE OBJECTIVES:**

To impart knowledge on the following topics

- Understanding Power Cable Characteristics and Applications.
- Cable Manufacturing.
- Installation of underground power cables
- Underground cable System Fault Locating.
- Testing and maintenance of Underground cable system.
- Cable Performance and Field Assessment of Power Cables

**UNIT I**

INTRODUCTION TO ELECTRICAL POWER CABLES (7+2 SKILL) 9


**UNIT II**

CABLE ARCHITECTURE, DIELECTRIC THEORY AND CABLE CHARACTERISTICS (7+2 SKILL)

UNIT III  SUPPLY DISTRIBUTION SYSTEMS AND CABLES (7+2 SKILL)  9

UNIT IV  TRANSMISSION SYSTEMS AND CABLES (7+2 SKILL)  9

UNIT V  CABLE INSTALLATION, TESTING, MAINTENANCE (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. Demonstration of cable architecture with cable samples of all types.
2. Understanding the cable manufacturing process through factory visit.
3. Familiarization of the cable laying procedure through field visits.
4. Familiarization of cable jointing / end termination techniques.
5. Understanding and familiarization of cable fault locating techniques through field visit to local distribution company or inhouse laboratory.
6. Understanding testing procedures and condition monitoring tests.

COURSE OUTCOMES:
CO1 Ability to understand the fundamental of underground cable system.
CO2 Ability to gain knowledge on the architecture of UG cable and physical and electrical characteristics of the UG cable.
CO3 Ability to understand different types of cable used in distribution system.
CO4 Ability to acquire knowledge on Underground cables used in transmission system
CO5 Ability to understand the cable installations procedures and practices.
CO6 Ability to understand the theory / methodology of cable fault detection and rectification, testing and maintenance.

TEXT BOOKS:

REFERENCES:

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EE3003 SUBSTATION ENGINEERING AND AUTOMATION

COURSE OBJECTIVES:

- To help engineering students to have a holistic understanding of the concepts behind substation engineering and design.
- The course aims to give an exposure to the students to the requirements of practical aspects including an overview of civil and mechanical aspects.
- Course aims to enhance the knowledge, and give the practical guidelines for site selection, construction, protection along with maintenance, safety in a substation.
- It also aims at providing knowledge about state-of-the-art technology in substation automation system

UNIT I SUBSTATION DESIGN DEVELOPMENT (7+2 SKILL)


UNIT II SUBSTATION EQUIPMENT (7+2 SKILL)

UNIT III  PROTECTION AND SUBSTATION AUTOMATION (7+2 SKILL)  9

UNIT IV  SUBSTATION DESIGN & LAYOUT ENGINEERING (7+2 SKILL)  9
Layout aspects of Outdoor Air Insulated Substation and GIS: Statutory Clearances, Equipment Layout engineering aspects for Outdoor Substation/GIS and related calculations, and guide lines, Cable routing layout, Erection Key Diagram (EKD), switchyard earthing design as per IEEE80, Importance and Types of Earthing, Earthing Design, Types of Earthing Material, Direct stroke Lightning Protection for switchyard with IS/ IEC 62305. LV Cables - Power & Control, MV Cables, Methods for Cable Installation, Practical aspects of Cable Sizing, Cable accessories, Illumination System Design.

UNIT V  INTERFACE ENGINEERING (7+2 SKILL)  9
Civil & Structural Engineering - Familiarization of site development plan, equipment supports structures, foundation for equipment, familiarization of control building and substation building, infrastructure development, Mechanical System- Fire Detection, Alarm System and Fire Suppression System for transformer, Heating, Ventilation and Air-conditioning (HVAC) for Substation.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (GROUP SEMINAR/ MINI PROJECT/ ASSIGNMENT/ CONTENT PREPARATION/ QUIZ/ SURPRISE TEST /SOLVING GATE QUESTIONS /ETC.  10

1. Battery sizing for a substation with a load cycle based on IEEE 1115 Ni-cd - A case study
   OR
2. DG and auxiliary transformer sizing for a substation auxiliary power supply- A case study
3. Overcurrent Relay coordination in a substation- A case study
4. Earthmat sizing calculation for an outdoor substation based on IEEE80- A case study
   OR
5. Direct stroke lightning protection calculation for outdoor switchyard based on IEC 62305- A case study

COURSE OUTCOMES:
On successful completion of the course student will be able to:
CO 1: Understand the key deciding factors involved in substation design and operation
CO 2: Know about the sizing and selection of equipment which forms part of substation
CO 3: Know about composite layout design aspects of the substation with different services and the challenges including statutory clearances.
CO 4: Understand about Interdisciplinary aspects involved in substation design
CO 5: Understand different protection and control scheme involved in substation design
CO 6: Know about substation automation system and different communication protocol involved for efficient operation of a substation

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EE3004 HVDC AND FACTS L T P C 3 0 0 3

COURSE OBJECTIVES:
To understand:
- The problems in AC transmission systems and DC transmission systems
- The operation and control of SVC and TCSC
- The concepts of IGBT based FACTS controllers
- The basic operation Line Commutated Converter(LCC) based HVDC links
- The features of voltage source converter based HVDC link.

UNIT I INTRODUCTION (7+2 Skill) 9
Reactive power control in electrical power transmission lines–load & system compensation, Uncompensated transmission line–shunt and series compensation. Need for HVDC Transmission, Comparison between AC & DC Transmission, Types of HVDC transmission System.

UNIT II STATIC VAR COMPENSATOR (SVC) AND THYRISTOR CONTROLLED SERIES COMPENSATOR (TCSC) (7+2 Skill) 9
VI characteristics of FC+TSR, TSC+TSR, Voltage control by SVC–Advantages of slope in dynamic characteristics–Influence of SVC on system voltage–Design of SVC voltage regulator, Thyristor Controlled Series Compensator (TCSC), Concept of TCSC, Operation of the TCSC–Different modes of operation, Applications:

UNIT III VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS (7+2 Skill) 9
UNIT IV LINE COMMUTATED HVDC TRANSMISSION (7+2 Skill) 9
Operation of Gratz bridge - Effect of delay in Firing Angle – Effect of commutation overlap - Equivalent circuit,. Basic concept of HVDC transmission. Model of operations and control of power flow CC and CIA mode of operation

UNIT V VSC BASED HVDC TRANSMISSION (7+2 Skill) 9
Basic 2 level IGBT inverter operation- 4 Quadrant operation- phase angle control- dq control- Control of power flow in VSC based HVDC Transmission, Topologies of MTDC system.

TOTAL: 45 PERIODS

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

1. Simulation of FC+TSR connected to IEEE 5 bus system
2. Realization of reactive power, support by SVC in open loop and closed loop control in simulation.
3. Regulation of line flows employing TCSC and TSSC in closed loop control in simulation
4. Simulation of two terminal HVDC Link, closed loop control in CC and CIA mode in simulation
5. Realization of four quadrant operation of VSC in open loop mode in simulation

COURSE OUTCOMES:
After completion the above subject, students will be able to understand

CO1: To Identify and understand the problems in AC transmission systems and understand the need for Flexible AC transmission systems and HVDC Transmission
CO2: To understand the operation and control of SVC and TCSC and its applications to enhance the stability and damping.
CO3: To Analyze basic operation and control of voltage source converter based FACTS controllers
CO4: To demonstrate basic operation and control of Line Commutated HVDC Transmission
CO5: To explain the d-q control based operation of VSC based HVDC Transmission

TEXT BOOKS:

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EE3005 ENERGY MANAGEMENT AND AUDITING

COURSE OBJECTIVES:

- To study the concepts behind economic analysis and Load management.
- To understand the basics of materials and energy balance.
- To analyze the energy efficiency in thermal utilities.
- To know the concept of compressed air system.
- To illustrate the concept of lighting systems and cogeneration.

UNIT I GENERAL ASPECTS OF ENERGY MANAGEMENT AND ENERGY AUDIT (7+2 Skill) 9


UNIT II MATERIAL AND ENERGY BALANCE (7+2 Skill) 9

Methods for preparing process flow - material and energy balance diagrams - Energy policy purpose - location of energy management - roles and responsibilities of energy manager – employees training and planning- Financial Management: financial analysis techniques, simple payback period, return on investment, net present value, internal rate of return – Case Study.
UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES (7+2 Skill) 9


UNIT IV ENERGY EFFICIENCY IN COMPRESSED AIR SYSTEM (7+2 Skill) 9


UNIT V ENERGY EFFICIENCY IN ELECTRICAL UTILITIES (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. Study of energy conservation and audit
2. Performance study of Electric Motors.
3. Analysis on fan characteristic curves at different operating points
4. Case study of illumination system
5. Performance analysis of Compressors

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

CO1 Students able to acquire knowledge in the field of energy management and auditing process.

CO2 Learned the about basic concepts of economic analysis and load management.

CO3 Able to design the effective thermal utility system.
CO4  Able to improve the efficiency in compressed air system.
CO5  Acquired the design concepts in the field of lighting systems, light sources and various forms of cogeneration.

TEXTBOOKS:


REFERENCES:


List of Open Source Software/ Learning website:


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EE3006  POWER QUALITY  L T P C  3 0 0 3

COURSE OBJECTIVES:

- To learn the basic definitions in Power Quality.
- To study the power quality issues in Single Phase and Three Phase Systems.
- To understand the principles of Power System Harmonics.
- To know the way to use DSTATCOM for Harmonic Mitigation.
- To learn the concepts related with Series Compensation.

UNIT I  INTRODUCTION  (7+2 Skill) 9


UNIT II  ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM  (7+2 Skill) 9


UNIT III  MITIGATION OF POWER SYSTEM HARMONICS  (7+2 Skill) 9


UNIT IV  LOAD COMPENSATION USING DSTATCOM  (7+2 Skill) 9


UNIT V  SERIES COMPENSATION OF POWER DISTRIBUTION 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)  

1. Harmonic analysis of single phase power converters (Semi converters and Full Converters) with R and RL load via simulation  
2. Harmonic analysis of three phase power converters (Semi converters and Full Converters) with R and RL load via simulation  
3. Harmonic analysis of single phase inverters with R and RL load via simulation  
4. Harmonic analysis of three phase inverters with R and RL load via simulation  
5. Mitigation of Harmonics using Tuned Filter

List of Open Source Software/ Learning website:
1. http://nptel.iitm.ac.in/courses.php
3. https://electricalacademia.com/electric-power
4. https://www.intechopen.com/books/6214
6. https://www.academia.edu/43237017/Use_Series_Compensation_in_Distribution_Networks_33_KV

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
CO1 Use various definitions of power quality for power quality issues
CO2 Describe the concepts related with single phase / three phase, linear / nonlinear loads and single phase / three phase sinusoidal, non-sinusoidal source
CO3 Solve problems related with mitigation of Power System Harmonics
CO4 Use DSTATCOM for load compensation
CO5 Demonstrate the role of DVR, SAFs UPQC in power distribution systems

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EE3007  SMART GRID  LT P C  3 0 0 3

COURSE OBJECTIVES:
- To understand the evolution of Smart and Interconnected energy systems.
- To understand the various challenges and benefits of smart grid and the national and international initiatives taken.
- To understand the concepts related with transmission and distribution in smart grid technologies.
- To get an insight of the various smart measurement technologies.
- To understand the various computing technologies for Smart Operation of the Grid.

UNIT I      INTRODUCTION (7+2 SKILL) 9
Evolution of Energy Systems, Concept, Definitions and Need, Difference between Conventional & Smart Grid, Drivers, structures, functions, opportunities, challenges and benefits of Smart Grid, Basics of Micro grid, National and International Initiatives in Smart Grid.

UNIT II     SMART METERING (7+2 SKILL) 9
Introduction to Advanced Metering infrastructure (AMI) - drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Real time management and control, Phasor Measurement Unit (PMU).

UNIT III    SMART GRID TECHNOLOGIES (Transmission) (7+2 SKILL) 9
Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, Wide area Monitoring, Protection and control.

UNIT IV     SMART GRID TECHNOLOGIES (Distribution) (7+2 SKILL) 9
DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Electric Vehicles.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS (7+2 SKILL) 9
Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Computing technologies for Smart Grid applications (Web Service
to CLOUD Computing), Role of big data and IoT, Cyber Security for Smart Grid.

**TOTAL: 45 PERIODS**

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

1. Assignment-Familiarization of National and International Initiatives in Smart Grid
2. Simulation of smart meter using (MATLAB/ ETAP/SCILAB/ LABVIEW/ Proteus/Equivalent open source software).
3. Visit to a substation for analysing the Automation Technologies like Monitoring, Protection and control.
4. Awareness about High- Efficiency Distribution Transformers, Phase Shifting Transformers in a substation.
5. Introduction to recent technologies in electric vehicles and understanding the operation of EV, HEV and PHEV.
6. Simulation of IoT based digital communication system for smart grid applications.

**COURSE OUTCOMES:**

After completion the above subject, students will be able to understand

- CO1: To be able to understand the importance and objectives of Power System Grid.
- CO2: To be able to know and understand the concept of a smart grid;
- CO3: To identify and discuss smart metering devices and associated technologies.
- CO4: To be able to get an overview of Microgrid and Electric Vehicle Technology.
- CO5: To be able to have an up to date knowledge on the various computing technologies; to understand the role of Big Data and IoT for effective and efficient operation of Smart Grid.

**TEXT BOOKS:**


**REFERENCES:**

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COURSE OBJECTIVES:
Students will be able to:
- Describe various types of deregulated markets in power system.
- Describe the technical and non-technical issues in deregulated power industry.
- Classify different market mechanisms and summarize the role of various entities in the market.
- Analyze the energy and ancillary services management in deregulated power industry.
- Understand the restructuring framework US and Indian power sector

UNIT I  INTRODUCTION  
(7+2 SKILL) 9
Reasons for restructuring - Understanding the restructuring process - objectives of deregulation of various power systems across the world - Consumer behavior - Supplier behavior - Market equilibrium - Short-run and Long-run costs - Various costs of production. The Philosophy of Market Models: Market models based on contractual arrangements - Market architecture.

UNIT II  TRANSMISSION CONGESTION MANAGEMENT  
(7+2 SKILL) 9
Importance of congestion management in deregulated environment - Classification of congestion management methods - Calculation of ATC - Non-market methods - Market based methods - Nodal pricing - Inter-zonal Intra-zonal congestion management - Price area congestion management - Capacity alleviation method.

UNIT III  LOCATIONAL MARGINAL PRICES(LMP) AND FINANCIAL TRANSMISSION RIGHTS  
(7+2 SKILL) 9

UNIT IV  ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK  
(7+2 SKILL) 9
Types of ancillary services - Load-generation balancing related services - Voltage control and reactive power support services - Black start capability service - Mandatory provision of ancillary services - Markets for ancillary services - Co-optimization of energy and reserve services - International comparison. Pricing of transmission network: wheeling - principles of transmission pricing - transmission pricing methods - Marginal transmission pricing paradigm - Composite pricing paradigm - loss allocation methods.

UNIT V  MARKET EVOLUTION  
(7+2 SKILL) 9

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

1. Analysis of ATC calculations using any one of the relevant software tool.
2. DCOPF based LMP calculations using any one of the relevant software tool.
3. ACOPF based LMP calculations using any one of the relevant software tool.
4. Analysis of social welfare maximization with different objectives.
5. Analysis of ABT components.
COURSE OUTCOMES:
Students will be able to:
CO1: describe the requirement for deregulation of the electricity market and the philosophy of various market models
CO2: analyze the various methods of congestion management in deregulated power system
CO3: analyze the locational marginal pricing and financial transmission rights
CO4: analyze the ancillary service management
CO5: analyze transmission pricing paradigm
CO6: understand the evolution of deregulation in Indian power sector

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:

MAPPING OF COs WITH POs AND PSOs

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VERTICAL II: CONVERTERS AND DRIVES

EE3009 SPECIAL ELECTRICAL MACHINES

COURSE OBJECTIVES:
- To understand the working of special machines like stepper motor, switched reluctance motor, BLDC motor & PMSM
- To derive torque equation and study the characteristics of special machines
- To design the controller for special machines
- To study the working principle of synchronous reluctance motor
- To simulate closed loop operation of BLDC motor

UNIT I STEPPER MOTORS
Constructional features – Principle of operation – Types – Torque predictions – Linear and Non-linear analysis – Characteristics – Drive circuits – Closed loop control – Applications

UNIT II SWITCHED RELUCTANCE MOTORS

UNIT III PERMANENT MAGNET BRUSHLESS DC MOTORS

UNIT IV PERMANENT MAGNET SYNCHRONOUS MOTORS

UNIT V STUDY OF OTHER SPECIAL ELECTRICAL MACHINES
Principle of operation and characteristics of Hysteresis motor – AC series motors – Linear motor – Applications.

30 PERIODS

LAB COMPONENT:
Using electromagnetic software
1) Simulation of BLDC motor
2) Simulation of SRM motor
3) Simulation of stepper motor
4) Simulation of PMSM motor
5) Simulation of any other special machines

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:
CO1 Ability to model and analyze power electronic systems and equipment using computational software.
CO2 Ability to optimally design magnetics required in special machines based drive systems using FEM based software tools.
CO3 Ability to analyse the dynamic performance of special electrical machines
CO4 Ability to understand the operation and characteristics of other special electrical machines.
CO5 Ability to design and conduct experiments towards research.

REFERENCES:

EE3010 ANALYSIS OF ELECTRICAL MACHINES 2023

COURSE OBJECTIVES:
- To model & simulate all types of DC machines
- To develop reference frame equations for various elements like R, L and C
- To model an induction (three phase and ‘n’ phase) and synchronous machine
- To drive reference frame equations for induction and synchronous machine
- To study the need and working of multiphase induction and synchronous machine

UNIT I MODELING OF BRUSHED-DC ELECTRIC MACHINERY

UNIT II    REFERENCE FRAME THEORY  
Historical background – phase transformation and commutator transformation – transformation of 
variables from stationary to arbitrary reference frame.

UNIT III    INDUCTION MACHINES  
Three phase induction machine - equivalent circuit– free acceleration characteristics – voltage and 
torque equations in machine variables and arbitrary reference frame variables – Simulation under no-
load and load conditions- Machine variable form, arbitrary reference variable form.

UNIT IV    SYNCHRONOUS MACHINES  
Three phase synchronous machine - voltage and torque equations in machine variables and rotor 
reference frame variables (Park’s equations).

UNIT V    MULTIPHASE (MORE THAN THREE-PHASE) MACHINES CONCEPTS 
Preliminary Remarks - Necessity of Multiphase Machines - Evolution of Multiphase Machines-
Synchronous Machine -Modeling of ‘n’ phase machine. Applications of Multiphase Machines

LAB COMPONENT:  
1. Modeling of DC machines. 
2. Simulation under no-load and loaded conditions for a PMDC motor 
4. Simulation under no-load and load conditions of a three phase induction machine in machine 
   variable form and arbitrary reference variable form. 
5. Simulation under no-load and load conditions of a three phase synchronous machine in machine 
   variable form and arbitrary reference variable form. 

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES: 
At the end of the course, students should be able to: 
CO1: Find the modeling for a brushed DC-Motor (Shunt, Series, Compound and separately 
excepted motor) and to simulate DC motors using state models. 
CO2: Apply reference frame theory for, resistive and reactive elements (three phase) 
CO3: Compute the equivalent circuit and torque of three phase induction motor and synchronous 
motor in machine variable arbitrary reference frame variable 
CO4: Find the need and advantages of multiphase machines 
CO5: Demonstrate the working of multiphase induction and synchronous machine. 
CO6: Compute the model of three phase and multiphase induction and synchronous machine.

REFERENCES:
2020.
5. R.Ramanujam, Modeling and Analysis of Electrical Machines, I.K.International Publishing House 
6. Chee Mun Ong, Dynamic Simulation of Electric Machinery using MATLAB, Prentice Hall, 1997,
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EE3011 MULTILEVEL POWER CONVERTERS L T P C

2 0 2 3

COURSE OBJECTIVES:

- To learn multilevel topology (Symmetry & Asymmetry) with common DC bus link.
- To study the working of cascaded H Bridge, Diode Clamped and Flying Capacitor MLI.
- To study the working of MLI with reduced switch count.
- To simulate three level diode clamped MLI and three level flying capacitor based MLI with resistive and reactive load.
- To simulate the MLI with reduced switch count.

UNIT I MULTILEVEL TOPOLOGIES 6

Introduction – Generalized Topology with a Common DC bus – Converters derived from the generalized topology – symmetric topology without a common DC link – Asymmetric topology.

UNIT II CASCADED H-BRIDGE MULTILEVEL INVERTERS 6


UNIT III DIODE CLAMPED MULTILEVEL CONVERTER 6


UNIT IV FLYING CAPACITOR MULTILEVEL CONVERTER 6

Introduction – Flying Capacitor topology – Modulation scheme for the FCMC – Dynamic voltage balance of FCMC.
UNIT V  MULTILEVEL CONVERTER WITH REDUCED SWITCH COUNT

Multilevel inverter with reduced switch count-structures, working principles and pulse generation methods.

30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Simulation of Fixed PWM, Sinusoidal PWM for an inverter,
2. Simulation of H bridge inverter with R load.
3. Simulation of three level diode clamped MLI with R load.
4. Simulation of three level capacitor clamped MLI with R load.
5. Simulation of MLI with reduced switch configuration.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:
At the end of the course, students should be able to:
CO1: Examine the different topologies of multilevel inverters (MLIs) with and without DC link capacitor.
CO2: Examine the performance of MLIs with Bipolar Pulse Width Modulation (PWM) Unipolar PWM Carrier-Based PWM Schemes Phase Level Shifted Multicarrier Modulation
CO3: Demonstrate the working principles of Cascaded H-Bridge MLI, diode clamped MLI, flying capacitor MLI and MLI with reduced switch count.
CO4: Analyze the voltage balancing performance in Diode clamped MLI.
CO5: Simulate three level, capacitor clamed and diode clamped MLI with R and RL load.
CO6: Simulate MLI with reduced switch configuration using fundamental switching scheme.

TEXT BOOKS:

REFERENCE BOOKS:
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### EE3012 ELECTRICAL DRIVES L T P C 2 0 2 3

**COURSE OBJECTIVES:**
At the end of the course, students should have the:
- To understand steady state operation and transient dynamics of a motor load system.
- To study and analyze the operation of the converter / chopper fed dc drive, both qualitatively and quantitatively.
- To study and understand the operation and performance of AC Induction motor drives.
- To study and understand the operation and performance of AC Synchronous motor drives.
- To analyze and design the current and speed controllers for a closed loop solid state DC motor drives.

**UNIT I DRIVE CHARACTERISTICS** 6

**UNIT II CONVERTER / CHOPPER FED DC MOTOR DRIVE** 6
Steady state analysis of the single and three phase converter fed separately excited DC motor drive – continuous and discontinuous conduction – Time ratio and current limit control – 4 quadrant operation of converter / chopper fed drive.

**UNIT III INDUCTION MOTOR DRIVES** 6
Stator voltage control – energy efficient drive – v/f control – constant air gap flux – field weakening mode – voltage / current fed inverter – closed loop control,

**UNIT IV SYNCHRONOUS MOTOR DRIVES** 6
V/f control and self-control of synchronous motor: Margin angle control and power factor control – permanent magnet synchronous motor.
UNIT V  
DESIGN OF CONTROLLERS FOR DRIVES

Transfer function for DC motor / load and converter – closed loop control with current and speed feedback – armature voltage control and field weakening mode – design of controllers; current controller and speed controller-converter selection and characteristics.

30 PERIODS

LAB COMPONENT:  
30 PERIODS

1. Simulation of converter and chopper fed DC drive
2. Simulation of closed loop operation of stator voltage control of induction motor drive
3. Simulation of closed loop operation of v/f control of induction motor drive
4. Simulation of synchronous motor drive

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to

CO1: Understand the basic requirements of motor selection for different load profiles.
CO2: Analyse the steady state behavior and stability aspects of drive systems.
CO3: Analyse the dynamic performance of the DC drive using converter and chopper control.
CO4: Simulate the AC drive.
CO5: Design the controller for electrical drives.

TEXTBOOKS:


REFERENCES:


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COURSE OBJECTIVES:
- To learn the working of isolated & non-isolated DC-DC converters
- To design isolated & non-isolated DC-DC converters.
- To drive the equations related with converter dynamics.
- To design and simulate P, PI & PID controller for buck, boost and buck-boost converters.
- To identify and study different configurations of the UPS.

UNIT I  ANALYSIS OF NON-ISOLATED DC-DC CONVERTERS  6
Basic topologies: Buck, Boost and Buck-Boost - Principles of operation – Continuous conduction mode– Concepts of volt-sec balance and charge balance – Analysis and design based on steady-state relationships – Introduction to discontinuous conduction mode.

UNIT II  ANALYSIS OF ISOLATED DC-DC CONVERTERS  6
Introduction - classification - forward- flyback- pushpull – half bridge – full bridge topologies- C’uk converter as cascade combination of boost followed by buck – isolated version of C’uk converter - design of SMPS – Introduction to design of magnetic components for SMPS, using relevant software- Simulation of bidirectional DC DC converter (both non-isolated and isolated) considering EV as an example application.

UNIT III  CONVERTER DYNAMICS  6
AC equivalent circuit analysis – State space averaging – Circuit averaging – Transfer function model for buck, boost and buck-boost converters – Simulation of basic topologies using state space model derived – Comparison with the circuit model based simulation already carried out.

UNIT IV  CONTROLLER DESIGN  6

UNIT V  POWER CONDITIONERS AND UPS  6

30 PERIODS

LAB COMPONENT:  30 PERIODS

1. Simulation of Basic topologies.
2. Simulation of bidirectional DC DC converter (both non-isolated and isolated) considering EV as an example application.
3. Simulation of basic topologies using state space model derived – Comparison with the circuit model based simulation already carried out.
4. Simulation study of controller design for basic topologies.
5. Simulation of battery charger for EV applications.
COURSE OUTCOMES:
At the end of the course, students should have the following capabilities:
CO1: Demonstrate the working of buck boost and buck-boost converters in continuous and discontinuous conduction mode.
CO2: Build buck/boost converters using suitable design method.
CO3: Analyze the behaviors of isolated DC-DC converters and to design SMPS for battery operated vehicle.
CO4: Compute state space averaged model and transfer function for buck, boost and buck-boost converters.
CO5: Demonstrate the P, PI and PID controller performance analytically and by simulation for buck boost and buck-boost converters.
CO6: Compare the different topologies of UPS and also simulate them.

TEXT BOOKS:

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EE3014 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS L T P C 2 0 2 3

COURSE OBJECTIVES:
- To learn the various types of renewable sources of energy.
- To understand the electrical machines to be used for wind energy conversion systems.
- To learn the principles of power converters used in solar PV system.
- To study the principle of power converters used in Wind system.
- To simulate the AC-DC, AC-AC Converters, Matrix Converters and PWM Inverters.
UNIT I  INTRODUCTION TO RENEWABLE ENERGY SYSTEMS  6
Classification of Energy Sources – Importance of Non-conventional energy sources – Advantages and disadvantages of conventional energy sources - Environmental aspects of energy - Impacts of renewable energy generation on the environment - Qualitative study of renewable energy resources: Ocean energy, Biomass energy, Hydrogen energy, - Solar Photovoltaic (PV), Fuel cells: Operating principles and characteristics, Wind Energy: Nature of wind, Types, control strategy, operating area.

UNIT II  ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS (WECS)  6
Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).

UNIT III  POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS  6

UNIT IV  POWER CONVERTERS FOR WIND SYSTEMS  6

UNIT V  HYBRID RENEWABLE ENERGY SYSTEMS  9
Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Diesel-PV, Wind-PV, Micro hydel-PV, Biomass-Diesel systems - Maximum Power Point Tracking (MPPT).

30 PERIODS

LAB COMPONENT:  30 PERIODS
1. Simulation on modelling of Solar PV System- V I Characteristics
2. Simulation on Modelling of fuel cell- V I Characteristics
4. Simulation of DFIG/ PMSG based Wind turbine.
5. Simulation on Grid integration of RES.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:
At the end of the course, students should be able to:
CO1: Examine the available renewable energy sources.
CO2: Demonstrate the working principles of electrical machines and power converters used for wind energy conversion system
CO3: Demonstrate the principles of power converters used for solar PV systems
CO4: Examine the available hybrid renewable energy systems.
CO5: Simulate AC-DC converters, buck/boost converters, AC-AC converters and PWM inverters.

REFERENCES:

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**EE3015 CONTROL OF POWER ELECTRONICS CIRCUITS**

L T P C

2 0 2 3

**COURSE OBJECTIVES:**
- To learn the basics of control system simulation.
- To do symbolic calculation.
- To study the principles of sliding mode control and the way of apply smc for buck converter.
- To learn the concept of power factor correction.
- To design simulate smc for buck converter and power factor correction circuit with controller.

**UNIT I SIMULATION BASICS IN CONTROL SYSTEMS**

Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions), state space modelling-transfer function from state space Model.

**UNIT II SYMBOLIC CALCULATIONS**


**UNIT III SLIDING MODE CONTROL BASICS**


**UNIT IV POWER FACTOR CORRECTION CIRCUITS**

Introduction, Operating Principle of Single-Phase PFCs, Control of boost converter based PFCs, Designing the Inner Average-Current-Control Loop, Designing the Outer Voltage-Control Loop, Example of Single-Phase PFC Systems.
UNIT V  CONTROLLER DESIGN FOR PFC CIRCUITS  6

Power factor correction circuit using other SMPS topologies: C’uk and SEPIC converter - PFC circuits employing bridgeless topologies.

30 PERIODS

LAB COMPONENT:  30 PERIODS

1. Simulation exercises on zero, first and second order basic blocks.
2. Simulation exercises based on symbolic calculations.
3. Simulation of Sliding mode control based buck converter.
5. Simulation of Single-Phase PFC circuit employing C’uk converters.

TOTAL: 30+30 = 60  PERIODS

COURSE OUTCOMES:

At the end of the course, students should have the:

CO1: To calculate transfer function for constant, differential, integral, First order and Second order factors.
CO2: To illustrate the effect of poles and zero’s in the ‘s’ plane.
CO3: To select Symbolic equations for solving problems related with Matrices, Polynomial and vectors.
CO4: To compute the control expression for DC – DC buck converter using sliding mode control theory.
CO5: To determine the controller expression for power factor correction circuits.
CO6: To simulate sliding mode control of buck converter and power factor correction circuit.

TEXT BOOKS:


REFERENCES:


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146
COURSE OBJECTIVES:
- To introduce the Building Blocks of an embedded System and Software Tools
- To emphasize the role of Input/output interfacing with Bus Communication protocol.
- To illustrate the ISR and scheduling for the multitasking process.
- To explain the basics of a Real-time operating system
- To analyze the applications based on embedded design approaches

UNIT I  INTRODUCTION TO EMBEDDED SYSTEMS  6
Introduction to Embedded Systems – Structural units in Embedded processor, selection of processor & memory devices- DMA — Memory management methods- Timer and Counting devices, Real Time Clock, In-circuit emulator, Target Hardware Debugging.

UNIT II  EMBEDDED NETWORKING  6

UNIT III  INTERRUPTS THE SERVICE MECHANISM AND DEVICE DRIVER  6
Programmed-I/O busy-wait approach without interrupt service mechanism-ISR concept-interrupt sources – multiple interrupts – context and periods for context switching, interrupt latency and deadline – Introduction to Device Drivers.

UNIT IV  RTOS-BASED EMBEDDED SYSTEM DESIGN  6
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication- shared memory, message passing- Interprocess Communication- Introduction to process synchronization using semaphores.

UNIT V  EMBEDDED SYSTEM APPLICATION DEVELOPMENT  6
Embedded Product Development Life Cycle - Case Study: Precision Agriculture- Autonomous car.

LAB COMPONENT:  30 PERIODS
1. Laboratory exercise: Use any Embedded processor/IDE/open source platform to give hands-on training on basic concepts of embedded system design:
   a) Introduction to IDE and Programming Environment.
   b) Configure timer block for signal generation (with given frequency).
   c) Interrupts programming example using GPIO.
   d) I²C communication with peripherals
   e) Master-slave communication between processors using SPI.
   f) Networking of processor using Wi-Fi.
   g) Basic RTOS concept and programming
2. Assignment: Introduction to VxWorks, C/COS-II, RT Linux
3. Embedded systems-based Mini project.

**TOTAL: 30+30 = 60 PERIODS**

**COURSE OUTCOMES:**

After completion of the above subject, students will be able to understand

**CO1:** The hardware functionalities and software strategies required to develop various Embedded systems
**CO2:** The basic differences between various Bus communication standards
**CO3:** The incorporation of the interface as Interrupt services
**CO4:** The various scheduling algorithms through a Real-time operating system.
**CO5:** The various embedded concepts for developing automation applications.

**TEXTBOOKS:**

**REFERENCES:**

**List of Open Source Software/ Learning websites:**
1. [https://nptel.ac.in/courses/108102045](https://nptel.ac.in/courses/108102045)
2. [https://ece.uwaterloo.ca/~dwharder/icsrts/Lecture_materials/A_practical_introduction_to_real-time_systems_for_undergraduate_engineering.pdf](https://ece.uwaterloo.ca/~dwharder/icsrts/Lecture_materials/A_practical_introduction_to_real-time_systems_for_undergraduate_engineering.pdf)
3. [https://www.circuitbasics.com/basics-of-the-i2c-communication-protocol/](https://www.circuitbasics.com/basics-of-the-i2c-communication-protocol/)

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COURSE OBJECTIVES:

- To expose the students to the fundamentals of embedded Programming
- To Introduce the GNU C Programming Tool Chain.
- To study the basic concepts of embedded C.
- To teach the basics of 8051 Programming
- To involve Discussions/ Practice/Exercise in revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT I BASIC C PROGRAMMING 6

Typical C Program Development Environment - Introduction to C Programming - Structured Program Development in C - Data Types and Operators - C Program Control - C Functions - Introduction to Arrays.

UNIT II EMBEDDED C 6


UNIT III 8051 Programming in C 6

Data types and time delay in 8051, I/O programming in 8051, Logic operations in 8051, Data conversion program in 8051 Accessing code ROM space in 8051, Data serialization using 8051

UNIT IV 8051 SERIAL PORT AND INTERRUPT PROGRAMMING IN C 6

Basics of serial communication, 8051 interface to RS232- serial port programming in 8051. 8051 interrupts and programming, Programming for timer configuration.

UNIT V 8051 INTERFACING 6

8051: ADC interfacing , DAC interfacing, Sensor interfacing, LCD interfacing, Stepper motor interfacing.

30 PERIODS

LAB COMPONENT: 30 PERIODS

1. Laboratory exercise: Use 8051 microcontroller/Embedded processor/IDE/open source platform to give hands-on training on Embedded C programming.
   a. Introduction to IDE (like code blocks, vscode, etc) and Programming Environment (like Keililu vision, Proteus)
   b. Configuring an I/O port using bitwise programming.
   c. Configuring timer for generating hardware delay.
   d. Flashing an LED using an interrupt
   e. Serial communication using UART port of 8051
   f. Interfacing an ADC with 8051
   g. Interfacing an analog sensor with 8051
   h. Interfacing 16x2 LCD with 8051
   i. configuring timer for generating PWM signal
   j. Interfacing a stepper motor with 8051

2. Assignment: Introduction to Arduino IDE, Raspberry Pi
3. Embedded C-Programming-based Mini project.

**TOTAL: 30+30 = 60 PERIODS**

**COURSE OUTCOMES:**
At the end of this course, the students will have the ability to

CO1: Deliver insight into embedded C programming and its salient features for embedded systems.

CO2: Illustrate the software and hardware architecture for distributed computing in embedded systems.

CO3: Develop a solution for problems by using the concept learned in programming using the embedded controllers.

CO4: Develop simple applications with 8051 by using its various features and interfacing with various external hardware.

CO5: Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded programming skills.

**TEXTBOOKS:**

**REFERENCES:**

List of Open Source Software/ Learning websites:
- [https://www.hackerrank.com/](https://www.hackerrank.com/)
- [https://www.cprogramming.com/](https://www.cprogramming.com/)
- [https://onlinecourses.nptel.ac.in/noc19_cs42/preview](https://onlinecourses.nptel.ac.in/noc19_cs42/preview)
- [https://microcontrollerslab.com/8051-microcontroller-tutorials-c/](https://microcontrollerslab.com/8051-microcontroller-tutorials-c/)

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COURSE OBJECTIVES:
- To introduce the architecture of the ARM processor.
- To train students in ARM programming.
- To discuss memory management, append location development with an ARM processor.
- To involve Discussions/ Practice/Exercise in revising & familiarizing the concepts
- To impart the knowledge on single board embedded processors.

UNIT I  ARM ARCHITECTURE
Architecture – Memory Organization – addressing modes -Registers – Pipeline - Interrupts – Coprocessors – Interrupt Structure

UNIT II  ARM MICROCONTROLLER PROGRAMMING
ARM general Instruction set – Thumb instruction set –Introduction to DSP on ARM- basic programming.

UNIT III  PERIPHERALS OF ARM

UNIT IV  ARM COMMUNICATION
ARM With CAN, I²C, and SPI protocols

UNIT V  INTRODUCTION TO SINGLE BOARD EMBEDDED PROCESSOR
Raspberry Pi Architecture - Booting Up RPi- Operating System and Linux Commands -Working with RPi using Python and Sensing Data using Python-programming - GPIO and interfacing peripherals With Raspberry Pi

LAB COMPONENTS:
1. Laboratory exercise:
   a) Programming with IDE - ARM microcontroller
   b) Advanced Timer Features, PWM Generator.
   c) RTC interfacing with ARM using Serial communication programming, Stepper motor control.
   d) ARM-Based Wireless Environmental Parameter Monitoring System displayed through Mobile device.
2. Seminar:
   a) ARM and GSM/GPS interfacing
   b) Introduction to ARM Cortex Processor
3. Raspberry Pi based Mini project.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will have the ability to
CO1: Interpret the basics and functionality of processor functional blocks.
CO2: Observe the specialty of RISC processor Architecture.
CO3: Incorporate the I/O hardware interface of processor with peripherals.
CO4: Emphasis the communication features of the processor.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in commercial embedded processors.
TEXTBOOKS:

REFERENCES:

List of Open Source Software/ Learning websites:
1. https://nptel.ac.in/courses/117106111
2. https://onlinecourses.nptel.ac.in/noc20_cs15/preview
3. https://www.csie.ntu.edu.tw/~cyy/courses/assembly/12fall/lectures/handouts/lec08_ARMARCH.pdf
5. https://www.youtube.com/watch?v=J4fhE4Pp55E&list=PLGs0VKk2DiYypuwUUM2wxzcl9BJHK4Bfh

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**COURSE OBJECTIVES:**
- To provide the control concept for electrical drives
- To emphasize the need of embedded systems for controlling the electrical drives
- To provide knowledge about various embedded system-based control strategies for electrical drives
- To impart the knowledge of optimization and machine learning techniques used for electrical drives
- To familiarize the high-performance computing for electrical drives.

**UNIT I INTRODUCTION TO ELECTRIC DRIVES**

**UNIT II EMBEDDED SYSTEM FOR MOTOR CONTROL**
Embedded Processors choice for motor control—Sensors and interface modules for Electric drives—IoT for Electrical drives applications.

**UNIT III INDUCTION MOTOR CONTROL**
Speed control methods—PWM techniques—VSI fed three-phase induction motor—Fuzzy logic Based speed control for three-phase induction motor—Embedded processor based three phase induction motor speed control.

**UNIT IV BLDC MOTOR CONTROL**
Overview of BLDC Motor—Speed control methods—PWM techniques—Embedded processor based BDLC motor speed control.

**UNIT V SRM MOTOR CONTROL**
Overview of SRM Motor—Speed control methods—PWM techniques—Embedded processor based SRM motor speed control.

**LAB COMPONENTS:**
1. Laboratory exercise: Use any System level simulator/MATLAB/open source platform to give hands-on training on simulation study on Electric drives and control.
   a. Simulation of four quadrant operation and speed control of DC motor
   b. Simulation of 3-phase inverter.
   c. Simulation of Speed control of Induction motor using any suitable software package.
   d. Simulation of Speed control of BLDC motor using any suitable software package.
   e. Simulation of Speed control of SRM using any suitable software package
3. Mini project.: Any Suitable Embedded processor-based speed control of Motors (DC/IM/BLDC/PMSM/SRM)

**TOTAL: 30+30 = 60 PERIODS**

**COURSE OUTCOMES:**
At the end of this course, the students will have the ability to
- CO1: Interpret the significance of embedded control of electrical drives
- CO2: Deliver insight into various control strategies for electrical drives.
- CO3: Developing knowledge of Machine learning and optimization techniques for motor control.
- CO4: Develop embedded system solutions for real-time application such as Electric vehicles and UAVs.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded system skills required for motor control strategy.

**TEXT BOOKS:**


**REFERENCES:**


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

1) [https://archive.nptel.ac.in/courses/108/104/108104140/](https://archive.nptel.ac.in/courses/108/104/108104140/)
2) [https://www.embedded.com/mcus-or-dsp-chips-which-is-in-motor-control/](https://www.embedded.com/mcus-or-dsp-chips-which-is-in-motor-control/)
3) [https://www.e3s-conferences.org/articles/e3sconf/pdf/2019/13/e3sconf_SeFet2019_01004.pdf](https://www.e3s-conferences.org/articles/e3sconf/pdf/2019/13/e3sconf_SeFet2019_01004.pdf)
4) [https://www.electronics-tutorials.ws/blog/pulse-width-modulation.html](https://www.electronics-tutorials.ws/blog/pulse-width-modulation.html)
5) [http://kaliasgoldmedal.yolasite.com/resources/SEM/SRM.pdf](http://kaliasgoldmedal.yolasite.com/resources/SEM/SRM.pdf)

**MAPPING OF COs WITH POs AND PSOs**

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COURSE OBJECTIVES:
- To introduce the smart system technologies and its role in real time applications
- To teach the architecture and requirements of Home Automation.
- To provide an insight into smart appliances and energy management concepts.
- To familiarize the design and needs of smart wearable devices
- To teach the basics of robotics and its role for automation.

UNIT I  INTRODUCTION  6
Overview of a smart system - Hardware and software selection - Smart sensors and Actuators – Communication protocols used for smart systems.

UNIT II  HOME AUTOMATION  6

UNIT III  SMART APPLIANCES AND ENERGY MANAGEMENT  6

UNIT IV  SMART WEARABLE DEVICES  6

UNIT V  EMBEDDED SYSTEMS AND ROBOTICS  6
Fundamental concepts in Robotics- Robots and Controllers components - Embedded processor based: pick and place robot- Mobile Robot Design- UAV.

30 PERIODS

LAB COMPONENTS: 30 PERIODS
1. Laboratory exercise: Use Arduino/ R pi/ any other Embedded processors to give hands on training to understand concepts related to smart automation.
   a) Hands on experiments based on Ubidots & Thing speak / Open-source Analytics Platform
   b) Design and implementation of a smart home system
   c) Bluetooth Based Home Automation Project using Android Phone
   d) GSM Based Home Devices Control
   e) Pick and place robots using Arduino/ any suitable Embedded processor
2. Assignment: Revolution of Smart Automation system across the world and its current scope available in India
3. Mini project: Design of a Smart Automation system ( for any application of students choice)

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will have the ability to
CO1: Understand the concepts of smart system design and its present developments.
CO2: Illustrate different embedded open-source and cost-effective techniques for developing solution for real time applications.
CO3: Acquire knowledge on different platforms and Infrastructure for Smart system design.
CO4: Infer about smart appliances and energy management concepts.
CO5: Improve Employability and entrepreneurship capacity due to knowledge upgradation on embedded system technologies.

TEXTBOOKS:


REFERENCES:


List of Open Source Software/ Learning website:

2. https://www.learnrobotics.org/blog/simple-robot/

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COURSE OBJECTIVES:
• To expose the students to the fundamentals and building of Electronic Engine Control systems.
• To teach on sensor functional components for vehicles.
• To discuss on programmable controllers for vehicles management systems.
• To teach logics of automation & communication techniques for vehicle communication.
• To introduce the infotainment system development.

UNIT I  INTRODUCTION TO AUTOMOTIVE SYSTEMS
Overview of Automotive systems, fuel economy, air-fuel ratio, emission limits and vehicle performance; Electronic control Unit– open-source ECU.

UNIT II  SENSORS AND ACTUATORS FOR AUTOMOTIVES
Review of automotive sensors- sensors interface to the ECU, Smart sensor and actuators for automotive applications.

UNIT III  VEHICLE MANAGEMENT SYSTEMS

UNIT IV  ONBOARD DIAGNOSTICS AND COMMUNICATION
OBD , Vehicle communication protocols- Bluetooth, CAN, LIN, FLEXRAY and MOST.

UNIT V  RECENT TRENDS
Navigation- Autonomous car- Role of IoT in Automotive systems.

30 PERIODS

LAB COMPONENTS:
1. Laboratory exercise: Use MATLAB SIMULINK / equivalent simulation / open source tools
   a) Simulation study of automotive sensors and actuators components
   b) Adaptive cruise control, Anti-Lock Braking System
   c) CAN Connectivity in an Automotive Application using vehicle network toolbox
   d) Interfacing a sensor used in car with microcontroller.
   e) Establishing connection between Bluetooth module and microcontroller.
2. Assignment: AUTOSAR
3. Mini project : Battery Management system for EV batteries.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will have the ability in
CO1: Insight into the significance of the role of embedded system for automotive applications.
CO2: Illustrate the need, selection of sensors and actuators and interfacing with ECU
CO3: Develop the Embedded concepts for vehicle management and control systems.
CO4: Demonstrate the need of Electrical vehicle and able to apply the embedded system technology for various aspects of EVs
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design and its application in automotive systems.
TEXTBOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
2) https://microcontrollerslab.com/can-communication-protocol/
4) https://www.tomtom.com/blog/automated-driving/what-is-adaptive-cruise-control/

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COURSE OBJECTIVES

- To explain the basic concepts of CMOS and
- To introduce the IC fabrication methods
- To introduce the Reconfigurable Processor technologies
- To introduce the basics of analog VLSI design and its importance.
- To learn about the programming of Programmable device using Hardware description Language.

UNIT I  CMOS BASICS  6
MOSFET Scaling - CMOS logic design- Dynamic CMOS –Transmission Gates- BiCMOS

UNIT II  IC FABRICATION  6
CMOS IC Fabrications: n well, p well, twin tub, Sol - Design Rules and Layout.

UNIT III  PROGRAMABLE LOGIC DEVICES  6
PAL, PLA, CPLD architecture and application.

UNIT IV  RECONFIGURABLE PROCESSOR  6
FPGA- Architecture, FPGA based application development- Introduction to FPAA.

UNIT V  HDL PROGRAMMING  6
Verilog HDL- Overview - structural and behavioural modeling concepts-Design examples- Carry Look ahead adders, ALU, Shift Registers.

LAB COMPONENTS:  30 PERIODS
1. Laboratory exercise : Use any FPGA Board /IDE/open source package/ platform to give hands on training on CMOS design/ reconfigurable processor based applications.
   a) CMOS logic circuit simulation using any open source software package
   b) Experiments : structural and behavioural modeling based Verilog HDL programs
   c) Experiment: Combinational and sequential Digital logic implementation with FPGA.
   d) Implementation of carry look ahead adder with FPGA
   e) Implementation of ALU with FPGA
2. Assignment : Low Power VLSI.
3. FPGA based Mini project.

COURSE OUTCOMES:
At the end of this course, the students will have the ability to
CO1: Develop CMOS design techniques
CO2: Learn and build IC fabrication
CO3: Explain the need of reconfigurable computing with PLDs.
CO4: Design and development of reprogrammable FPGA.
CO5: Illustrate and develop HDL computational processes with improved design strategies.
TEXTBOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1) https://archive.nptel.ac.in/courses/108/107/108107129/
4) https://kanchiuniv.ac.in/coursematerials/GSK_Notes_on_PLD_in_VLSI_design.pdf
7) https://www.tutorialspoint.com/vlsi_design/vlsi_design_vhdl_introduction.htm#:~:text=VHDL%20stands%20for%20very%20high,DoD)%20under%20the%20VHSIC%20program.

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COURSE OBJECTIVES:

- To introduce the diverse technological and functional approaches of MEMS/NEMS and applications.
- To understand the microstructures and fabrication methods.
- To provide an insight of micro and nano sensors, actuators.
- To emphasize the need for NEMS technology.
- To update the ongoing trends and real time applications of MEMS and NEMS technology.

UNIT I      INTRODUCTION TO MEMS and NEMS
Overview of Micro electro mechanical systems and Nano Electro mechanical systems, devices and technologies, Laws of scaling- Materials for MEMS and NEMS - Applications of MEMS and NEMS.

UNIT II     MICRO-MACHINING AND MICROFABRICATION TECHNIQUES
Photolithography- Micro manufacturing, Bulk micro machining, surface micro machining, LIGA.

UNIT III    MICRO SENSORS AND MICRO ACTUATORS
Micromachining : Capactive Sensors- Piezoresistive Sensors- Piezoelectric actuators.

UNIT IV     NEMS TECHNOLOGY
Atomic scale precision engineering- Nano Fabrication techniques – NEMS for sensors and actuators.

UNIT V      MEMS and NEMS APPLICATION
Bio MEMS- Optical NEMS- Micro motors- Smart Sensors - Recent trends in MEMS and NEMS.

TOTAL: 30 PERIODS

LAB COMPONENTS:

1. Laboratory experiment: Simulation of MEMS sensors and actuators using Multi physics tool
   a) Simulation of a typical piezo resistive sensor
   b) Simulation of a typical Piezoelectric actuator
   c) Simulation study of a bio sensor
   d) Simulation study of a micro motor

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Explain the material properties and the significance of MEMS and NEMS for industrial automation.

CO2: Demonstrate knowledge delivery on micromachining and micro fabrication.

CO3: Apply the fabrication mechanism for MEMS sensor and actuators.

CO4: Apply the concepts of MEMS and NEMS to models, simulate and process the sensors and actuators.

CO5: Improved Employability and entrepreneurship capacity due to knowledge upgradation on MEMS and NEMS technology.
**TEXTBOOKS:**

**REFERENCES:**

**List of Open Source Software/ Learning website:**
1. https://www.academia.edu/Lectures_on_MEMS_and_MICROSYSTEMS_DESIGN_AND_MANUFACTURE
2. https://nptel.ac.in/courses
3. https://www.iitk.ac.in/me/mems-fabrication
4. http://mems.iiti.ac.in/
5. https://onlinecourses.nptel.ac.in/noc22_ee36/preview

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COURSE OBJECTIVES:

- To introduce the concept of analyzing discrete time signals & systems in the time and frequency domain through mathematical representation.
- To study the various time to frequency domain transformation techniques.
- To understand the computation algorithmic steps for Fourier Transform.
- To study about filters and their design for digital implementation.
- To introduce the programmable digital signal processor & its application.

UNIT I INTRODUCTION
Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect. Digital signal representation.

UNIT II DISCRETE TIME SYSTEM ANALYSIS
Z-transform and its properties, inverse z-transforms; difference equation – Solution by z-transform, application to discrete systems - Stability analysis, frequency response – Convolution – Introduction to Fourier Transform– Discrete time Fourier transform.

UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION

UNIT IV DESIGN OF DIGITAL FILTERS
FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. IIR design: Analog filter design - Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation - Warping, prewarping -Frequency transformation.

UNIT V DIGITAL SIGNAL PROCESSORS
Introduction – Architecture of one DSP processor for motor control – Features – Addressing Formats– Functional modes - Introduction to Commercial Processors

LAB COMPONENTS:

1. Laboratory exercise : Use any DSP processor/MATLAB/open source platform to give hands on training on basic concepts of Digital Signal Processing
   a) To determine impulse and step response of two vectors
   b) To perform convolution between two vectors .
   c) To compute DFT and IDFT of a given sequence.
   d) To perform linear convolution of two sequence using DFT
   e) Design and Implementation of FIR Filter
   f) Design and Implementation of IIR Filter
   g) To determine z-transform from the given transfer function and its ROC
2. Assignment : Implementation of FIR/IIR filter with FPGA.
3. DSP processors based Mini project.

TOTAL: 30+30 = 60 PERIODS
COURSE OUTCOMES:
At the end of this course, the students will have the ability to
CO1: Explain the concepts of digital signal processing
CO2: Illustrate the system representation using transforms
CO3: Learn the transformation techniques for time to frequency conversion
CO4: Design suitable digital FIR, IIR algorithm for the given specification
CO5: Use digital signal processor for application development

TEXTBOOKS:
2. Robert J.Schilling & Sandra L.Harris,’ Introduction to Digital Signal Processing using

REFERENCES:
1. Emmanuel C Ifeachor and Barrie W Jervis, "Digital Signal Processing – A Practical approach" 
5. B. Venkataramani, M. Bhaskar, 'Digital Signal Processors, Architecture, Programming and 

List of Open Source Software/ Learning website:
1. https://nptel.ac.in/courses/117102060
4. https://www.sciencedirect.com/topics/computer-science/digital-signal-processing-
   algorithm#:~:text=Digital%20signal%20processing%20algorithms%20are,known%20as%20
   operations%20or%20ops.
5. https://www.electronicshub.org/introduction-to-fpga/

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COURSE OBJECTIVES:

- To learn the structure of Electric Vehicle, Hybrid Electric Vehicle
- To study about the EV conversion components
- To know about the details and specifications for Electric Vehicles
- To understand the concepts of Plug-in Hybrid Electric Vehicle
- To model and simulate all types of DC motors

UNIT I VEHICLE ARCHITECTURE and SIZING (7+2 Skill) 9

UNIT II VEHICLE MECHANICS (7+2 Skill) 9

UNIT III POWER COMPONENTS AND BRAKES (7+2 Skill) 9
Power train Component sizing- Gears, Clutches, Differential, Transmission and Vehicle Brakes. EV power train sizing, HEV Powertrain sizing, Example.

UNIT IV HYBRID VEHICLE CONTROL STRATEGY (7+2 Skill) 9
Vehicle supervisory control, Mode selection strategy, Modal Control strategies.

UNIT V PLUG-IN HYBRID ELECTRIC VEHICLE (7+2 Skill) 9
Introduction-History-Comparison with electrical and hybrid electrical vehicle-Construction and working of PHEV-Block diagram and components-Charging mechanisms-Advantages of PHEVs.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / etc) Basics of MATLAB simulation 10
1. Variables and Expressions Formats, Vectors and Matrices,
2. Arrays, Vectors,
3. Matrices, Built-in functions, Trigonometric functions,
4. Data types and Plotting.
5. Simulation of drive cycles.

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
CO1: Summarize the History and Evolution of EVs, Hybrid and Plug-In Hybrid EVs
CO2: Describe the various EV components
CO3: Describe the concepts related in the Plug-In Hybrid Electric Vehicles
CO4: Analyse the details and Specifications for the various EVs developed.
CO5: Describe the hybrid vehicle control strategy.
REFERENCES:
5. Heavy-duty Electric Vehicles from Concept to Reality, Shashank Arora, Alireza Tashakori Abkenar, Shantha Gamini Jayasinghe, Kari Tammi, Elsevier Science, 2021

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EE3026 DESIGN OF MOTOR AND POWER CONVERTERS FOR ELECTRIC VEHICLES

COURSE OBJECTIVES:
- To review the drive cycles and requirements of EVs
- To know the working of motors used in Electric Vehicle
- To analyze and model the buck/boost converter operation and to design the same
- To learn the simulation basics of control systems
- To derive transfer functions for DC-DC converters

UNIT I ELECTRIC VEHICLE DYNAMICS
Standard drive cycles-Dynamics of Electric Vehicles-Tractive force-Maximum speed, torque, power, energy requirements of EVs.

UNIT II MOTORS FOR ELECTRIC VEHICLES
Introduction – Speed And Torque control of above and below rated speed-Speed control of EV in the constant power region of electric motors. DC Motors, Induction Motor, Permanent Magnet Synchronous Motors (PMSM), Brushless DC Motors, Switched Reluctance Motors (SRMs). Synchronous Reluctance Machines-Choice of electric machines for EVs.
UNIT III  BASICS OF SIMULATION IN CONTROL SYSTEMS  
Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions), state space modelling-transfer function from state space Model.

UNIT IV  MODELING OF DC-DC CONVERTERS  
Overview of PWM Converter Modelling -Power Stage Modelling - PWM Block Modelling - Voltage Feedback Circuit and Small-Signal Model of PWM Converter - Averaging Power Stage Dynamics - Average Models for buck/boost Converter - Small-Signal Model of Converter Power Stage - Frequency Response of Converter

UNIT V  POWER STAGE TRANSFER FUNCTIONS OF DC – DC CONVERTERS  

30 PERIODS

LAB COMPONENT:  
1. Simple simulation exercises of basic control systems
2. Bode plots and calculation of Gain margin and Phase margin for power stage transfer function via simulation.
3. Design of buck converter
4. Design of boost converter
5. Simulation of buck, boost and buck boost converter-open loop (With power circuit and Transfer function).

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:  
Upon completion of the course, students will be able to:
CO1: To use appropriate electric machine for electric vehicle application
CO2: To compute transfer function with factors such as constant, integral, differential, first order factor and second order factor (both numerators & denominators)
CO3: To compute transfer function from state models
CO4: To design buck, boost and buck-boost converter.
CO5: To compute a power stage transfer functions for DC-DC converters
CO6: To simulate DC-DC converters and to obtain gain margin and phase margin.

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EE3027 ELECTRIC VEHICLE DESIGN, MECHANICS AND CONTROL

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COURSE OBJECTIVES:
- To learn the basics of EV and vehicle mechanics
- To know the EV architecture
- To study the energy storage system concepts
- To derive model for batteries and to know the different types of batteries and its charging methods
- To learn the control preliminaries for DC-DC converters.

UNIT I INTERNAL COMBUSTION ENGINES

UNIT II ELECTRIC VEHICLES AND VEHICLE MECHANICS
Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics.

UNIT III BATTERY MODELING, TYPES AND CHARGING

UNIT IV CONTROL PRELIMINARIES
Control Design Preliminaries - Introduction - Transfer Functions – Bode plot analysis for First order and second order systems - Stability - Transient Performance- Power transfer function for boost converter - Gain margin and Phase margin study-open loop mode.

UNIT V CONTROL OF AC MACHINES
Introduction- Reference frame theory, basics-modeling of induction and synchronous machine in various frames-Vector control- Direct torque control.

30 PERIODS
LAB COMPONENT: 

1. Develop a model that could estimate Soc and SoH of Li-Ion Battery.
2. Modelling and thermal analysis of Li-Ion Battery.
3. Simulation of boost converter and calculating gain and phase margin from the transfer function.
4. Simulation of vector control of induction motor

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
CO1: To describe the concepts related with EV, HEV and to compare the same with internal combustion engine vehicles
CO2: To find gain margin & phase margin for various types of transfer functions of boost converter
CO3: To demonstrate the Control of A C Machines
CO4: To explain the concepts related with batteries and parameters of battery
CO5: To module the battery and to study the research and development for batteries

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COURSE OBJECTIVES:
- To know the charging station and standards
- To learn the concepts of power converters in charging
- To find the charging scheme in renewable based EV charging
- To demonstrate the wireless power transfer technique
- To design & simulate power factor correction circuits

UNIT I  CHARGING STATIONS AND STANDARDS
Introduction-Charging technologies- Conductive charging, EV charging infrastructure, International standards and regulations - Inductive charging, need for inductive charging of EV, Modes and operating principle, Static and dynamic charging, Bidirectional power flow, International standards and regulations

UNIT II  POWER ELECTRONICS FOR EV CHARGING
Layouts of EV Battery Charging Systems-AC charging-DC charging systems- Power Electronic Converters for EV Battery Charging- AC–DC converter with boost PFC circuit, with bridge and without bridge circuit - Bidirectional DC–DC Converters- Non-isolated DC–DC bidirectional converter topologies- Half-bridge bidirectional converter.

UNIT III  EV CHARGING USING RENEWABLE AND STORAGE SYSTEMS
Introduction- - EV charger topologies , EV charging/discharging strategies - Integration of EV charging-home solar PV system , Operation modes of EVC-HSP system , Control strategy of EVC-HSP system - fast-charging infrastructure with solar PV and energy storage.

UNIT IV  WIRELESS POWER TRANSFER

UNIT V  POWER FACTOR CORRECTION IN CHARGING SYSTEM
Need for power factor correction- Boost Converter for Power Factor Correction, Sizing the Boost Inductor, Average Currents in the Rectifier and calculation of power losses-

LAB COMPONENT:
1. Simulation and analysis for bi-directional charging V2G and G2V.
2. Design and demonstrate solar PV based EV charging station.
3. Simulate and infer wireless power charging station for EV charging.
4. Simulation of boost converter based power factor correction.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:
CO1: To illustrate various charging techniques and to know charging standards and regulations.
CO2: To demonstrate the working o DC-DC converters used for charging systems and principles
CO3: To illustrate the advantages of renewable system based charging systems
CO4: To demonstrate the principles of wireless power transfer.
CO5: To analyze the standards for wireless charging
CO6: To design and simulate boost converter based power factor correction.
REFERENCES:

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EE3029 TESTING OF ELECTRIC VEHICLES

COURSE OBJECTIVES:
- To know various standardization procedures
- To learn the testing procedures for EV & HEV components
- To know the functional safety and EMC
- To realize the effect of EMC in EVs
- To study the effect of EMI in motor drives and in DC-DC converter system

UNIT I EV STANDARDIZATION
Introduction - Current status of standardization of electric vehicles, electric Vehicles and Standardization - Standardization Bodies Active in the Field – Standardization activities in countries like Japan. The International Electro Technical Commission - Standardization of Vehicle Components.

UNIT II TESTING OF ELECTRIC MOTORS AND CONTROLLERS FOR ELECTRIC AND HYBRID ELECTRIC VEHICLES
UNIT III  FUNDAMENTALS OF FUNCTIONAL SAFETY AND EMC  6

UNIT IV  EMC IN ELECTRIC VEHICLES  6
Introduction - EMC Problems of EVs, EMC Problems of Motor Drive, EMC Problems of DC-DC Converter System, EMC Problems of Wireless Charging System, EMC Problem of Vehicle Controller, EMC Problems of Battery Management System, Vehicle EMC Requirements-

UNIT V  EMI IN MOTOR DRIVE AND DC-DC CONVERTER SYSTEM  6

30 PERIODS

LAB COMPONENT:  30 PERIODS
1. Design and simulate motor controller for hybrid electric vehicle applications
2. Simulation of EMC analysis for Wireless power transfer EV charging.
3. Design and simulation of EMI filter

TOTAL: 30+30 = 60  PERIODS

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
CO1: To describe the status and other details of standardization of EVs
CO2: To illustrate the testing protocols for EVs and HEV components
CO3: To analyze the safety cycle and need for functions safety for EVs
CO4: To analyze the problems related with EMC for EV components.
CO5: To evaluate the EMI in motor drive and DC-DC converter system.

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EE3030 GRID INTEGRATION OF ELECTRIC VEHICLES

COURSE OBJECTIVES:

- To know the basic details of V2G
- To study the benefits & challenges of V2G
- To learn EV & V2G on the smart grids renewable energy systems
- To know the grid integration

UNIT I DEFINITION, And STATUS Of V2G (7+2 Skill) 9
Defining Vehicle to Grid (V2G) - History and Development of V2G. Incorporating V2G to the EV, Auditing and Metering, V2G in Practice, V2G - Power Markets and Applications, Electricity Markets and V2G Suitability, Long-Term Storage, Renewable Energy, and Other Grid Applications, Beyond the Grid: Other Concepts Related to V2G.

UNIT II BENEFITS AND CHALLENGES OF V2G (7+2 Skill) 9

UNIT III CHALLENGES TO V2G (7+2 Skill) 9

UNIT IV IMPACT OF EV AND V2G ON THE SMART GRID AND RENEWABLE ENERGY SYSTEMS (7+2 Skill) 9
UNIT V GRID INTEGRATION AND MANAGEMENT OF EVS (7+2 Skill) 9
Introduction - Machine to Machine (M2M) in distributed energy management systems - M2M communication for EVs - M2M communication architecture (3GPP) - Electric vehicle data logging - Scalability of electric vehicles - M2M communication with scheduling.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/Surprise Test / etc) 10
1. Simulation of connecting three phase inverter to the grid.
2. Simulate and analyse the power quality issues of V2G systems
3. Design and simulate battery management system for smart grid with distributed generation.

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
CO1 : Explain the concepts related with V2G
CO2 : Study the grid connection of 3 phase Q inverter
CO3 : Explain the technical, economics. business, regulatory & political challenges related with V2G
CO4 : Demonstrate the impact of EV and V2G on smart grid and renewable energy system
CO5 : Explain the concept of grid integration and management of EVs.

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EE3031  INTELLIGENT CONTROL OF ELECTRIC VEHICLES  L  T  P  C
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COURSE OBJECTIVES:
- To design and drive the mathematical model of a BLDC motor and its characteristics
- To learn the different control schemes for BLDC motor
- To study the basics of fuzzy logic
- To study the FPGA & VHDL basics
- To implement fuzzy logic control of BLDC motor in real time

UNIT I  MATHEMATICAL MODEL AND CHARACTERISTICS ANALYSIS OF THE BLDC MOTOR

UNIT II  SPEED CONTROL FOR ELECTRIC DRIVES

UNIT III  FUZZY LOGIC

UNIT IV  FPGA AND VHDL BASICS

UNIT V  REAL TIME IMPLEMENTATION
Inverter design, identifying rotor position via hall effect sensors, open loop and fuzzy logic control of 48 V BLDC motor using FPGA.

LAB COMPONENT:
1. Design and simulate speed controller for induction motors in EV for both dynamic and steady state performance
2. Simulate a fuzzy logic controller based energy storage system for EV.
3. Fuzzy logic control of BLDC motor using FPGA in real time

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:
Upon the successful completion of the course, students will be able to:
CO1: To design the mathematical model of a BLDC motor and to discuss about its characteristics
CO2: To demonstrate the PID control, ant windup controller, Intelligent Controller and Vector Control. Control applied to BLDC motor.
CO3: To illustrate the basics of fuzzy logic system
CO4: To describe the basics of VHDL & FPGA applied to control of EVs.
CO5: To design and implement of fuzzy logic control scheme for BLDC motor using FPGA in real time.

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CIC331  PROCESS MODELING AND SIMULATION       L   T   P   C
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COURSE OBJECTIVES:
- To understand the importance 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)  9
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)  9
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)  9
Concept of degree of freedom analysis: System and its subsystem, System interaction, Degree
of freedomin 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)  9
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)  9
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.

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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

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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 system

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 system–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:

REFERENCE

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 CLOSED-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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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 Studies

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 system L5.
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 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
Features of linear and non-linear systems - Common physical non-linearities – Methods of
linearization Concept of phase portraits – Singular points – Limit cycles – Construction of
phaseportraits – Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT III  DESCRIBING FUNCTION ANALYSIS  (7+2 SKILL)  9
Basic concepts, derivation of describing functions for common non-linearities – Describing

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 nonlinearities 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://in.mathworks.com/discovery/kalman-filter.html
https://onlinecourses.nptel.ac.in/noc22_ee24/preview

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  CALCU LUS 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


TOTAL:45 PERIODS

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

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#qlg
2. https://www.codeproject.com/Articles/863257/Simple-Software-for-Optimal-Control
5. https://www.vlab.co.in/

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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)
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:**

1. [https://archive.nptel.ac.in/courses/108/102/108102113/](https://archive.nptel.ac.in/courses/108/102/108102113/)
5. [https://www.vlab.co.in/](https://www.vlab.co.in/)

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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.

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.

TEXT BOOKS:
REFERENCES:

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

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COURSE OBJECTIVES:
Students will be able to:

- understand the various types of energy storage technologies.
- analyze thermal storage systems.
- analyze different battery storage technologies.
- analyze the thermodynamics of fuel cell.
- study the various applications of energy storage systems.

UNIT I  INTRODUCTION
Necessity of energy storage – types of energy storage – comparison of energy storage technologies – Applications.

UNIT II  THERMAL STORAGE SYSTEM
Thermal storage – Types – Modeling of thermal storage units – Simple water and rock bed storage system – pressurized water storage system – Modelling of phase change storage system – Simple units, packed bed storage units - Modelling using porous medium approach, Use of TRNSYS.

UNIT III  ELECTRICAL ENERGY STORAGE
Fundamental concept of batteries – measuring of battery performance, charging and discharging, power density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel – Cadmium, Zinc Manganese dioxide, Li-ion batteries - Mathematical Modelling for Lead Acid Batteries – Flow Batteries.

UNIT IV  FUEL CELL

UNIT V  ALTERNATE ENERGY STORAGE TECHNOLOGIES

TOTAL: 45 PERIODS

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

1. Model, simulate and analyze the performance characteristics of thermal storage systems.
2. Develop a model for latent heat storage in phase changing materials.
3. Model, simulate and analyze the performance characteristics of Lead Acid Batteries.
4. Model, simulate and analyze the performance characteristics of Fuel Cell.
5. Techno-economic analysis of different types of storage systems.

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

CO1: Understand different types storage technologies.
CO2: Design a thermal storage system
CO3: Model battery storage system
CO4: Analyze the thermodynamics of fuel cell
CO5: Analyze the appropriate storage technologies for different applications
CO6: explore the alternate energy storage technologies.

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COURSE OBJECTIVES:

- To provide knowledge about different types of hybrid energy systems.
- To analyze the various electrical Generators used for the Wind Energy Conversion Systems.
- To design the power converters used in SPV Systems.
- To analyze the various power converters used in hybrid energy systems and to understand the importance of standalone and grid-connected operation in Hybrid renewable energy systems.
- To analyze the performance of the various hybrid energy systems

UNIT I

INTRODUCTION TO HYBRID ENERGY SYSTEMS


UNIT II

ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS

Review of reference theory fundamentals –Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).

UNIT III

POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS

Power Converters for SPV Systems - Line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing - Analysis of SPV Systems - Block diagram of the solar PV systems - Types of Solar PV systems: Stand-alone PV systems,

UNIT IV

ANALYSIS OF POWER CONVERTERS FOR HYBRID ENERGY SYSTEMS


UNIT V

CASE STUDIES FOR HYBRID RENEWABLE ENERGY SYSTEMS


TOTAL : 45 PERIODS

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

1. Simulation of Wind energy conversion system
2. Simulation of power converters
3. Simulations of AC-DC-AC converters, PWM inverters and Matrix Converters with Resistive and dynamic loads
COURSE OUTCOMES:
Upon completion of the course, students will be able to:
CO1: Analyze the impacts of hybrid energy technologies on the environment and
demonstrate them to harness electrical power.
CO2: Select a suitable Electrical machine for Wind Energy Conversion Systems and simulate
wind energy conversion system
CO3: Design the power converters such as AC-DC, DC-DC, and AC-AC converters for
SPV systems.
CO4: Analyze the power converters such as AC-DC, DC-DC, and AC-AC converters for
Hybrid energy systems.
CO5: Interpret the hybrid renewable energy systems.

TEXTBOOKS:

REFERENCES:
Impression, 2005.
7. B.H.Khan "Non-conventional Energy sources", Tata McGraw hill Publishing Company, New Delhi,

List of Open Source Software/ Learning website:
1. https://www.sciencedirect.com/topics/engineering/hybrid-energy-system
3. https://www.academia.edu/35619294/Modeling_and_Performance_Analysis_of_Solar_PV_S
4. System_and_DC_DC_Converters
5. https://www.mdpi.com/journal/energies/special_issues/Power_Converter_Electric_Machines
6. _Renewable_Energy_Systems_Transportation
7. https://www.intechopen.com/chapters/64317
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EE3034 DESIGN AND MODELLING OF RENEWABLE ENERGY SYSTEMS

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<td>• To review the renewable energy systems and technology</td>
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<td>• To learn the Single phase grid-connected photovoltaic systems and three phase photovoltaic systems</td>
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<td>• To illustrate the small wind energy systems</td>
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<td>• To simulate the Doubly-fed induction generator based WECS</td>
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UNIT I RENEWABLE ENERGY SYSTEMS: TECHNOLOGY OVERVIEW AND PERSPECTIVES (7+2 Skill) 9

Introduction-State of the Art- Examples of Recent Research and Development Challenges and Future Trends

UNIT II SINGLE-PHASE GRID-CONNECTED PHOTOVOLTAIC SYSTEMS (7+2 Skill) 9


UNIT III THREE-PHASE PHOTOVOLTAIC SYSTEMS: STRUCTURES, TOPOLOGIES (7+2 Skill) 9


UNIT IV SMALL WIND ENERGY SYSTEMS (7+2 Skill) 9

UNIT V DOUBLY-FED INDUCTION GENERATOR-BASED WECS (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. Simulation of inverter for PV systems
2. Simulation of WECS with DFIG

List of Open Source Software/ Learning website:

4. academia.edu/32704493/Wind_Power_Lecture_Notes

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

CO1: Review the perspectives of renewable energy systems
CO2: Integrate photovoltaic systems with grid
CO3: Study inverter for PV systems
CO4: Elaborate the working of small wind power systems
CO5: Study the features of induction machine and doubly fed induction machine

TEXT BOOKS:


REFERENCES:

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EE3035  GRID INTEGRATING TECHNIQUES AND CHALLENGES  L T P C  2023

COURSE OBJECTIVES:

- To study about the present power Scenario
- To model a micro grid system
- To model power converter for grid interconnection
- To integrate wind energy conversion system with grid
- To simulate power converters like three phase inverters and DC-DC converters

UNIT I  PRESENT POWER SCENARIO IN INDIA  6

UNIT II  POWER GRIDS  6

UNIT III  MODELING OF CONVERTERS IN POWER GRID DISTRIBUTED GENERATION SYSTEMS  6
UNIT IV  WIND ENERGY SYSTEM GRID INTEGRATION 6

UNIT V  GRID INTER CONNECTION 6
Grid Code requirements-Grid integration of WECS-Grid Integration of PV systems

30 PERIODS

LAB COMPONENT 30 PERIODS
1. Develop a model for the control of DC micro grid for non linear loads
2. Simulation study of three phase inverters with fixed and sine PWM techniques, Simulation and Design of buck/boost converters.
3. Simulate a Grid Connected Wind Energy System with STATCOM and investigate the improvement in power quality.

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:
Upon completion of the course, Students able to
CO1  Review the power sector scenario in India.
CO2  Model a microgrid system
CO3  Model a converter for power grid distributed system.
CO4  Integrate wind energy system.
CO5  Simulate three phase inverter with fixed and sine PWM.

TEXT BOOKS:

REFERENCES:
List of Open Source Software/ Learning website:

1. https://www.academia.edu/14628492/Current_Power_Scenario_In_India
2. https://energyeducation.ca/encyclopedia/Electrical_grid
3. https://www.academia.edu/32120081/Power_Converters_Modeling_in_Matlab_Simulink_for_Microgrid_Simulations

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EE3036 SUSTAINABLE AND ENVIRONMENTAL FRIENDLY HV INSULATION SYSTEM

COURSE OBJECTIVES:

- To Know about the products related with sustainable application.
- To learn about Green Gaseous, liquid solid insulators.
- To understand the standards for green insulation systems.

UNIT I SUSTAINABLE AND ENVIRONMENTAL ENERGY AND PRODUCTS
Carbon print, global warming potential, environment requirement for any product and system.

UNIT II ALTERNATE GREEN GASEOUS INSULATORS
SF6 gas and its hazardous environmental effects, alternate gases, gaseous mixtures and other sources and its properties.

UNIT III ALTERNATE GREEN LIQUID INSULATORS
hazardous effects of existing liquid dielectric materials (such as organic oil), alternate sources of environmental friendly liquid such as ester oil, vegetable oils dielectric and it’s properties.

UNIT IV ALTERNATE GREEN SOLID INSULATORS
hazardous effects of existing solid dielectric materials, alternate sources of environmental friendly solid dielectric and its properties.

UNIT V EVOLVING STANDARDS FOR GREEN INSULATION SYSTEMS
Requirements, evolving standards of management, testing, usage and disposal of alternate insulation systems, Major applications and standards
REFERENCES:

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
CO1: Know about sustainable and environmental energy and products.
CO2: Describe the alternate green gaseous insulators.
CO3: Describe the alternate green liquid insulators
CO4: Describe the alternate green solid insulators
CO5: Elaborate the standards for Green insulation systems.

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EE3037 POWER SYSTEM TRANSIENTS LT P C 3 0 0 3

OBJECTIVES:
- To study the generation of switching transients and their control using circuit – theoretical concept.
- To study the mechanism of lighting strokes and the production of lighting surges.
- To study the propagation, reflection and refraction of travelling waves.
- To study the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

UNIT I INTRODUCTION AND SURVEY (7+2 Skill) 9
Sources of different types of transients - RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients - study of transients in system planning - Importance of grounding.

UNIT II SWITCHING TRANSIENTS (7+2 Skill) 9
Basic concept of switching transients - resistance switching and equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current
chopping - effective equivalent circuit - capacitance switching with a restrike, with multiple rests - ferro resonance.

UNIT III LIGHTNING TRANSIENTS (7+2 Skill) 9
Theories of cloud formation - mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT IV TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS (7+2 Skill) 9
Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely’s lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves. Computation of overvoltages using EMTP.

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM 9
The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines - overvoltage induced by faults - switching surges on integrated system Qualitative application of EMTP for transient computation.

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 8
1. Simulation of circuit transients
2. Computation of over voltages for switching surges
3. Computation of over voltages for lightning surges
4. Computation of transients

COURSE OUTCOMES:
After completing the course, the students will be able to
CO1: Explain the principles of transients and its concepts
CO2: Know the different types of switching transients and the way to draw the necessary equivalent circuit.
CO3: Explain the concepts behind lighting and the way to protect the same.
CO4: Compute the transient behavior in transmission line.
CO5: Explain the behavior of the Circuit during switching and to learn the simulation tool.

TEXT BOOKS:

REFERENCES:
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CEI331 PLC PROGRAMMING

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

UNIT I INTRODUCTION (7+2 SKILL) 9
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) 9
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) 9
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) 9
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) 9
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,
Code Converters- DC motor Control- Alarm Circuit.

TOTAL : 45 PERIODS
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.
CO2 Explain the logic and flow of any particular programming written for a process.
CO3 Apply the knowledge to design or improve an existing program to increase productivity of any process.
CO4 Breakdown SCADA architecture and communication protocols.
CO5 Build and logic in any of the programming languages from IEC- 61131- 3 standard.

REFERENCES
2. https://nptel.ac.in/courses/108105062
4. https://nptel.ac.in/courses/108106022
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TEXT BOOKS:

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
software.html
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COURSE OBJECTIVES:
- To understand big data.
- To learn and use NoSQL big data management.
- To learn mapreduce analytics using Hadoop and related tools.
- To work with map reduce applications.
- To understand the usage of Hadoop related tools for Big Data Analytics.

UNIT I  UNDERSTANDING BIG DATA  5

UNIT II  NOSQL DATA MANAGEMENT  7

UNIT III MAP REDUCE APPLICATIONS  6

UNIT IV BASICS OF HADOOP  6

UNIT V HADOOP RELATED TOOLS  6

TOTAL: 30 PERIODS

COURSE OUTCOMES:
After the completion of this course, students will be able to:
CO1: Describe big data and use cases from selected business domains.
CO2: Explain NoSQL big data management.
CO3: Install, configure, and run Hadoop and HDFS.
CO4: Perform map-reduce analytics using Hadoop.
CO5: Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.
LIST OF EXPERIMENTS:  30 PERIODS
1. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.
2. Hadoop Implementation of file management tasks, such as Adding files and directories, retrieving files and Deleting files
3. Implement of Matrix Multiplication with Hadoop Map Reduce
4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
5. Installation of Hive along with practice examples.
6. Installation of HBase, Installing thrift along with Practice examples
7. Practice importing and exporting data from various databases.

Software Requirements:
  Cassandra, Hadoop, Java, Pig, Hive and HBase.

TOTAL: 60 PERIODS

TEXT BOOKS:
3. Sadalage, Pramod J. "NoSQL distilled", 2013

REFERENCES:

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MANDATORY COURSES I

MX3081 INTRODUCTION TO WOMEN AND GENDER STUDIES

COURSE OUTLINE

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

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

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

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

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

TOTAL : 45 PERIODS

MX3082 ELEMENTS OF LITERATURE

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

1. COURSE CONTENTS
Introduction to Elements of Literature

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

2. Elements of fiction
   a) Fiction, fact and literary truth.
   b) Fictional modes and patterns.
   c) Plot character and perspective.

3. Elements of poetry
   a) Emotions and imaginations.
b) Figurative language.
c) (Simile, metaphor, conceit, symbol, pun and irony).
d) Personification and animation.
e) Rhetoric and trend.

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

3. READINGS:

3.1 Textbook:

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

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

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

   TOTAL : 45 PERIODS

OUTCOME OF THE COURSE:
   • Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.

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

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

TEXT BOOKS:

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
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MANDATORY COURSES II

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

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

UNIT I HEALTH AND ITS IMPORTANCE

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

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

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

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

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

TOTAL : 45 PERIODS

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

REFERENCES:
1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001
1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
2. Simple lifestyle modifications to maintain health
   https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,%20have%20time%20to%20cook.
3. Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html
7. BMI https://www.hsph.harvard.edu/nutritionsource/healthy-weight/
   https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations
8. Yoga https://www.healthifyme.com/blog/types-of-yoga/
   https://yogamedicine.com/guide-types-yoga-styles/
   Ayurveda: https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda
10. CAM : https://www.hindawi.com/journals/ecam/2013/376327/
11. Preventive herbs : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/

COURSE OUTCOMES:
After completing the course, the students will be able to:
• Learn the importance of different components of health
• Gain confidence to lead a healthy life
• Learn new techniques to prevent lifestyle health disorders
• Understand the importance of diet and workouts in maintaining health
UNIT I CONCEPTS AND PERSPECTIVES
Meaning of History
Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history
Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism.
Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

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

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

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

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

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

TOTAL : 45 PERIODS

MX3087 POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY
Pre-Requisite: None. (Desirable: Universal Human Values 1, Universal Human Values 2)

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

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

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

(Refs: Adam smith, J S Mill)

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

Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.

(Refs: Marx, Lenin, Mao, M N Roy) (5 lectures)

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

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

(Refs: M K Gandhi, Schumacher, Kumarappa)

Essential elements of Indian civilization. (3 lectures)

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

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

Conclusion (2 lectures)

Total lectures: 39

Preferred Textbooks: See Reference Books

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

GRADING:

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

TOTAL : 45 PERIODS

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

OBJECTIVES

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

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

UNIT II  STANDARDS AND REGULATIONS

UNIT III  SAFETY ACTIVITIES

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

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

TOTAL : 45 PERIODS

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

REFERENCES
5. Society of Safety Engineers, USA

ONLINE RESOURCES

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<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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GE3751  PRINCIPLES OF MANAGEMENT  L T P C  3 0 0 3

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  9
Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers-
managerial roles and skills – Evolution of Management –Scientific, human relations, system and
contingency approaches– Types of Business organization- Sole proprietorship, partnership,
company-public and private sector enterprises- Organization culture and Environment – Current
trends and issues in Management.

UNIT II  PLANNING  9
Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting
objectives – Policies – Planning premises – Strategic Management – Planning Tools and
Techniques – Decision making steps and process.

UNIT III  ORGANISING  9
Nature and purpose – Formal and informal organization – Organization chart – Organization
structure – Types – Line and staff authority – Departmentalization – delegation of authority –
Centralization and decentralization – Job Design - Human Resource Management – HR
Planning, Recruitment, selection, Training and Development, Performance Management, Career
planning and management.

UNIT IV  DIRECTING  9
Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational
techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership
– Communication – Process of communication – Barrier in communication – Effective
communication – Communication and IT.

UNIT V  CONTROLLING  9
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.

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GE3752 TOTAL QUALITY MANAGEMENT L T P C
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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 9
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM -- Benefits of TQM.

UNIT II TQM PRINCIPLES 9

UNIT III TQM TOOLS & TECHNIQUES I 9
UNIT IV  TQM TOOLS & TECHNIQUES II
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 andFMEA.
CO4: Ability to understand Taguchi’s Quality Loss Function, Performance Measures and applyQFD, TPM, COQ and BPR.
CO5: Ability to apply QMS and EMS in any organization.

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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 compensation
 To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.

UNIT I            INTRODUCTION TO HUMAN RESOURCE MANAGEMENT                                   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.
CO3: Students will develop the skills needed for a successful HR manager.
CO4: Students would be prepared to implement the concepts learned in the workplace.
CO5: Students would be aware of the emerging concepts in the field of HRM

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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.

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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 & Dements.

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

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

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

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

TOTAL: 45 PERIODS

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

CO1 Explain basic concepts of management; approaches to management; contributors to
management studies; various forms of business organization and trade unions function in professional organizations.

CO2 Discuss the planning; organizing and staffing functions of management in professional organization.
CO3 Apply the leading; controlling and decision making functions of management in professional organization.
CO4 Discuss the organizational theory in professional organization.
CO5 Apply principles of productivity and modern concepts in management in professional organization.

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OPEN ELECTIVE I AND II

OCS351  ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS

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

UNIT I  INTELLIGENT AGENT AND UNINFORMED SEARCH 6
Introduction  - Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI -
Intelligent Agents  - Nature of Environment - Structure of Agent - Problem Solving Agents -
Formulating Problems - Uninformed Search - Breadth First Search - Dijkstra's algorithm or
uniform-cost search - Depth First Search - Depth Limited Search

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

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

UNIT IV  SUPERVISED LEARNING 6
Neural Network: Introduction, Perceptron Networks – Adaline - Back propagation networks -
Decision Tree: Entropy – Information gain - Gini Impurity - classification algorithm - Rule based
Classification - Naïve Bayesian classification - Support Vector Machines (SVM)

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

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

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

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

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

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

TOTAL PERIODS: 60

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

REFERENCES

OCS352 IOT CONCEPTS AND APPLICATIONS

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
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

UNIT II DATA MANIPULATION

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

UNIT IV DATA VISUALIZATION

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

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

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

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

TOTAL PERIODS: 60

TEXT BOOKS

REFERENCES

CCS333 AUGMENTED REALITY/VIRTUAL REALITY

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

UNIT I INTRODUCTION

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

UNIT IV    APPLICATIONS

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

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

TOTAL PERIODS: 60

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

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

OHS351 ENGLISH FOR COMPETITIVE EXAMINATIONS

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

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

UNIT I

UNIT II

UNIT III

UNIT IV
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/

CO-PO & PSO MAPPING

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

Note: The average value of this course to be used for program articulation matrix.
COURSE OBJECTIVES
- to understand the importance of sustainable development
- to acquire a reasonable knowledge on the legal frameworks pertaining to pollution control and environmental management
- to comprehend the role of NGOs in attaining sustainable development

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

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

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

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

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

TOTAL 45 : PERIODS

OUTCOMES
Upon completion of this course, the student will:
C01 Have a thorough grounding on the issues and challenges being faced in attaining sustainable development
C02 have a knowledge on the role of NGOs towards sustainable development
C03 present strategies for NGOs in attaining sustainable development
C04 recognize the importance of providing energy, food security and health equity to all members of the society without damaging the environment
C05 understand the environmental legislations

REFERENCE BOOKS

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

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

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

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

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

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

TOTAL 45 : PERIODS

REFERENCES:
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.
To explore the various bio-energy technologies.
To study the ocean and geothermal technologies.

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

UNIT II SOLAR ENERGY

UNIT III WIND ENERGY

UNIT IV BIO-ENERGY

UNIT V OCEAN AND GEOTHERMAL ENERGY

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

OME354 APPLIED DESIGN THINKING L T P C

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

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

UNIT II ENDUSER-CENTRIC INNOVATION
Importance of customer-centric innovation - Problem Validation and Customer Discovery - Understanding problem significance and problem incidence - Customer Validation. Target user, User persona & user stories. Activity: Customer development process - Customer interviews and field visit

UNIT III APPLIED DESIGN THINKING TOOLS
Concept of Minimum Usable Prototype [MUP] - MUP challenge brief - Designing & Crafting the value proposition - Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design

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

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

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

TOTAL: 45 PERIODS

240
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.
3. Proposition Design: How to Create Products and Services Customers Want, Wiley

REFERENCES
1. https://www.ideou.com/pages/design-thinking#process
4. https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e
6. https://blog.forgeforward.in/star_tup-failure-is-like-true-lie-7812c8de9b85

MF3003 REVERSE ENGINEERING LT P C 3 0 0 3

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

UNIT I INTRODUCTION & GEOMETRIC FORM 9

UNIT II MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION 9

UNIT III DATA PROCESSING 9
UNIT IV  3D SCANNING AND MODELLING

UNIT V  INDUSTRIAL APPLICATIONS

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
- Apply the fundamental concepts and principles of reverse engineering in product design and development.
- Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
- Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.
- Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
- Analyze the various legal aspect
- Applications of reverse engineering in product design and development.

TEXT BOOKS:

REFERENCES:

OPR351  SUSTAINABLE MANUFACTURING

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

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

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

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

UNIT V TRENDS IN SUSTAINABLE OPERATIONS

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:
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1 – Slight, 2 – Moderate, 3 – Substantial

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.

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:
2. Lino Guzzella, "Vehicle Propulsion System” Springer Publications, 2005

CO’s – PO’s & PSO’s MAPPING

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OAS352 SPACE ENGINEERING

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 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
Group Behaviour - Groups - Contributing factors - Group Norms, Communication - Process - Barriers to communication - Effective communication, leadership - formal and informal characteristics – Managerial Grid - Leadership styles - Group Decision Making - Leadership Role in
Group Decision, Group Conflicts - Types - Causes - Conflict Resolution - Inter-group relations and conflict, Organization centralization and decentralization - Formal and informal - Organizational Structures Organizational Change and Development - Change Process – Resistance to Change - Culture and Ethics.

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Understand the basic concepts of industrial management
CO2: Identify the group conflicts and its causes.
CO3: Perform swot analysis
CO4: Analyze the learning curves
CO5: Understand the placement and performance appraisal

REFERENCES:

OIE354 QUALITY ENGINEERING L T P C
3 0 0 3

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

UNIT I INTRODUCTION

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

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:

OIE354 QUALITY ENGINEERING L T P C
3 0 0 3
UNIT III   SPECIAL CONTROL PROCEDURES
Warning and modified control limits, control chart for individual measurements, multi-vari chart,
X̄ 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.

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

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OSF351   FIRE SAFETY ENGINEERING

COURSE OBJECTIVES
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 PERIODES

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:
OML351  INTRODUCTION TO NON-DESTRUCTIVE TESTING             L  T  P  C
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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:

- Understanding the 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 the testing methods for inspecting materials in accordance with industry specifications and standards.
- Acquiring the knowledge on the selection of the suitable NDT technique for a given application

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

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

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

UNIT IV  ULTRASONIC TESTING & AET                  9
UNIT V RADIOGRAPHY TESTING

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

TOTAL: 45 PERIODS

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

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

TEXT BOOKS:


REFERENCES:


CO’s- PO’s & PSO’s MAPPING

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

UNIT I  INTRODUCTION AND SENSORS

UNIT II  8085 MICROPROCESSOR

UNIT III  PROGRAMMABLE PERIPHERAL INTERFACE

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

UNIT V  ACTUATORS AND MECHATRONICS SYSTEM DESIGN

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

TEXT BOOKS

REFERENCES

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1 – Slight, 2 – Moderate, 3 – Substantial

### ORA351 FOUNDATION OF ROBOTICS

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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

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

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

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

TOTAL : 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

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1 – Slight, 2 – Moderate, 3 – Substantial
OBJECTIVES:
• To acquire the knowledge on the Historical evaluation of Airplanes
• To learn the different component systems and functions
• To know the concepts of basic properties and principles behind the flight
• To learn the basics of different structures & construction
• To learn the various types of power plants used in aircrafts

UNIT I HISTORY OF FLIGHT
8
Balloon flight-ornithopter-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

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

UNIT III BASICS OF AERODYNAMICS
9

UNIT IV BASICS OF AIRCRAFT STRUCTURES
9

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

TOTAL : 45 PERIODS

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 Kataria & sons, 2015

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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

UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL

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

TOTAL:45 PERIODS

COURSE OUTCOMES:
- On completion of the course, the student is expected to
  CO 1 Understand the concepts and laws related to remote sensing
  CO 2 Understand the interaction of electromagnetic radiation with atmosphere and earth material
  CO3 Acquire knowledge about satellite orbits and different types of satellites
  CO4 Understand the different types of remote sensors
  CO5 Gain knowledge about the concepts of interpretation of satellite imagery
TEXTBOOKS:

REFERENCES:

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OAI351 URBAN AGRICULTURE L T P C 3 0 0 3

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

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

UNIT II VERTICAL FARMING
Vertical farming- types, green facade, living/green wall-modular green wall, vegetated mat wall- Structures and components for green wall system: plant selection, growing media, irrigation and

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

UNIT IV  MODERN CONCEPTS
Growth of plants in vertical pipes in terraces and inside buildings, micro irrigation concepts suitable for roof top gardening, rain hose system, Green house, polyhouse and shade net system of crop production on roof tops.

UNIT V  WASTE MANAGEMENT
Concept, scope and maintenance of waste management- recycle of organic waste, garden wastes- solid waste management-scope, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, waste utilization.

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

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<td>To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill</td>
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<td>To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.</td>
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<td>To inculcate entrepreneurial skills through strong Industry-Institution linkage.</td>
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**OEN351 DRINKING WATER SUPPLY AND TREATMENT**

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

**UNIT I SOURCES OF WATER**
Public water supply system - Planning, Objectives, Design period, Population forecasting; Water demand - Sources of water and their characteristics, Surface and Groundwater - Impounding Reservoir - Development and selection of source - Source Water quality - Characterization - Significance - Drinking Water quality standards.

**UNIT II CONVEYANCE FROM THE SOURCE**
Water supply - intake structures - Functions; Pipes and conduits for water - Pipe materials - Hydraulics of flow in pipes - Transmission main design - Laying, jointing and testing of pipes - appurtenances - Types and capacity of pumps - Selection of pumps and pipe materials.

**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**
Requirements of water distribution - Components - Selection of pipe material - Service reservoirs - Functions - Network design - Economics - Computer applications - Appurtenances - Leak detection - Principles of design of water supply in buildings - House service connection - Fixtures and fittings, systems of plumbing and types of plumbing.

**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:

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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.

OCE353 LEAN CONCEPTS, TOOLS AND PRACTICES L T P C
3 0 0 3

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:  

OEI353  INTRODUCTION TO PLC PROGRAMMING  
L T P C  3 0 0 3

COURSE OBJECTIVES:  
1. Understand basic PLC terminologies digital principles, PLC architecture and operation.
2. Familiarize different programming language of PLC.
3. Develop PLC logic for simple applications using ladder logic.
4. Understand the hardware and software behind PLC and SCADA.
UNIT I INTRODUCTION TO PLC
Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers/DSP, PLC/DDC- PLC Construction: What is a PLC, PLC Memories, PLC I/O, , PLC Special I/O, PLC Types.

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

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

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

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

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

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

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

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

List of Open Source Software/ Learning website:
1. https://nptel.ac.in/courses/108105063
UNIT I  INTRODUCTION  
General definition and size effects–important nano structured materials and nano particles-
importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials –Ionic properties of nanomaterials- Nano catalysis.

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

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

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

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

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<th>Course Outcomes</th>
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<td>describes about the shape, size, structure of composite nano materials and their interference</td>
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<td>understand the different characterization techniques for nanomaterials</td>
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<td>CO5</td>
<td>develop a deeper knowledge in the application of nanomaterials in different fields</td>
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OBJECTIVE:

- The course emphasis on the molecular safe assembly and materials for polymer electronics

UNIT I  INTRODUCTION


UNIT II  MOLECULAR SELF ASSEMBLY


UNIT III  BIO-INSPIRED MATERIALS


UNIT IV  SMART OR INTELLIGENT MATERIALS

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

UNIT V  MATERIALS FOR POLYMER ELECTRONICS

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

TOTAL: 45 PERIODS

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.

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:
OPY352 IPR FOR PHARMA INDUSTRY

COURSE OBJECTIVES:

- To provide the basic fundamental knowledge of different forms of Intellectual Property Rights in national and international level.
- To provide the significance of the Intellectual Property Rights about the patents, copyrights, industrial design, plant and geographical indications.
- This paper is to study significance of the amended patent act on pharma industry.

UNIT I INTRODUCTION- INTELLECTUAL PROPERTY RIGHTS 9
Introduction, Types of Intellectual Property Rights - patents, plant varieties protection, geographical indicators, copyright, trademark, trade secrets.

UNIT II PATENTS 9
Patents-Objective, Introduction, Requirement for patenting- Novelty, Inventive step (Non-obviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, compulsory license.

UNIT III PLANT VARIETY-TRADITIONAL KNOWLEDGE –GEOGRAPHICAL INDICATIONS 9
Plant variety- Justification, criteria for protection of plant variety and protection in India. Traditional knowledge- Concept of traditional knowledge, protection of traditional knowledge under Intellectual Property frame works in national level and Traditional knowledge digital library (TKDL). Geographical Indications – Justification for protection, National and International position.

UNIT IV ENFORCEMENT AND PRACTICAL ASPECTS OF IPR 9

UNIT V INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY 9

TOTAL:45 PERIODS

TEXT BOOKS:

REFERENCES:
2. Basic Principles of patent law – Basics principles and acquisition of IPR. Ramakrishna T. CIPRA, NLSIU, Bangalore, 2005
**Course Outcome**

The student will be able to

- **C1** Understand and differentiate the categories of intellectual property rights.
- **C2** Describe about patents and procedure for obtaining patents.
- **C3** Distinguish plant variety, traditional knowledge and geographical indications under IPR.
- **C4** Provide the information about the different enforcements and practical aspects involved in protection of IPR.
- **C5** Provide different organizations role and responsibilities in the protection of IPR in the international level.
- **C6** Understand the interrelationships between different Intellectual Property Rights on International Society

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**OTT351** **BASICS OF TEXTILE FINISHING**

**OBJECTIVE:**

- To enable the students to understand the basics and different types of finishes required for textile materials and machines used for finishing.

**UNIT I RESIN FINISHING**


**UNIT II FLAME PROOF & WATERPROOF**

Concept of Flame proof & flame retardancy. Flame retardant finishes for cotton, Concept of waterproof and water repellent Finishes, Durable & Semi durable and Temporary finishes, Concept of Antimicrobial finish.

**UNIT III SOIL RELEASE AND ANTISTATIC FINISHES**


**UNIT IV MECHANICAL FINISHES**

UNIT V STIFFENING AND SOFTENING
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.

**OUTCOMES:**
Upon the completion of the course the student shall be able to understand
CO1: Fundamental concepts of industrial Engineering and productivity
CO2: Method study
CO3: Motion analysis
CO4: Work measurement and SAM
CO5: Ergonomics and its application to garment industry

**TOTAL: 45 PERIODS**

**TEXTBOOKS:**

**REFERENCES**

**CO’s- PO’s & PSO’s MAPPING**

| Course Outcomes | Statement | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|----------------|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | Fundamental concepts of industrial Engineering and productivity | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | - |
| CO2 | Method study | 1 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | - |
| CO3 | Motion analysis | 1 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | - |
| CO4 | Work measurement and SAM | 1 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 2 | 1 | 1 | - |

271
### OTT353 BASICS OF TEXTILE MANUFACTURE

**OBJECTIVES:**
- To enable the students to learn about the basics of fibre forming, yarn production, fabric formation, coloration of fabrics and garment manufacturing

**UNIT I  NATURAL FIBRES**
Introduction: Definition of staple fibre, filament; Classification of natural and man-made fibres, essential and desirable properties of fibres. Production and cultivation of Natural Fibers: Cultivation of cotton, production of silk (sericulture), wool and jute – physical and chemical structure of these fibres.

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

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

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

**UNIT V  BASICS OF KNITTING AND NONWOVEN**

**TOTAL : 45 PERIODS**

**OUTCOMES:**
On completion of this course, the students shall have the basic knowledge on
- CO1: Classification of fibres and production of natural fibres
- CO2: Regenerated and synthetic fibres
- CO3: Yarn spinning
- CO4: Weaving
- CO5: Knitting and nonwoven

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
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.
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  9

UNIT II  CRACKING  9
Cracking, Thermal Cracking, Vis-breaking, Catalytic Cracking (FCC), Hydro Cracking, Coking and Air Blowing of Bitumen

UNIT III  REFORMING AND HYDROTREATING  9

UNIT IV  INTRODUCTION TO PETROCHEMICALS  9
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  9
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**

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**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

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

UNIT II EXTRUSION

UNIT III INJECTION MOLDING
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 & Time-invariant, Causal & Non-causal, Stable & Unstable.

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

UNIT III  LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS  9
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:
   Education, New Delhi, 2015.(Units I - V)

REFERENCES:
2. M. J. Roberts, “Signals and Systems Analysis using Transform methods and
## CO's- PO's & PSO's MAPPING

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OEC352  FUNDAMENTALS OF ELECTRONIC DEVICES AND CIRCUITS  

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COURSE OBJECTIVES:
- To give a comprehensive exposure to all types of devices and circuits constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits.
- To analyze the frequency response of small signal amplifiers.
- To design and analyze single stage and multistage amplifier circuits.
- To study about feedback amplifiers and oscillators principles.
- To understand the analysis and design of multi vibrators.

UNIT I  SEMICONDUCTOR DEVICES
PN junction diode, Zener diode, BJT, MOSFET, UJT –structure, operation and V-I characteristics, Rectifiers – Half Wave and Full Wave Rectifier, Zener as regulator.

UNIT II  AMPLIFIERS
Load line, operating point, biasing methods for BJT and MOSFET, BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT III  MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER
Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis – Tuned amplifiers – Gain and frequency response – Neutralization methods.

UNIT IV  FEEDBACK AMPLIFIERS AND OSCILLATORS

UNIT V  POWER AMPLIFIERS AND DC/DC CONVERTERS
Power amplifiers- class A-Class B-Class AB-Class C-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.

COURSE OUTCOMES:
At the end of the course the students will be able to
CO1: Explain the structure and working operation of basic electronic devices.
CO2: Design and analyze amplifiers.
CO3: Analyze frequency response of BJT and MOSFET amplifiers.
CO4: Design and analyze feedback amplifiers and oscillator principles.
CO5: Design and analyze power amplifiers and supply circuits.

TEXT BOOKS:

REFERENCES:

**CO’s- PO’s & PSO’s MAPPING**

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CBM348 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT  

**OBJECTIVES:**
- To understand the global trends and development methodologies of various types of products and services.
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems.
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them into design specification.
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics.
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer.

**UNIT I  BASICS OF PRODUCT DEVELOPMENT**

**UNIT II  REQUIREMENTS AND SYSTEM DESIGN**

**UNIT III  DESIGN AND TESTING**
Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of

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

UNIT V  BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY  9

TOTAL: 45 PERIODS

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

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

REFERENCES:

COs- POs & PSOs MAPPING

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282
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
3. 3D Printing in Orthopaedic Surgery, Matthew Dipaola, Elsevier 2019 ISBN 978 -0-323-
OBJECTIVES:
This course will help the students to
- determine the optimum solution for Linear programming problems.
- study the Transportation and assignment models and various techniques to solve them.
- acquire the knowledge of optimality, formulation and computation of integer programming problems.
- acquire the knowledge of optimality, formulation and computation of dynamic programming problems.
- determine the optimum solution for non-linear programming problems.

UNIT I LINEAR PROGRAMMING

UNIT II TRANSPORTATION AND ASSIGNMENT PROBLEMS

UNIT III INTEGER PROGRAMMING

UNIT IV DYNAMIC PROGRAMMING PROBLEMS

UNIT V NON - LINEAR PROGRAMMING PROBLEMS

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

- Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.
- analyze the concept of developing, formulating, modeling and solving transportation and assignment problems.
- solve the integer programming problems using various methods.
- conceptualize the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming.
- determine the optimum solution for non-linear programming problems.

TEXT BOOKS:

REFERENCES:

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OMA353 ALGEBRA AND NUMBER THEORY L T P C

OBJECTIVES:
- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To examine the key questions in the Theory of Numbers.
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.
UNIT I  GROUPS AND RINGS
Groups: Definition - Properties - Homomorphism - Isomorphism - Cyclic groups - Cosets - Lagrange’s theorem.
Rings: Definition - Sub rings - Integral domain - Field - Integer modulo n - Ring homomorphism.

UNIT II  FINITE FIELDS AND POLYNOMIALS
Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.

UNIT III  DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS
Division algorithm- Base-b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM.

UNIT IV  DIOPHANTINE EQUATIONS AND CONGRUENCES
Linear Diophantine equations – Congruence’s – Linear Congruence’s - Applications : Divisibility tests - Modular exponentiation - Chinese remainder theorem – 2x2 linear systems.

UNIT V  CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS
Wilson’s theorem – Fermat’s Little theorem – Euler’s theorem – Euler’s Phi functions – Tau and Sigma functions.

OUTCOMES:
- Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
- Demonstrate accurate and efficient use of advanced algebraic techniques.
- The students should be able to demonstrate their mastery by solving non-trivial problems related to the concepts, and by proving simple theorems about the, statements proven by the text.

TEXT BOOKS:

REFERENCES:

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TOTAL: 45 PERIODS
COURSE OBJECTIVES:
- To test the consistency and solve system of linear equations.
- To find the basis and dimension of vector space.
- To obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
- To find orthonormal basis of inner product space and find least square approximation.
- To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

UNIT I  MATRICES AND SYSTEM OF LINEAR EQUATIONS  9
Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination
method - Gauss Jordan method.

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

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

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

UNIT V  EIGENVALUE PROBLEMS AND MATRIX DECOMPOSITION  9
Eigen value Problems : Power method, Jacobi rotation method - Singular value decomposition –
QR decomposition.

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
1. Faires J.D. and Burden R., Numerical Methods, Brooks/Cole (Thomson Publications), New
   Delhi, 2002.

REFERENCES
1. Bernard Kolman, David R. Hill, Introductory Linear Algebra, Pearson Educations, New Delhi,

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**OBT352**

**BASICS OF MICROBIAL TECHNOLOGY**

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**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**

Introduction to microbes, existence of microbes, inventions of great scientist and history, types of microorganisms – Bacteria, Virus, Fungi.

**UNIT II**

**MICROBIAL TECHNIQUES**

Sterilization – types – physical and chemical sterilization, Decontamination, Preservation methods, fermentation, Cultivation and growth of microbes, Diagnostic methods.

**UNIT III**

**PATHOGENIC MICROBES**

Infectious Disease – Awareness, Causative agent, Prevention and control - Cholera, Dengu, Malaria, Diarrhea, Tuberculosis, Typhoid, Covid, HIV.

**UNIT IV**

**BENEFICIAL MICROBES**

Applications of microbes – Clinical microbiology, agricultural microbiology, Food Microbiology, Environmental Microbiology, Animal Microbiology, Marine Microbiology.

**UNIT V**

**PRODUCTS FROM MICROBES**

Fermented products – Fermented Beverages, Curd, Cheese, Mushroom, Agricultural products – Biopesticide, Biofertilizers, Vermi compost, Pharmaceutical products - Antibiotics, Vaccines

**TOTAL: 45 PERIODS**

**COURSE OUTCOME:**

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

1. Microbes and their types
2. Cultivation of microbes
3. Pathogens and control measures for safety
4. Microbes in different industry for economy.

TEXT BOOKS

OBT353  BASICS OF BIOMOLECULES

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

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

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

UNIT III  AMINO ACIDS AND PROTEIN.

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

UNIT V  VITAMINS AND HORMONES

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

UNIT III BIO-MEMBRANE TRANSPORT

UNIT IV CELL CYCLE
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

TOTAL: 45 PERIODS

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

COURSE OBJECTIVE

The Course will enable Learners to,

- Understand the essentials of project writing.
- Perceive the difference between general writing and technical writing.
- Assimilate the fundamental features of report writing.
- Understand the essential differences that exist between general and technical writing.
- Learn the structure of a technical and project report.

UNIT I

UNIT II

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

UNIT IV

UNIT V

TOTAL:45 PERIODS

OUTCOMES

By the end of the course, learners will be able to

- Write effective project reports.
- Use statistical tools with confidence.
- Explain the purpose and intension of the proposed project coherently and with clarity.
- Create writing texts to suit achieve the intended purpose.
- Master the art of writing winning proposals and projects.
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- Note: The average value of this course to be used for program articulation matrix.

OMA355 ADVANCED NUMERICAL METHODS

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

UNIT I ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEM

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

UNIT III NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS

UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS
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:

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OMA356  RANDOM PROCESSES  L  T  P  C
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OBJECTIVES:
- To introduce the basic concepts of probability, one and two dimensional random variables with applications to engineering which can describe real life phenomenon.
• To understand the basic concepts of random processes which are widely used in communication networks.
• To acquaint with specialized random processes which are apt for modelling the real time scenario.
• To understand the concept of correlation and spectral densities.
• To understand the significance of linear systems with random inputs.

UNIT I  RANDOM VARIABLES 9

UNIT II  RANDOM PROCESSES 9

UNIT III  SPECIAL RANDOM PROCESSES 9

UNIT IV  CORRELATION AND SPECTRAL DENSITIES 9

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

TOTAL: 45 PERIODS

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

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**OMA357**  
**QUEUEING AND RELIABILITY MODELLING**  
**L T P C**  
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**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/Er/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
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

UNIT III PRODUCTION & OPERATIONS PLANNING
Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of production process systems – Steps for production process- Production Planning Control Functions – Planning phase- Action phase- Control phase - Aggregate production planning

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS

UNIT V CONTROLLING PRODUCTION & OPERATIONS MANAGEMENT

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

UNIT I  INTRODUCTION

UNIT II  VAT POLYMERIZATION AND MATERIAL EXTRUSION

UNIT III  POWDER BED FUSION AND BINDER JETTING

UNIT IV  MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course students shall be able to:
CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.
CO2: Acquire knowledge on process vat polymerization and material extrusion processes and its applications.
CO3: Elaborate the process and applications of powder bed fusion and binder jetting.
CO4: Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.
CO5: Acquire knowledge on sheet lamination and direct write technology.
TEXT BOOKS:

REFERENCES:

CME343 NEW PRODUCT DEVELOPMENT

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

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

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

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

TOTAL :45 PERIODS

OUTCOMES:
At the end of the course the students would be able to
1. Discuss fundamental concepts and customer specific requirements of the New Product development
2. Discuss the Material specification standards, analysis and fabrication, manufacturing process.
3. Develop Feasibility Studies & reporting of New Product development
4. Analyzing the New product qualification and Market Survey on similar products of new product development
5. Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

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

REFERENCES:
1. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark
2. Change by Design
5. Product Design & Value Engineering – Dr. M.A. Bulsara &Dr. H.R. Thakkar

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Low (1) ; Medium (2) ; High (3)
OBJECTIVES:
The course aims to
- Outline Fundamental concepts in UI & UX
- Introduce the principles of Design and Building an mobile app
- Illustrate the use of CAD in product design
- Outline the choice and use of prototyping tools
- Understanding design of electronic circuits and fabrication of electronic devices

UNIT I  UI/UX

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

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

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

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

TOTAL: 45 PERIODS

Course Outcomes
At the end of the course, learners will be able to:
- Create quick UI/UX prototypes for customer needs
- Develop web application to test product traction / product feature
- Develop 3D models for prototyping various product ideas
- Built prototypes using Tools and Techniques in a quick iterative methodology

Text Books
MF3010 MICRO AND PRECISION ENGINEERING LT P C 3 0 0 3

COURSE OBJECTIVES:
At the end of this course the student should be able to
- Learn about the precision machine tools
- Learn about the macro and micro components.
- Understand handling and operating of the precision machine tools.
- Learn to work with miniature models of existing machine tools/robots and other instruments.
- Learn metrology for micro system

UNIT I INTRODUCTION TO MICROSYSTEMS  9
Design, and material selection, micro-actuators: hydraulic, pneumatic, electrostatic/ magnetic etc. for medical to general purpose applications. Micro-sensors based on Thermal, mechanical, electrical properties; micro-sensors for measurement of pressure, flow, temperature, inertia, force, acceleration, torque, vibration, and monitoring of manufacturing systems.

UNIT II FABRICATION PROCESSES FOR MICRO-SYSTEMS:  9
Additive, subtractive, forming process, microsystems-Micro-pumps, micro- turbines, micro engines, micro-robot, and miniature biomedical devices

UNIT III INTRODUCTION TO PRECISION ENGINEERING  9
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  9
Precision machining processes for macro components - Diamond turning, fixed and free abrasive processes, finishing processes.

UNIT V METROLOGY FOR MICRO SYSTEMS  9
Metrology for micro systems - Surface integrity and its characterization. TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon the completion of this course the students will be able to
- Select suitable precision machine tools and operate
- Apply the macro and micro components for fabrication of micro systems.
- Apply suitable machining process
- Able to work with miniature models of existing machine tools/robots and other instruments.
- Apply metrology for micro system

References

304
TEXT BOOKS:

REFERENCES:

OMF354   COST MANAGEMENT OF ENGINEERING PROJECTS   LT P C
3 0 0 3

COURSE OBJECTIVES:
Summarize the costing concepts and their role in decision making
Infer the project management concepts and their various aspects in selection
Interpret costing concepts with project execution
Develop knowledge of costing techniques in service sector and various budgetary control techniques
Illustrate with quantitative techniques in cost management

UNIT I    INTRODUCTION TO COSTING CONCEPTS
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 9
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand the costing concepts and their role in decision making.
CO2: Understand the project management concepts and their various aspects in selection.
CO3: Interpret costing concepts with project execution.
CO4: Gain knowledge of costing techniques in service sector and various budgetary control techniques.
CO5: Become familiar with quantitative techniques in cost management.

TEXT BOOKS:

REFERENCES:

AU3002 BATTERIES AND MANAGEMENT SYSTEM L T P C
3 0 0 3

COURSE OBJECTIVES:
The objective of this course is to make the students understand the working and characteristics of different types of batteries and their management.

UNIT I ADVANCED BATTERIES 9
Li-ion Batteries-different formats, chemistry, safe operating area, efficiency, aging. Characteristics- SOC, DOD, SOH. Balancing-Passive Balancing Vs Active Balancing. Other Batteries- NCM and NCA Batteries. NCR18650B specifications.

UNIT II BATTERY PACK 9
Battery Pack-design, sizing, calculations, flow chart, real and simulation Model. Peak power – definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging.
UNIT III  BATTERY MODELLING  
Battery Modelling Methods-Equivalent Circuit Models, Electrochemical Model, Neural Network Model. ECM Comparisons- Rint model, Thevenin model, PNGV model. State space Models- Introduction. Battery Modelling software/simulation frameworks

UNIT IV  BATTERY STATE ESTIMATION  

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

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

UNIT I  INTRODUCTION TO MEASUREMENTS AND SENSORS  
UNIT II VARIABLE RESISTANCE AND INDUCTANCE SENSORS

Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors
Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT

UNIT III VARIABLE AND OTHER SPECIAL SENSORS

Variable air gap type, variable area type and variable permittivity type- capacitor microphone

UNIT IV AUTOMOTIVE ACTUATORS


UNIT V AUTOMATIC TEMPERATURE CONTROL ACTUATORS

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

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:


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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 9
Energy and Efficiencies of power plants for space vehicles – Typical Performance Values – Mission design – Structural design aspects during launch - role of launch environment on launch vehicle integrity.

UNIT II SELECTION OF ROCKET PROPULSION SYSTEMS 9
Ascent flight mechanics – Launch vehicle selection process – Criteria for Selection for different missions – selection of subsystems – types of staging – Interfaces – selection and criteria for stages and their role in launch vehicle configuration design.

UNIT III ENGINE SYSTEMS, CONTROLS, AND INTEGRATION 9

UNIT IV THRUST VECTOR CONTROL 9
TVC Mechanisms with a Single Nozzle – TVC with Multiple Thrust Chambers or Nozzles – Testing – Integration with Vehicle – SITVC method – other jet control methods - exhaust plume problems in space environment

UNIT V NOSE CONE CONFIGURATION 9
Aerodynamic aspects on the selection of nose shape of a launch vehicle - design factors in the finalization of nose configuration with respect to payload - nose cone thermal protection system - separation of fairings - payload injection mechanism

OUTCOMES:

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

- Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.
- Apply knowledge in selecting the appropriate rocket propulsion systems.
- interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.
- Analyze aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.
- Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.
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.

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

OURSEOUTCOMES:
Upon completion of the course, Students will be able to
CO1: Plan an organizational structure for a given context in the organisation to carry out production operation through Work-study.
CO2: Survey the markets, customers and competition better and price the given products appropriately.
CO3: Ensure quality for a given product or service.
CO4: Plan, schedule and control projects through PERT and CPM.
CO5: Evaluate strategy for a business or service organization.

**TEXTBOOKS:**

**REFERENCES:**

**CO’s- PO’s & PSO’s MAPPING**

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**OIM353 PRODUCTION PLANNING AND CONTROL**

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**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-Prerequisite 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

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

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**OIE353 OPERATIONS MANAGEMENT L T P C 3 0 0 3**

**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

REFERENCES

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

UNIT I INTRODUCTION AND SCOPE

UNIT II MONITORING FOR SAFETY, HEALTH & ENVIRONMENT
Occupational Health and Environment Safety Management System, ILO and EPA Standards Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.

UNIT III OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION

UNIT IV OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT

UNIT V INDUSTRIAL HAZARDS

TOTAL PERIODS: 45

COURSE OUTCOMES:
Students able to
CO1: Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems.
CO2: Specify designs that avoid occupation related injuries.
CO3: Define and apply the principles of work design, motion economy, and work environment design.
CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.

CO5: Acknowledge the impact of workplace design and environment on productivity

TEXT BOOKS:

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

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OSF353 CHEMICAL PROCESS SAFETY

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 ISAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES
Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief - relief valve sizing calculations - storage and handling of hazardous
chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation - pipe line transport - safety in chemical laboratories.

UNIT II       CHEMICAL REACTION HAZARDS  
Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self - heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening,

UNIT III    SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS                                        
Design principles -Process design development -types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares- new concepts in safety design and operation- Pressure vessel testing standards-Inspection techniques for boilers and reaction vessels.

UNIT IV SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS                            
Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards -standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures- condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

UNIT V  SAFETY AND ANALYSIS                                                                                                
Safety vs reliability- quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.  

TOTAL: 45 PERIODS

COURSE OUTCOMES: 
Students able to  
CO1Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.  
CO2Develop thorough knowledge about safety in the operation of chemical plants.  
CO3Apply the principles of safety in the storage and handling of gases.  
CO4Identify the conditions that lead to reaction hazards and adopt measures to prevent them.  
CO5Develop thorough knowledge about  

TEXT BOOK 

REFERENCES:  

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

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Understanding the importance of various materials used in electrical, electronics and magnetic applications
2. Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
3. Gaining knowledge on the selection of suitable materials for the given application
4. Knowing the fundamental concepts in Semiconducting materials
5. Getting equipped with the materials used in optical and optoelectronic applications.

UNIT I DIELECTRIC MATERIALS  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


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

TEXT BOOKS:

REFERENCE BOOKS:

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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 NANO MATERIALS
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

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.

TEXT BOOKS:

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**OMR352  HYDRAULICS AND PNEUMATICS**

**COURSE OBJECTIVES:**
1. To gain 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  9

UNIT V  TROUBLE SHOOTING AND APPLICATIONS  9

TOTAL: 45 PERIODS

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

CO’s- PO’s & PSO’s MAPPING

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1 – Slight, 2 – Moderate, 3 – Substantial
COURSE OBJECTIVES:
1. To learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics.
2. To understand basic working principle, construction, Application and characteristics of displacement, speed and ranging sensors.
3. To understand and analyze the working principle, construction, application and characteristics of force, magnetic and heading sensors.
4. To learn and analyze the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors.
5. To familiarize students with different signal conditioning circuits design and data acquisition system.

UNIT I  SENSOR CLASSIFICATION, CHARACTERISTICS AND SIGNAL TYPES  9

UNIT II  DISPLACEMENT, PROXIMITY AND RANGING SENSORS  9

UNIT III  FORCE, MAGNETIC AND HEADING SENSORS  9

UNIT IV  OPTICAL, PRESSURE, TEMPERATURE AND OTHER SENSORS  9

UNIT V  SIGNAL CONDITIONING  9

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors. They can also analyze the sensor response.
CO2: Analyze and select suitable sensor for displacement, proximity and range measurement.
CO3: Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.
CO4: Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.
CO5: Select and design suitable signal conditioning circuit with proper compensation and linearizing element based on sensor output signal.

TEXT BOOKS

REFERENCES

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1 – Slight, 2 – Moderate, 3 – Substantial
COURSE OBJECTIVES
1. To introduce mobile robotic technology and its types in detail.
2. To learn the kinematics of wheeled and legged robot.
3. To familiarize the intelligence into the mobile robots using various sensors.
4. To acquaint the localization strategies and mapping technique for mobile robot.
5. To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT I INTRODUCTION TO MOBILE ROBOTICS

UNIT II KINEMATICS

UNIT III PERCEPTION

UNIT IV LOCALIZATION

UNIT V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Evaluate the appropriate mobile robots for the desired application.
CO2: Create the kinematics for given wheeled and legged robot.
CO3: Analyse the sensors for the intelligence of mobile robotics.
CO4: Create the localization strategies and mapping technique for mobile robot.
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.

TEXTBOOK

REFERENCES:

MV3501 MARINE PROPULSION L T P C
3 0 0 3

COUROSE OBJECTIVES:
1. To impart knowledge on basics of propulsion system and ship dynamic movements
2. To educate them on basic layout and propulsion equipment’s
3. To impart basic knowledge on performance of the ship
4. To impart basic knowledge on ship propeller and its types
5. To impart knowledge on ship rudder and its types

UNIT I BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS
law of floatation - Basics principle of propulsion- Earlier methods of propulsion- ship propulsion machinery- boiler, Marine steam engine, diesel engine, ship power transmission system, ship dynamic structure, Marine propulsion equipment - shaft tunnel, Intermediate shaft and bearing, stern tube, stem tube sealing etc. degree of freedom, Modern propelling methods- water jet propulsion , screw propulsion.

UNIT II SHIPS MOVEMENTS AND SHIP STABILIZATION
Thrust augmented devices, Ship hull, modern ship propulsion design, bow thruster – Advantages, various methods to stabilize the ship- passive and active stabilizer, fin stabilizer, bilge keel - stabilizing and securing ship in port- effect of tides on ship – effect of river water and sea water sailing vessel, Load line and load line of marking- draught markings.

UNIT III SHIPS SPEED AND ITS PERFORMANCE
Ship propulsion factors, factors affecting ships speed, various velocities of ship, hull drag, effects of fouling on ships hull, ship wake, relation between powers, Fuel consumption of ship, cavitations - effects of cavitation’s, ship turning radius.

UNIT IV BASICS OF PROPELLER

UNIT V BASICS OF RUDDER
Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings- Rudder pintle - Rudder types- Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits of various types of rudders, Propeller and rudder interaction, Rudder stopper, movement of rudders, Basic construction of Rudder

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

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

UNIT II Types of Ship
General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships - Oil tankers- Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gascarriers - Chemical tankers - Passenger ships

UNIT III Shipbuilding Materials
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
Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its effects on propeller

UNIT V Governing Bodies for Shipping Industry
Role of IMO (International Maritime Organization), SOLAS (International Convention for the Safety of Life at Sea), MARPOL (International Convention for the Prevention of Pollution from Ships), MLC (Maritime Labour Convention), STCW 2010 (International Convention on Standards of Training, Certification and Watch keeping for Seafarers), Classification societies Administration authorities

OUTCOMES:
Upon completion of this course, students would
1. Acquire Knowledge on floatation of ships
2. Acquire Knowledge on features of various ships
3. Acquire Knowledge of Shipbuilding Materials
4. Acquire Knowledge to identify the different types of marine propeller and rudder
5. Understand the Roles and responsibilities of governing bodies

TEXT BOOKS:
2. Dr.DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006

REFERENCES:
2. MARPOL Consolidated Edition , Bhandakar Publications, 2018

OMV352 ELEMENTS OF MARINE ENGINEERING 3 0 0 3

OBJECTIVES:
At the end of the course, students are expected to
1. Understand the role of Marine machinery systems
2. Be familiar with Marine propulsion machinery system
3. Acquaint with Marine Auxiliary machinery system
4. Have acquired basics of Marine Auxiliary boiler system
5. Be aware of ship propellers and steering system

UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS
Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems
UNIT II MARINE PROPULSION MACHINERY SYSTEM
Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system

UNIT III MARINE AUXILIARY MACHINERY SYSTEM
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications

UNIT IV MARINE BOILER SYSTEM
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories

UNIT V SHIP PROPELLERS AND STEERING MECHANISM
Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, students should able to,
1. Distinguish the role of various marine machinery systems
2. Relate the components of marine propulsion machinery system
3. Explain the importance of marine auxiliary machinery system
4. Acquire knowledge of marine boiler system
5. Understand the importance of ship propellors and steering system

TEXT BOOKS:

REFERENCES:
1. Alan L.Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006
2. A.S.Tambwekar, “Naval Architecture and Ship Construction”, The Institute of Marine Engineers (India), Mumbai, 2015
CRA332 DRONE TECHNOLOGIES  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

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Know about a various type of drone technology, drone fabrication and programming.
CO2: Execute the suitable operating procedures for functioning a drone
CO3: Select appropriate sensors and actuators for Drones
CO4: Develop a drone mechanism for specific applications
CO5: Createthe programs for various drones

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

CO’s- PO’s & PSO’s MAPPING

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OGI352 GEOGRAPHICAL INFORMATION SYSTEM

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

UNIT I FUNDAMENTALS OF GIS

UNIT II SPATIAL DATA MODELS
UNIT III DATA INPUT AND TOPOLOGY  
Scanner - Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input – 
Digitizer – Datum Projection and reprojection -Coordinate Transformation – Topology - Adjacency, 
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

TEXTBOOKS:
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction 

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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TOTAL:45 PERIODS

332
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 programmes (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)/SSI/MSME sectors- Venture capital (VC), contract framing (CF) and Joint Venture (JV), public-private partnerships (PPP) - overview of agricultural engineering industry, characteristics of Indian farm
machinery industry.

**COURSE OUTCOMES**

1. Judge about agricultural finance, banking and cooperation
2. Evaluate basic concepts, principles and functions of financial management
3. Improve the skills on basic banking and insurance schemes available to customers
4. Analyze various financial data for efficient farm management
5. Identify the financial institutions

**TEXT BOOKS**


**REFERENCES**


**CO’s- PO’s & PSO’s MAPPING**

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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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<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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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 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.

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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.

OCE354 BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT L T P C
3 0 0 3

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 TRENDS 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).

OEI354  INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS  LT P C

3 0 0 3

COURSE OBJECTIVES:

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

UNIT I  INTRODUCTION

UNIT II AUTOMATION COMPONENTS
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT III COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS
Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT V DISTRIBUTED CONTROL SYSTEM
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL: 45 PERIODS

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

COURSE OUTCOMES:
Students able to
CO1 Design a signal conditioning circuits for various application (L3).
CO2 Acquire a detail knowledge on data acquisition system interface and DCS system (L2).
CO3 Understand the basics and Importance of communication buses in applied automation Engineering (L2).
CO4 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.(L3)
CO5 Able to develop a PLC logic for a specific application on real world problem. (L5)

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1. https://archive.nptel.ac.in/courses/108/105/108105062/
2. https://nptel.ac.in/courses/108105063

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OCH353 ENERGY TECHNOLOGY L T P C 3 0 0 3

UNIT I INTRODUCTION 8
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources

UNIT II CONVENTIONAL ENERGY 8
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III NON-CONVENTIONAL ENERGY 10
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Graviian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV BIOMASS ENERGY 10
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte
fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

**UNIT V ENERGY CONSERVATION**

Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.

**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>
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<th>Course Outcomes</th>
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<td>Statements</td>
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</table>
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.

OVERALL CO

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

OBJECTIVE:
- To enable the students to analyze properties of a surfaces and correlate them to structure, chemistry, and physics and surface modification technique.

UNIT I SURFACE STRUCTURE AND EXPERIMENTAL PROBES
- Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, absorbate structure, Band and Vibrational structure. Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy.

UNIT II ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT SURFACES
- Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods.

UNIT III LIQUID INTERFACES
- Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells.

UNIT IV HETEROGENEOUS CATALYSIS
- Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, Fischer-Tropsch and Automotive catalysis, Role of promoters and poisons, Bimetallic surfaces, surface functionalization and clusters in catalysis, Role of Sabatier principle in catalyst design, Rate oscillations and spatiotemporal pattern formation.

UNIT V EPITAXIAL GROWTH AND NANO SURFACE-STRUCTURES
- Origin of surface forces, Role of stress and strain in epitaxial growth, Energetic and growth modes, Nucleation theory, Non-equilibrium growth modes, MBE, CVD and ablation techniques, Catalytic growth of nanotubes, Etching of surfaces, Formation of nanopillars and nanorods and its application in photoelectrochemical processes, Polymer surfaces and biointerfaces.

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:

REFERENCE:

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

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

UNIT I
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 electrode-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 L T P C**

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

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

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

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

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

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

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  L T P C
3 0 0 3

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**

11

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

**UNIT V SAFETY ISSUES**

6

Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues International and national.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

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

**REFERENCES:**

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

| 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  

LT 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 dyeing- 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

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<th>Course Outcomes</th>
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<td>Regenerate and synthetic fibres</td>
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<td>Yarn spinning</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

FT3201 FIBRE SCIENCE L T P C 3 0 0 3

COURSE OBJECTIVES
- To enable the students to learn about the types of fibre and its properties

UNIT I INTRODUCTION TO TEXTILE FIBRES 9
Definition of various forms of textile fibres - staple fibre, filament, bicomponent fibres. Classification of Natural and Man-made fibres, essential and desirable properties of Fibres. Production and cultivation of Natural Fibers: Cotton, Silk, Wool -Physical and chemical structure of the above fibres.
UNIT II REGENERATED FIBRES
Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel, Tencel

UNIT III SYNTHETIC FIBRES
Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass, carbon. Introduction to spin finishes and texturization

UNIT IV SPECIALITY FIBRES
Properties and end uses of high tenacity and high modulus fibres, high temperature and flame retardant fibres, Chemical resistant fibres

UNIT V FUNCTIONAL SPECIALITY FIBRES
Properties and end uses: Fibres for medical application – Biodegradable fibres based on PLA, Super absorbent fibres elastomeric fibres, ultra-fine fibres, 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:
OTT355  GARMENT MANUFACTURING TECHNOLOGY  L T P C
3 0 0 3

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 349abelling 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 abelling

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

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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OPE353          INDUSTRIAL SAFETY                  L T P C
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OBJECTIVES:

- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen’s Compensation and other laws) enacted for the protection of employees health at work settings
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I  INTRODUCTION  9
Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.

UNIT II  OCCUPATIONAL HEALTH AND HYGIENE  9

UNIT III  WORKPLACE SAFETY AND SAFETY SYSTEMS  9
UNIT IV HAZARDS AND RISK MANAGEMENT

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 Chattopadhya Khanna Publishers, Delhi-6 1996

COURSE OBJECTIVES
- Understand the advantages, disadvantages and general classification of plastic materials
- To know the manufacturing, sources, and applications of engineering thermoplastics
- Understand the basics as well as the advanced applications of various plastic materials in the industry
- To understand the preparation methods of thermosetting materials
- Select suitable specialty plastics for different end applications
UNIT I INTRODUCTION TO PLASTIC MATERIALS
Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic
and thermosetting behavior, amorphous polymers, crystalline polymers and cross-linked
structures. General purpose thermoplastics/ Commodity plastics: manufacture, structure,
properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene,
polyvinyl chloride-compounding, formulation, polypropylene (PP)

UNIT II ENGINEERING THERMOPLASTICS AND APPLICATIONS
Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and
applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET,
PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides,
PMMA, polyphenylene oxide, thermoplastic polyurethane (PU)

UNIT III THERMOSETTING PLASTICS
Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of
phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester
resin, epoxy resin, silicone resins, polyurethane resins.

UNIT IV MISCELLANEOUS PLASTICS FOR END APPLICATIONS
Miscellaneous plastics- Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN,
poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl
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
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
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  

CO’s- PO’s & PSO’s MAPPING

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CBM370 WEARABLE DEVICES L T P C 3 0 0 3

OBJECTIVES:  
The student should be made to:  
- To know the hardware requirement of wearable systems  
- To understand the communication and security aspects in the wearable devices  
- To know the applications of wearable devices in the field of medicine

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9  

UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES 9  
Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant
information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS  9

UNIT IV SMART TEXTILE  9

UNIT V APPLICATIONS OF WEARABLE SYSTEMS  9
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Describe the concepts of wearable system.
CO2: Explain the energy harvestings in wearable device.
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile
CO5: Compare the various wearable devices in healthcare system

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

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Preamble:
1. To study the applications of information technology in health care management.
2. This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

UNIT I  INTRODUCTION TO MEDICAL INFORMATICS  9
Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues , Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics

UNIT II  COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING  9
Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III  COMPUTERISED PATIENT RECORD  9
Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT IV  COMPUTER ASSISTED MEDICAL DECISION-MAKING  9
Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer–assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis in clinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V  RECENT TRENDS IN MEDICAL INFORMATICS  9
Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.

TOTAL  : 45 PERIODS

Course Outcomes:
Upon completion of the course, students will be able to:
1. Explain the structure and functional capabilities of Hospital Information System.
2. Describe the need of computers in medical imaging and automated clinical laboratory.
3. Articulate the functioning of information storage and retrieval in computerized patient record system.
4. Apply the suitable decision support system for automated clinical diagnosis.
5. Discuss the application of virtual reality and telehealth technology in medical industry.

TEXT BOOKS:
2. R.D.Lele, "Computers in medicine progress in medical informatics", Tata Mcgraw Hill,2005

REFERENCES:
OBT355  BIOTECHNOLOGY FOR WASTE MANAGEMENT  

UNIT I  BIOLOGICAL TREATMENT PROCESS  

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

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

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

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

TOTAL: 45 PERIODS

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

**TEXT BOOKS**

**REFERENCE BOOKS**

**OBT356 LIFESTYLE DISEASES**

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<td>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.</td>
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<td>Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment</td>
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<td>CARDIOVASCULAR DISEASES</td>
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<td>Coronary atherosclerosis – Coronary artery disease; Causes - Fat and lipids, Alcohol abuse — Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation</td>
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<td>DIABETES AND OBESITY</td>
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<td>Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI</td>
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<td>RESPIRATORY DISEASES</td>
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<td>Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing</td>
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**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

**REFERENCES:**
COURSE OBJECTIVES
The aim of this course is to
1. Create higher standard of knowledge on healthcare system and services
2. Prioritize advanced technologies for the diagnosis and treatment of various diseases

UNIT I  PUBLIC HEALTH

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

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

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

UNIT V  BASICS OF IMAGING MODALITIES

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE BOOKS
LEARNING OBJECTIVES
1. To acquire the knowledge of the decision areas in finance.
2. To learn 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:

UNIT IV FINANCING AND DIVIDEND DECISION

UNIT V WORKING CAPITAL DECISION

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
2. Prasanna Chandra, Financial Management,
OBJECTIVES:
1. Describe the investment environment in which investment decisions are taken.
2. Explain how to Value bonds and equities
3. Explain the various approaches to value securities
4. Describe how to create efficient portfolios through diversification
5. Discuss the mechanism of investor protection in India.

UNIT I   THE INVESTMENT ENVIRONMENT 9
The investment decision process, Types of Investments - Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.

UNIT II   FIXED INCOME SECURITIES 9
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.

UNIT III   APPROACHES TO EQUITY ANALYSIS 9
Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT IV   PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES 9
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India

UNIT V   INVESTOR PROTECTION 9
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors’ awareness and activism

TOTAL : 45 PERIODS

REFERENCES
OBJECTIVES

- Understand the Banking system in India
- Grasp how banks raise their sources and how they deploy it
- Understand the development in banking technology
- Understand the financial services in India
- Understand the insurance Industry in India

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM
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
2. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018
UNIT I  CURRENCY EXCHANGE AND PAYMENT
Understand the concept of Crypto currency- Bitcoin and Applications -Cryptocurrencies and Digital
Cryto Wallets -Types of Cryptocurrencies - Cryptocurrencies and Applications, block chain,
Artificial Intelligence, machine learning. Fintech users, Individual Payments, RTGS Systems,
Immediate Page 54 of 90 Payment Service (IMPS), Unified Payments Interface (UPI),Legal and
Regulatory Implications of Crypto currencies, Payment systems and their regulations. Digital
Payments Smart Cards, Stored-Value Cards, EC Micropayments, Payment Gateways, Mobile
Payments, Digital and Virtual Currencies, Security, Ethical, Legal, Privacy, and Technology Issues

UNIT II DIGITAL FINANCE AND ALTERNATIVE FINANCE
A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity
and Equity, Introduction to the concept of Initial Coin Offering

UNIT III INSURETECH
InsurTech Introduction, Business model disruption, AI/ML in InsurTech, IoT and InsurTech, Risk
Modeling, Fraud Detection Processing claims and Underwriting Innovations in Insurance Services

UNIT IV PEER TO PEER LENDING
P2P and Marketplace Lending, New Models and New Products in market place lending P2P
Infrastructure and technologies, Concept of Crowdfunding Crowdfunding Architecture and
Technology, P2P and Crowdfunding unicorns and business models, SME/MSME Lending: Unique
opportunities and Challenges, Solutions and Innovations

UNIT V REGULATORY ISSUES
FinTech Regulations: Global Regulations and Domestic Regulations, Evolution of RegTech,
RegTech Ecosystem: Financial Institutions, RegTech Ecosystem: Startups RegTech,
Startups: Challenges, RegTech Ecosystem: Regulators, Use of AI in regulation and Fraud detection

TOTAL : 45 PERIODS

REFERENCE
1. Swanson Seth, Fintech for Beginners: Understanding and Utilizing the power of technology,
2. Models AuTanda, Fintech Bigtech And Banks Digitalization and Its Impact On Banking
   Business, Springer, 2019
3. Henning Diedrich, Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized
   Independent Publishing Platform, 2016
5. IIBF, Digital Banking, Taxmann Publication, 2016
   2016
OBJECTIVES:
1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I INTRODUCTION
Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY
FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III INSURANCE INDUSTRY

UNIT IV FINTECH AROUND THE GLOBE

UNIT V FUTURE OF FINTECH
How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

REFERENCES
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
6. Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018
VERTICAL 2: ENTREPRENEURSHIP

CMG337 FOUNDATIONS OF ENTREPRENEURSHIP

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 businessess.
- To empower the learners to run a Technology driven business efficiently and effectively

UNIT I INTRODUCTION TO ENTREPRENEURSHIP
Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development.

UNIT II BUSINESS OWNERSHIP & ENVIRONMENT

UNIT III FUNDAMENTALS OF TECHNOPRENEURSHIP
Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends

UNIT IV APPLICATIONS OF TECHNOPRENEURSHIP
Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship — Success Stories of Technopreneurs - Case Studies

UNIT V EMERGING TRENDS IN ENTREPRENEURSHIP

TOTAL 45 : PERIODS

OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of Entrepreneurship
CO 2 Understand the business ownership patterns and environment
CO 3 Understand the Job opportunities in Industries relating to Technopreneurship
CO 4 Learn about applications of technopreneurship and successful technopreneurs
CO 5 Acquaint with the recent and emerging trends in entrepreneuruship

TEXT BOOKS:
2) Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning,

REFERENCES :
4) David Sheff 2002, China Dawn: The Story of a Technology and Business Revolution,
7) Basics of Technoprenuership: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP
8) Journal articles pertaining to Entrepreneurship

CMG338 TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS

COURSE OBJECTIVES
- To develop and strengthen the Leadership qualities and motivation of learners.
- To impart the Leadership skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of Team Building in managing Technology oriented businesses.
- To empower the learners to build robust teams for running and leading a business efficiently and effectively

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

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.

TOTAL 45 : PERIODS

REFERENCES:

CMG339  CREATIVITY & INNOVATION IN ENTREPRENEURSHIP

COURSE OBJECTIVES
• To develop the creativity skills among the learners
• To impart the knowledge of creative intelligence essential for entrepreneurs
• To know the applications of innovation in entrepreneurship.
• To develop innovative business models for business.

UNIT I  CREATIVITY
Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- Creative Personality and Motivation.

UNIT II  CREATIVE INTELLIGENCE
Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training–Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III  INNOVATION
UNIT IV INNOVATION AND ENTREPRENEURSHIP

UNIT V INNOVATIVE BUSINESS MODELS

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

COURSE OBJECTIVES:
- To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
- To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
- To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.

UNIT I INTRODUCTION TO MARKETING MANAGEMENT

UNIT II MARKETING ENVIRONMENT
Introduction - Environmental Scanning - Analysing the Organisation’s Micro Environment and Macro Environment - Differences between Micro and Macro Environment – Techniques of
UNIT III PRODUCT AND PRICING MANAGEMENT  

UNIT IV PROMOTION AND DISTRIBUTUION MANAGEMENT  

UNIT V CONTEMPORARY ISSUES IN MARKETING MANAGEMENT  

TOTAL 45 : PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to:
CO1 Have the awareness of marketing management process
CO2 Understand the marketing environment
CO3 Acquaint about product and pricing strategies
CO4 Knowledge of promotion and distribution in marketing management.
CO5 Comprehend the contemporary marketing scenarios and offer solutions to marketing issues.

REFERENCES:
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
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 LT P C 3 0 0 3

UNIT I
1. Meaning, Nature and Scope of Public Administration
2. Importance of Public Administration
3. Evolution of Public Administration

UNIT II
1. New Public Administration
2. New Public Management
3. Public and Private Administration

UNIT III
1. Relationships with Political Science, History and Sociology
2. Classical Approach
3. Scientific Management Approach

UNIT IV
1. Bureaucratic Approach: Max Weber
2. Human Relations Approach: Elton Mayo
3. Ecological Approach: Riggs

UNIT V
1. Leadership: Leadership - Styles - Approaches
2. Communication: Communication Types - Process - Barriers

TOTAL: 45 PERIODS

REFERENCES:
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.
CMG344  CONSTITUTION OF INDIA  L T P C  3 0 0 3

UNIT I
1. Constitutional Development Since 1909 to 1947
3. Constituent Assembly

UNIT II
1. Fundamental Rights
2. Fundamental Duties
3. Directive Principles of State Policy

UNIT III
1. President
2. Parliament
3. Supreme Court

UNIT IV
1. Governor
2. State Legislature
3. High Court

UNIT V
1. Secularism
2. Social Justice
3. Minority Safeguards

REFERENCES:
4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi

TOTAL: 45 PERIODS

CMG345  PUBLIC PERSONNEL ADMINISTRATION  L T P C  3 0 0 3

UNIT I
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

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

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

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UNIT IV
1. All India Services
2. Service Conditions
3. State Public Service Commission

UNIT V
1. Employer Employee Relations
2. Wage and Salary Administration
3. Allowances and Benefits

REFERENCES:
1. Stahl Glean O: Public Personnel Administration
4. Dwivedi O.P and Jain R.B: India’s Administrative state.
7. Davar R.S. Personnel Management & Industrial Relations

TOTAL: 45 PERIODS
UNIT I
Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India

UNIT II
Role & Functions of the District Collector, Relationship between the District Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government

UNIT III
Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992

UNIT IV
Coalition politics in India, Integrity and Vigilance in Indian Administration

UNIT V
Corruption – Ombudsman, Lok Pal & Lok Ayuktha

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

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

UNIT 4: BUSINESS DATA ANALYTICS

CMG349 STATISTICS FOR MANAGEMENT L T P C
3 0 0 3

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

UNIT I INTRODUCTION
Basic definitions and rules for probability, Baye’s theorem and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT II SAMPLING DISTRIBUTION AND ESTIMATION
Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters.

UNIT III TESTING OF HYPOTHESIS - PARAMETIRC TESTS
Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.

UNIT IV NON-PARAMETRIC TESTS

UNIT V CORRELATION AND REGRESSION

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.

TOTAL: 45 PERIODS
REFERENCES:

CMG350 DATAMINING FOR BUSINESS INTELLIGENCE L T P C
3 0 0 3

OBJECTIVES:
- To know how to derive meaning form huge volume of data and information.
- To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION
Data mining, Text mining, Web mining, Data ware house.

UNIT II DATA MINING PROCESS
Datamining process – KDD, CRISP-DM, SEMMA
Prediction performance measures

UNIT III PREDICTION TECHNIQUES
Data visualization, Time series – ARIMA, Winter Holts,

UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES
Classification, Association, Clustering.

UNIT V MACHINE LEARNING AND AI
Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization

TOTAL: 45 PERIODS

OUTCOMES:
1. Learn to apply various data mining techniques into various areas of different domains.
2. Be able to interact competently on the topic of data mining for business intelligence.
3. Apply various prediction techniques.
4. Learn about supervised and unsupervised learning technique.
5. Develop and implement machine learning algorithms

REFERENCES:
1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.

CMG351 HUMAN RESOURCE ANALYTICS L T P C 3 0 0 3

OBJECTIVE:

- To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
- To know the different types of HR metrics and understand their respective impact and application.
- To understand the impact and use of HR metrics and their connection with HR analytics.
- To understand common workforce issues and resolving them using people analytics.

UNIT I INTRODUCTION TO HR ANALYTICS 9
People Analytics - stages of maturity - Human Capital in the Value Chain: impact on business – HR metrics and KPIs.

UNIT II HR ANALYTICS I: RECRUITMENT 9
Recruitment Metrics: Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio - Quality of hire.

UNIT III HR ANALYTICS - TRAINING AND DEVELOPMENT 9
Training & Development Metrics: Percentage of employees trained - Internally and externally trained - Training hours and cost per employee - ROI.

UNIT IV HR ANALYTICS EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION 9
Employee Engagement Metrics: Talent Retention index - Voluntary and involuntary turnover - 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
OUTCOME:

- The learners will be conversant about HR metrics and ready to apply at work settings.
- The learners will be able to resolve HR issues using people analytics.

REFERENCES:


CMG352    MARKETING AND SOCIAL MEDIA WEB ANALYTICS     L T P C
3 0 0 3

OBJECTIVE:

- To showcase the opportunities that exist today to leverage the power of the web and social media

UNIT I   MARKETING ANALYTICS
Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT II  COMMUNITY BUILDING AND MANAGEMENT
History and Evolution of Social Media - Understanding Science of Social Media – Goals for using Social Media - Social Media Audience and Influencers - Digital PR - Promoting Social Media Pages - Linking Social Media Accounts - The Viral Impact of Social Media.

UNIT III    SOCIAL MEDIA POLICIES AND MEASUREMENTS
Social Media Policies-Etiquette, Privacy - ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV    WEB ANALYTICS
Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT V    SEARCH ANALYTICS
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

TOTAL: 45 PERIODS
OUTCOME:
- The Learners will understand social media, web and social media analytics and their potential impact.

REFERENCES:
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004

CMG353  OPERATION AND SUPPLY CHAIN ANALYTICS  L T P C
3 0 0 3

OBJECTIVE:
- To treat the subject in depth by emphasizing on the advanced quantitative models and methods in operations and supply chain management and its practical aspects and the latest developments in the field.

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

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

UNIT III  INVENTORY MANAGEMENT  9
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV  TRANSPORTATION NETWORK MODELS  9

UNIT V  MCDM MODELS  9
Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic 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 L T P C
3 0 0 3

OBJECTIVE:
➢ This course introduces a core set of modern analytical tools that specifically target finance applications.

UNIT I CORPORATE FINANCE ANALYSIS 9
Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.

UNIT II FINANCIAL MARKET ANALYSIS 9
Estimation and prediction of risk and return (bond investment and stock investment) –Time series-examining nature of data, Value at risk, ARMA, ARCH and GARCH.

UNIT III PORTFOLIO ANALYSIS 9
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.

UNIT IV TECHNICAL ANALYSIS 9

UNIT V CREDIT RISK ANALYSIS 9
Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.

TOTAL: 45 PERIODS

OUTCOME
➢ The learners should be able to perform financial analysis for decision making using excel, Python and R.

REFERENCES:
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", Springer 2005
OBJECTIVES:
• To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.

UNIT I AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS
Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT
Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT III WATER MANAGEMENT
Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT IV ENERGY AND WASTE MANAGEMENT
Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS
Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS
OUTCOME

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

CO1 Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture

CO2 Discuss the sustainable ways in managing soil health, nutrients, pests and diseases

CO3 Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources

CO4 Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas

CO5 Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

REFERENCES:

1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020


CO – PO Mapping - SUSTAINABLE AGRICULTURE PRACTICES

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CES333 SUSTAINABLE BIOMATERIALS

OBJECTIVES
- To impart knowledge of biomaterials and their properties
- To learn about fundamentals aspects of biopolymers and their applications
- To learn about bioceramics and biopolymers
- To introduce the students about metals as biomaterials and their usage as implants
- To make the students understand the significance of bionanomaterials and its applications.

UNIT I INTRODUCTION TO BIOMATERIALS 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)-Polyactic acid (PLA) and polyglycolic acid (PGA)- Polycaprolactone (PCL)- Other biodegradable polymers-Polyurethan- reactions polymers for medical purposes- Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT III BIO CERAMICS AND BIOCOMPOSITES 9
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 9
Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys-Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants- biological tolerance of implant metals

UNIT V NANOBIOIMATERIALS 9

TOTAL: 45 PERIODS

OUTCOMES
- Students will gain familiarity with Biomaterials and they will understand their importance.
- Students will get an overview of different biopolymers and their properties
- Students gain knowledge on some of the important Bioceramics and Biocomposite materials
- Students gain knowledge on metals as biomaterials
- Student gains knowledge on the importance of nanobiomaterials in biomedical applications.
REFERENCES
6. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018

CES334 MATERIALS FOR ENERGY SUSTAINABILITY L T P C
3 0 0 3

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 9
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 9
Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O2 battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO2, LiFePO4, LiMn2O4) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)
UNIT III      FUEL CELLS

UNIT IV     PHOTOVOLTAICS

UNIT V  SUPERCAPACITORS
Supercapacitor – types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non-Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL : 45 PERIODS

OUTCOMES
• Students will acquire knowledge about energy sustainability.
• Students understand the principles of different electrochemical devices.
• Students learn about the working of fuel cells and their application.
• Students will learn about various Photovoltaic applications and the materials used.
• The students gain knowledge on different types of supercapacitors and the performance of various materials

REFERENCES
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh

CES335 GREEN TECHNOLOGY L T P C 3 0 0 3

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

UNIT I PRINCIPLES OF GREEN CHEMISTRY 9
Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.

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

UNIT III GREEN REAGENTS AND GREEN SYNTHESIS 9
Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions

UNIT IV DESIGNING GREEN PROCESSES 9
Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention

UNIT V GREEN NANOTECHNOLOGY 9
Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

TOTAL: 45 PERIODS

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

TEXT BOOKS
REFERENCE BOOKS
1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

CES336 ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS L T P C 3 0 0 3

OBJECTIVES:
- to understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.

UNIT I ENVIRONMENTAL MONITORING AND STANDARDS 9

UNIT II MONITORING OF ENVIRONMENTAL PARAMETERS 9

UNIT III ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING 9
Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods - Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT IV ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISK ASSESSMENT 9

UNIT V AUTOMATED DATA ACQUISITION AND PROCESSING 9
Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks - Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

TOTAL: 45 PERIODS
COURSE OUTCOMES
After completion of this course, the students will know

CO1 Basic concepts of environmental standards and monitoring.
CO2 the ambient air quality and water quality standards;
CO3 the various instrumental methods and their principles for environmental monitoring
CO4 The significance of environmental standards in monitoring quality and sustainability of the environment.
CO5 the various ways of raising environmental awareness among the people.
CO6 Know the standard research methods that are used worldwide for monitoring the environment.

TEXTBOOKS
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and solid wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc

REFERENCES
1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.

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
Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security.

UNIT II ENERGY AND ENVIRONMENT
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

UNIT III SUSTAINABLE DEVELOPMENT

UNIT IV RENEWABLE ENERGY TECHNOLOGY

UNIT V ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the world and Indian energy scenario
2. Analyse energy projects, its impact on environment and suggest control strategies
3. Recognise the need of Sustainable development and its impact on human resource development
4. Apply renewable energy technologies for sustainable development
5. Fathom Energy policies and planning for sustainable development.

REFERENCES:
7. https://www.niti.gov.in/verticals/energy

CES338            ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT          L T P C
                                                              3 0 0 3

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                               9
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                                    9
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              9
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        9
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                            9

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
REFERENCES: