I. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To provide the students with a strong foundation in the required sciences in order to pursue studies in Electronics and Communication Engineering.
2. To gain adequate knowledge to become good professional in electronic and communication engineering associated industries, higher education and research.
3. To develop attitude in lifelong learning, applying and adapting new ideas and technologies as their field evolves.
4. To prepare students to critically analyze existing literature in an area of specialization and ethically develop innovative and research oriented methodologies to solve the problems identified.
5. To inculcate in the students a professional and ethical attitude and an ability to visualize the engineering issues in a broader social context.

II. PROGRAM OUTCOMES (POs)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7 **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10 **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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

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

### III. PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Design, develop and analyze electronic systems through application of relevant electronics, mathematics and engineering principles

PSO2: Design, develop and analyze communication systems through application of fundamentals from communication principles, signal processing, and RF System Design & Electromagnetics.

PSO3: Adapt to emerging electronics and communication technologies and develop innovative solutions for existing and newer problems

PEOs(1 to 5) mapped with POs and PSOs

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1 - low, 2 - medium, 3 - high, '-' - no correlation
## ANNA UNIVERSITY, CHENNAI
### NON- AUTONOMOUS AFFILIATED COLLEGES
#### REGULATIONS 2021
#### B. E. ELECTRONICS AND COMMUNICATION ENGINEERING
##### CHOICE BASED CREDIT SYSTEM
##### CURRICULUM AND SYLLABI FOR SEMESTERS I TO VIII
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$^*$ Skill Based Course

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**TOTAL** 17 1 14 33 26

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

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\(^\#\) Skill Based Course

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\(^\#\) NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
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* Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under Mandatory Course-I)

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*Open Elective – I Shall be chosen from the list of open electives offered by other Programmes

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

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

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

** Open Elective II - IV (Shall be chosen from the list of open electives offered by other Programmes).

* Elective - Management shall be chosen from the Elective Management courses.

### 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 : 162**

### ELECTIVE – MANAGEMENT COURSES

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*Mandatory Courses are offered as Non-Credit Courses

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

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<th>Vertical I</th>
<th>Vertical II</th>
<th>Vertical III</th>
<th>Vertical IV</th>
<th>Vertical V</th>
<th>Vertical VI</th>
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<td>Wide Bandgap Devices</td>
<td>Advanced Digital Signal Processing</td>
<td>RF Transceivers</td>
<td>Wearable Devices</td>
<td>Underwater Instrumentation System</td>
<td>IoT Processors</td>
<td>Radar Technologies</td>
<td>Optical Communication &amp; Networks</td>
</tr>
<tr>
<td>Validation and Testing Technology</td>
<td>Image Processing</td>
<td>Signal Integrity</td>
<td>Human Assist Devices</td>
<td>Underwater Imaging Systems and Image Processing</td>
<td>IoT Based System Design</td>
<td>Avionics Systems</td>
<td>Wireless Broad Band Networks</td>
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<tr>
<td>VLSI Testing and Design For Testability</td>
<td>Software Defined Radio</td>
<td>MICs and RF System Design</td>
<td>Medical Imaging Systems</td>
<td>Ocean Observation Systems</td>
<td>Industrial IoT and Industry 4.0</td>
<td>Satellite Communication</td>
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<td>Analog IC Design</td>
<td>Computer Vision</td>
<td>RF ID System Design &amp; Testing</td>
<td>Body Area Networks</td>
<td>Ocean Acoustics</td>
<td>Fundamentals of Nanoelectronics</td>
<td>Rocketry and Space Mechanics</td>
<td>Advanced Wireless Communication Techniques</td>
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**Registration of Professional Elective Courses from Verticals:**

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

### VERTICAL 1: SEMICONDUCTOR CHIP DESIGN AND TESTING

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### VERTICAL 8: HIGH SPEED COMMUNICATIONS

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(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).

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ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

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

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

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

Complete details are available in clause 4.10 (Amendments) of Regulations 2021.

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<td>Constitution of India</td>
<td>Datamining for Business Intelligence</td>
<td>Sustainable Agriculture and Environmental Management</td>
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<td>Banking, Financial Services and Insurance</td>
<td>Creativity &amp; Innovation in Entrepreneurship</td>
<td>Public Personnel Administration</td>
<td>Human Resource Analytics</td>
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<td>Fintech Personal Finance and Payments</td>
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<td>Indian Administrative System</td>
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<td>Integrated Energy Planning for Sustainable Development</td>
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<td>Energy Efficiency for Sustainable Development</td>
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(choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

**VERTICAL 1: FINTECH AND BLOCK CHAIN**

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### VERTICAL 4: BUSINESS DATA ANALYTICS

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## VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

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

REFERENCES:

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

CO’s-PO’s & PSO’s MAPPING

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MA3151 MATRICES AND CALCULUS L T P C
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COURSE OBJECTIVES:
• To develop the use of matrix algebra techniques that are needed by engineers for practical applications.
• To familiarize the students with differential calculus.
To familiarize the student with functions of several variables. This is needed in many branches of engineering.
To make the students understand various techniques of integration.
To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I MATRICES

UNIT II DIFFERENTIAL CALCULUS

UNIT III FUNCTIONS OF SEVERAL VARIABLES

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

UNIT V MULTIPLE INTEGRALS

TOTAL: 60 PERIODS

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

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

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PH3151  ENGINEERING PHYSICS  L  T  P  C
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COURSE OBJECTIVES:
- To make the students effectively 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 successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I  MECHANICS

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

UNIT III OSCILLATIONS, OPTICS AND LASERS


UNIT IV BASIC QUANTUM MECHANICS

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

UNIT V APPLIED QUANTUM MECHANICS

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

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

CO1:Understand the importance of mechanics.

CO2:Express their knowledge in electromagnetic waves.

CO3:Demonstrate a strong foundational knowledge in oscillations, optics and lasers.

CO4:Understand the importance of quantum physics.

CO5:Comprehend and apply quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

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

REFERENCES:

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CY3151  
ENGINEERING CHEMISTRY

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

UNIT I  
WATER AND ITS TREATMENT


UNIT II  
NANOCHEMISTRY

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

UNIT III  
PHASE RULE AND COMPOSITES

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

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

Fuels: Introduction; Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel.

Combustion of fuels: Introduction; Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO\(_2\) emission and carbon footprint.

UNIT V  ENERGY SOURCES AND STORAGE DEVICES

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion - battery; Electric vehicles - working principles; Fuel cells: H\(_2\)-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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### GE3151 PROBLEM SOLVING AND PYTHON PROGRAMMING

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

#### UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING

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

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

#### UNIT IV LISTS, TUPLES, DICTIONARIES
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.
UNIT V FILES, MODULES, PACKAGES
Files and 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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1 - low, 2 - medium, 3 - high, '-' - no correlation
UNIT I  LANGUAGE AND LITERATURE

UNIT II  HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

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. தமிழக வரலொறு – மக்களும் பணை பொடும் – கக.கக.பிள்ளள (தவளியீடு:தமிழ்நொடு பொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. குகரிகஞ்சி தமிழ் – பாராகியால் ஜி.சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – பாலக திகச்சவு நாக்க கங்கால கங்கால தகங்கி (தகங்கால் கங்கால தகங்கி).
4. மாம்மநாள் – அரசியல்கள தகங்கி (தகங்கால் கங்கால தகங்கி)
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:
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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அலகு I மரபின் பங்கு தமிழில்


அலகு II மரப் – பரப்பு கற்றைச்சிக்கு விளக்க தினமலர வகை – கிளைக் கலை

3 துறவு பைத் திங்க கற்றைச்சிக்கு விளக்க – ஆர்ப்பாத்திய கற்றைச்சிக்கு விளக்க மற்றும் நோய்விளக்கு கற்றைச்சிக்கு விளக்க, விளக்கமலர கற்றைச்சிக்கு விளக்க, விளக்கமலர கற்றைச்சிக்கு விளக்க மற்றும் நோய்விளக்கு கற்றைச்சிக்கு விளக்க, விளக்கமலர கற்றைச்சிக்கு விளக்க, விளக்கமலர கற்றைச்சிக்கு விளக்க, விளக்கமலர கற்றைச்சிக்கு விளக்க, விளக்கமலர கற்றைச்சிக்கு விளக்க - நோய்விளக்கு கற்றைச்சிக்கு விளக்க, விளக்கமலர கற்றைச்சிக்கு விளக்க, விளக்கமலர கற்றைச்சிக்கு விளக்க, விளக்கமலர கற்றைச்சிக்கு விளக்க, விளக்கமலர கற்றைச்சிக்கு விளக்க, விளக்கமலர கற்றைச்சிக்கு விளக்க, விளக்கமலர கற்றைச்சிக்கு விளக்க, விளக்கமலர கற்றைச்சிக்கு விளக்க.

அலகு III தமிழ் பைத் தமிழ்கு கலையாளர்கள் நூற்றை சிற்பங்களை

3 குறிக்கையாளர், குறிப்பிட்டு, மீனம்பைருடன், குறிப்பிட்டு, மீனம்பைருடன், குறிப்பிட்டு, மீனம்பைருடன், குறிப்பிட்டு, மீனம்பைருடன்.
TEXT-CUM-REFERENCE BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

TOTAL : 15 PERIODS

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

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Implement programs in Python using conditionals and loops for solving problems..
CO4: Deploy functions to decompose a Python program.
CO5: Process compound data using Python data structures.
CO6: Utilize Python packages in developing software applications.

TEXT BOOKS:


REFERENCES:

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

**CO’s-PO’s & PSO’s MAPPING**

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**BS3171**

**PHYSICS AND CHEMISTRY LABORATORY**

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**PHYSICS LABORATORY : (Any Seven Experiments)**

**COURSE OBJECTIVES:**
- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student 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 wavelength 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.

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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 Na₂CO₃ as a primary standard and estimation of acidity of a water sample using the primary standard
2. Determination of types and amount of alkalinity in a 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.
12. Estimation of sodium /potassium present in water using a flame photometer.
13. Preparation of nanoparticles (TiO₂/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

TOTAL : 30 PERIODS
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:

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

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

GE3172 ENGLISH LABORATORY

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

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

UNIT II NARRATION AND SUMMATION
6
Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings- engaging in small talk- describing requirements and abilities.
UNIT III  DESCRIPTION OF A PROCESS / PRODUCT  6
Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities(large & small)-talking about precautions.

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

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

TOTAL : 30 PERIODS

LEARNING OUTCOMES:
At the end of the course, learners will be able
CO1:To listen to and comprehend general as well as complex academic information
CO2:To listen to and understand different points of view in a discussion
CO3:To speak fluently and accurately in formal and informal communicative contexts
CO4:To describe products and processes and explain their uses and purposes clearly and accurately
CO5:To express their opinions effectively in both formal and informal discussions

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

CO’s-PO’s & PSO’s MAPPING

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

Note: The average value of this course to be used for program articulation matrix.
COURSE OBJECTIVES:
- To engage learners in meaningful language activities to improve their reading and writing skills
- To learn various reading strategies and apply in comprehending documents in professional context.
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To demonstrate an understanding of job applications and interviews for internship and placements

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

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

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

UNIT IV   REPORTING OF EVENTS AND RESEARCH   6

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

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

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

MA3251  STATISTICS AND NUMERICAL METHODS  L T P C
        3 1 0 4

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

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

UNIT II  DESIGN OF EXPERIMENTS  9 + 3
One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - $2^2$ factorial design.
UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9 + 3

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

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9 +3

TOTAL: 60 PERIODS

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

TEXT BOOKS:

REFERENCES:
## CO’s-PO’s & PSO’s MAPPING

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### PH3254 PHYSICS FOR ELECTRONICS ENGINEERING

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**COURSE OBJECTIVES:**
- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- 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.

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### UNIT I CRYSTALLOGRAPHY


### UNIT II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS


### UNIT III SEMICONDUCTORS AND TRANSPORT PHYSICS

UNIT IV  OPTICAL PROPERTIES OF MATERIALS  9

UNIT V  NANO DEVICES  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the students should be able to
CO1: know basics of crystallography and its importance for varied materials properties
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 impart knowledge in types, construction and working of transformers
- To impart knowledge in types, construction and working of DC machines
- To impart knowledge in types, construction and working of AC rotating machines
- To introduce the functional elements and working of measuring instruments.
- To introduce the basics of power system and protection schemes

UNIT I TRANSFORMER


UNIT II DC MACHINES

Introduction – Constructional Features– Motor and Generator mode - EMF and Torque equation – Circuit Model – Methods of Excitation- Characteristics – Starting and Speed Control – Universal Motor- Stepper Motors – Brushless DC Motors- Applications

UNIT III AC ROTATING MACHINES


UNIT IV MEASUREMENTS AND INSTRUMENTATION


UNIT V BASICS OF POWER SYSTEMS

Power system structure -Generation , Transmission and distribution , Various voltage levels, Earthing – methods of earthing, protective devices- switch fuse unit- Miniature circuit breaker-moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid

COURSE OUTCOMES:

After completing this course, the students will be able to

CO1: Explain the working principle of electrical machines
CO2: Analyze the output characterizes of electrical machines
CO3: Choose the appropriate electrical machines for various applications
CO4: Explain the types and operating principles of measuring instruments
CO5: Explain the basic power system structure and protection schemes

TEXT BOOKS:

REFERENCES:

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GE3251 ENGINEERING GRAPHICS

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

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

UNIT I PLANE CURVES
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
Orthographic projection - principles - Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.
UNIT III  PROJECTION OF SOLIDS AND FREEHAND SKETCHING  6+12
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles — Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects.
Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

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

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

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

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

TEXT BOOKS:

REFERENCES:
Publication of Bureau of Indian Standards:

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

CO’s-PO’s & PSO’s MAPPING

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EC3251 CIRCUIT ANALYSIS

COURSE OBJECTIVES:
- To learn the basic concepts and behaviour of DC and AC circuits.
- To understand various methods of circuit/ network analysis using network theorems.
- To understand the transient and steady state response of the circuits subjected to DC excitations and AC with sinusoidal excitations.
- To learn the concept of coupling in circuits and topologies.

UNIT I DC CIRCUIT ANALYSIS 12
Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchoff’s Current Law, Kirchoff’s voltage law, The single Node – Pair Circuit, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis.

UNIT II NETWORK THEOREM AND DUALITY 12

UNIT III SINUSOIDAL STEADY STATE ANALYSIS 12
UNIT IV TRANSIENTS AND RESONANCE IN RLC CIRCUITS 12

UNIT V COUPLED CIRCUITS AND TOPOLOGY 12
Magnetically Coupled Circuits, mutual Inductance, the Linear Transformer, the Ideal Transformer, An introduction to Network Topology, Trees and General Nodal analysis, Links and Loop analysis.

SUGGESTED ACTIVITIES:
- Practice solving variety of problems

COURSE OUTCOMES
On successful completion of this course, the student will be able to
- CO1: Apply the basic concepts of circuit analysis such as Kirchoff’s laws, mesh current and node voltage method for analysis of DC and AC circuits.
- CO2: Apply suitable network theorems and analyze AC and DC circuits
- CO3: Analyze steady state response of any R, L and C circuits
- CO4: Analyze the transient response for any RC, RL and RLC circuits and frequency response of parallel and series resonance circuits.
- CO5: Analyze the coupled circuits and network topologies

TOTAL: 60 PERIODS

TEXT BOOKS:

REFERENCES:

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

52
UNIT I  WEAVING AND CERAMIC TECHNOLOGY  3
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II  DESIGN AND CONSTRUCTION TECHNOLOGY  3
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple) - Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III  MANUFACTURING TECHNOLOGY  3

UNIT IV  AGRICULTURE AND IRRIGATION TECHNOLOGY  3
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V  SCIENTIFIC TAMIL & TAMIL COMPUTING  3

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. தமிழ் வரலை மக்களும் பண்பொடும் - ககச்சீரம் பலாயனம் - தமிழ் பொடநூல் (தவளியீடு: தமிழ்நொடு பொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கருவிகள் தமிழ் - கச்சீரம் நூல். கருவிகள். (தினத்த பிரசுரம்).
3. சீலுட்பு - தமிழ் திக்கித்துறையின் சங்ககொலநகர நொகரிகம் (ததொல்லியல் துளறதவளியீடு).
4. பாக்கநகர் - கச்சீரம் தொகையிற். (தமிழ் தொகையிற் தொகையிற்)
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,
அறிவியல் அலகு

அறிவு மீன்வளம்

கொல்நளட

அலகு

நொணயங்கள்

உருக்குதல்

கப்பல்

சொகரொதசனிக்

மஹொல்

பற்றி

சிற்பங்களும்

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அதிகம் பரப்பு கணினியாக்கப்படாதை

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10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)


TOTAL : 15 PERIODS
TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலை மக்களும் பண ் பொடும் – கக கக பிள்ளள (தவளியீடு: தமிழ்நொடுப் பொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

2. கணினித் தமிழ் – முளனவர் இலசுந்தரம். (விகடன் பிரசுரம்).

3. கீழடி சங்ககொல நகரிகம் (ததொல்லியல் துளறதவளியீடு)

4. பருவிலதை தவளியீடு (ததொல்லியல் துளற)

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

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**TOTAL: 30 PERIODS**
## NCC Credit Course Level 1*  
**NATIONAL INTEGRATION AND AWARENESS**
- **NI 1** National Integration: Importance & Necessity
- **NI 2** Factors Affecting National Integration
- **NI 3** Unity in Diversity & Role of NCC in Nation Building
- **NI 4** Threats to National Security

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

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

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

**TOTAL : 30 PERIODS**
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**TOTAL : 30 PERIODS**
COURSE OBJECTIVES:
The main learning objective of this course is to provide hands on training to the students in:

- Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household work.
- Wiring various electrical joints in common household electrical wire work.
- Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
- Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I  CIVIL ENGINEERING PRACTICES  15

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

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

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

PART II  ELECTRICAL ENGINEERING PRACTICES  15

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

PART III MECHANICAL ENGINEERING PRACTICES

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

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

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

SHEET METAL WORK:
   a) Making of a square tray

FOUNDRY WORK:
   a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES

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

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

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

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

   CO1: Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
   CO2: Wire various electrical joints in common household electrical wire work.
   CO3: Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
   CO4: Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

TOTAL: 60 PERIODS
COURSES

CO’s-PO’s & PSO’s MAPPING

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EC3271                              CIRCUIT ANALYSIS LABORATORY                              L T P C
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COURSE OBJECTIVES:
- To gain hands-on experience in Thevenin & Norton theorem, KVL & KCL, and Superposition Theorems.
- To understand the working of RL, RC and RLC circuits

List of Experiments:
1. Verifications of KVL & KCL.
2. Verifications of Thevenin & Norton theorem.
3. Verification of Superposition Theorem.
4. Verification of maximum power transfer Theorem
5. Determination of Resonance Frequency of Series & Parallel RLC Circuits.

COURSE OUTCOMES:
At the end of the course, the student will be able to
- Design RL and RC circuits.

TEXT BOOKS

REFERENCES
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GE3272 COMMUNICATION LABORATORY L T P C 0 0 4 2

COURSE OBJECTIVES:

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

UNIT I

12 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

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

UNIT III

12 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

12 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

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

TOTAL: 60 PERIODS
LEARNING OUTCOMES

CO1: Speak effectively in group discussions held in formal/semi formal contexts.

CO2: Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions.

CO3: Write emails, letters and effective job applications.

CO4: Write critical reports to convey data and information with clarity and precision.

CO5: Give appropriate instructions and recommendations for safe execution of tasks.

Assessment Pattern

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

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

MA3355  RANDOM PROCESSES AND LINEAR ALGEBRA  L  T  P  C  3  1  0  4

COURSE OBJECTIVES:

- To introduce the basic notions of vector spaces which will then be used to solve related problems.
- To understand the concepts of vector space, linear transformations, inner product spaces and orthogonalization.
- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To provide necessary basics in probability that are relevant in applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.

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 RANDOM PROCESSES 9 + 3
Classification – Stationary process – Markov process - Poisson process - Discrete parameter Markov chain – Chapman Kolmogorov equations (Statement only) - Limiting distributions.

UNIT - IV VECTOR SPACES 9 + 3
Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

UNIT - V LINEAR TRANSFORMATION AND INNER PRODUCT SPACES 9 + 3

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

CO1: Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.

CO2: Demonstrate accurate and efficient use of advanced algebraic techniques.

CO3: Apply the concept of random processes in engineering disciplines.

CO4: Understand the fundamental concepts of probability with a thorough knowledge of standard distributions that can describe certain real-life phenomenon.

CO5: Understand the basic concepts of one and two dimensional random variables and apply them to model engineering problems.

TEXTBOOKS:

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CS3353 C PROGRAMMING AND DATA STRUCTURES L T P C

3 0 0 3

COURSE OBJECTIVES:

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

UNIT I C PROGRAMMING FUNDAMENTALS (8+1 SKILL)

Data Types – Variables – Operations – Expressions and Statements – Conditional Statements –
Functions – Recursive Functions – Arrays – Single and Multi-Dimensional Arrays.

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

Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays and
Functions – File Handling – Preprocessor Directives.

UNIT III LINEAR DATA STRUCTURES (8+1 SKILL)

Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List – Doubly-
Linked Lists – Circular Linked List – Stack ADT – Implementation of Stack – Applications – Queue
ADT – Priority Queues – Queue Implementation – Applications.

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

Trees – Binary Trees – Tree Traversals – Expression Trees – Binary Search Tree – Hashing - Hash
Functions – Separate Chaining – Open Addressing – Linear Probing– Quadratic Probing – Double
Hashing – Rehashing.

UNIT V SORTING AND SEARCHING TECHNIQUES (8+1 SKILL)

Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.

TOTAL: 45 PERIODS

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

5

COURSE OUTCOMES:

CO1: Develop C programs for any real world/technical application.
CO2: Apply advanced features of C in solving problems.
CO3: Write functions to implement linear and non-linear data structure operations.
CO4: Suggest and use appropriate linear/non–linear data structure operations for solving a given problem.

CO5: Appropriately use sort and search algorithms for a given application.

CO6: Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
https://www.coursera.org/specializations/data-structures-algorithms
https://nptel.ac.in/courses/112107243
https://nptel.ac.in/courses/112105598

CO’s-PO’s & PSO’s MAPPING

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EC3354 SIGNALS AND SYSTEMS

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 6+6
UNIT II  ANALYSIS OF CONTINUOUS TIME SIGNALS  6+6
Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and Properties

UNIT III  LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS  6+6

UNIT IV  ANALYSIS OF DISCRETE TIME SIGNALS  6+6
Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT)– Properties of DTFT - Z Transform & Properties

UNIT V  LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS  6+6

TOTAL: 30+30 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1:determine if a given system is linear/causal/stable
CO2: determine the frequency components present in a deterministic signal
CO3:characterize continuous LTI systems in the time domain and frequency domain
CO4:characterize discrete LTI systems in the time domain and frequency domain
CO5:compute the output of an LTI system in the time and frequency domains

TEXT BOOKS:

REFERENCES:

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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, diffusion and transition capacitance - 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 –MOSFET small signal model– Analysis of CS, CG and Source follower – Gain and frequency response- High frequency analysis.

UNIT III MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER

UNIT IV FEEDBACK AMPLIFIERS AND OSCILLATORS

UNIT V POWER AMPLIFIERS AND DC/DC CONVERTERS
Power amplifiers- class A-Class B-Class AB-Class C-Power MOSFET-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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EC3351 CONTROL SYSTEMS L T P C 3 0 0 3

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

UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION
Control System: Terminology and Basic Structure- Feed forward and Feedback control theory- Electrical and Mechanical Transfer Function Models- Block diagram Models- Signal flow graphs models- DC and AC servo Systems - Synchronous - Multivariable control system

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

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS
Closed loop frequency response- Performance specification in frequency domain- Frequency response of standard second order system- Bode Plot - Polar Plot - Nyquist plots- Design of compensators using Bode plots- Cascade lead compensation- Cascade lag compensation

UNIT IV CONCEPTS OF STABILITY ANALYSIS
UNIT V CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS

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

COURSE OUTCOMES :
Upon successful completion of the course the student will be able to
CO1: Compute the transfer function of different physical systems.
CO2: Analyse the time domain specification and calculate the steady state error.
CO3: Illustrate the frequency response characteristics of open loop and closed loop system response.
CO4: Analyse the stability using Routh and root locus techniques.
CO5: Illustrate the state space model of a physical system and discuss the concepts of sampled data control system.

TEXT BOOK:

REFERENCE:

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EC3352 DIGITAL SYSTEMS DESIGN L T P C
3 0 2 4

COURSE OBJECTIVES :
- To present the fundamentals of digital circuits and simplification methods
- To practice the design of various combinational digital circuits using logic gates
- To bring out the analysis and design procedures for synchronous and asynchronous Sequential circuits
- To learn integrated circuit families.
- To introduce semiconductor memories and related technology
UNIT I  BASIC CONCEPTS  9
Review of number systems-representation-conversions, Review of Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms min term and max term, Simplification of Boolean expressions-Karnaugh map, completely and incompletely specified functions, Implementation of Boolean expressions using universal gates ,Tabulation methods.

UNIT II  COMBINATIONAL LOGIC CIRCUITS  9
Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux, Case study: Digital trans-receiver / 8 bit Arithmetic and logic unit, Parity Generator/Checker, Seven Segment display decoder

UNIT III  SYNCHRONOUS SEQUENTIAL CIRCUITS  9
Latches, Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment,lock - out condition circuit implementation - Counters, Ripple Counters, Ring Counters, Shift registers, Universal Shift Register. Model Development: Designing of rolling display/real time clock

UNIT IV  ASYNCHRONOUS SEQUENTIAL CIRCUITS  9
Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Fundamental and Pulse mode sequential circuits, Design of Hazard free circuits.

UNIT V  LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES  9
Logic families- Propagation Delay, Fan - In and Fan - Out - Noise Margin - RTL ,TTL,ECL, CMOS - Comparison of Logic families - Implementation of combinational logic/sequential logic design using standard ICs, PROM, PLA and PAL, basic memory, static ROM,PROM,EPROM,EEPROM EAPROM.

PRACTICAL EXERCISES :  30 PERIODS
1. Design of adders and subtractors & code converters.
2. Design of Multiplexers & Demultiplexers.
3. Design of Encoders and Decoders.
4. Design of Magnitude Comparators
5. Design and implementation of counters using flip-flops
6. Design and implementation of shift registers.

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

CO1: Use Boolean algebra and simplification procedures relevant to digital logic.
CO2: Design various combinational digital circuits using logic gates.
CO3: Analyse and design synchronous sequential circuits.
CO4: Analyse and design asynchronous sequential circuits.
CO5: Build logic gates and use programmable devices

TOTAL:75 PERIODS

TEXTBOOKS :
REFERENCES:

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EC3361 ELECTRONIC DEVICES AND CIRCUITS LABORATORY L T P C
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COURSE OBJECTIVES
- To learn the characteristics of PN Junction diode and Zener diode.
- To understand the operation of rectifiers and filters.
- To study the characteristics of amplifier.

LIST OF EXPERIMENTS
2. Full Wave Rectifier with Filters.
3. Design of Zener diode Regulator.
5. MOSFET Drain current and Transfer Characteristics.
6. Frequency response of CE and CS amplifiers.
7. Frequency response of CB and CC amplifiers.
8. Frequency response of Cascode Amplifier
9. CMRR measurement of Differential Amplifier

COURSE OUTCOMES
At the end of the laboratory course, the student will be able to understand the
CO1: Characteristics of PN Junction Diode and Zener diode.
CO2: Design and Testing of BJT and MOSFET amplifiers.
CO3: Operation of power amplifiers.

REFERENCE:
XYZ of Oscilloscope – Application note: Tektronix USA.

TOTAL: 45 PERIODS
CS3362 C PROGRAMMING AND DATA STRUCTURES LABORATORY

L T P C
0 0 3 1.5

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
CO’s-PO’s & PSO’s MAPPING

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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
CO1: Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
CO2: Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
CO3: Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.
COURSE OBJECTIVES:
- To impart knowledge on the basics of static electric field and the associated laws
- To impart knowledge on the basics of static magnetic field and the associated laws
- To give insight into coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To gain the behaviour of the propagation of EM waves
- To study the significance of Time varying fields.

UNIT I  INTRODUCTION
Electromagnetic model, Units and constants, Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Null identities, Helmholtz's theorem, Verify theorems for different path, surface and volume.

UNIT II  ELECTROSTATICS
Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Conductors in static electric field, Dielectrics in static electric field, Electric flux density and dielectric constant, Boundary conditions, Electrostatics boundary value problems, Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations, Uniqueness of electrostatic solutions, Current density and Ohm's law, Electromotive force and Kirchhoff's voltage law, Equation of continuity and Kirchhoff's current law

UNIT III  MAGNETOSTATICS
Lorentz force equation, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity and idea of relative permeability, Calculation of magnetic field intensity for various current distributions Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors, Magnetic energy, Magnetic forces and torques

UNIT IV  TIME-VARYING FIELDS AND MAXWELL's EQUATIONS
Faraday's law, Displacement current and Maxwell-Ampere law, Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and solutions, Time-harmonic fields, Observing the Phenomenon of wave propagation with the aid of Maxwell's equations

UNIT V  PLANE ELECTROMAGNETIC WAVES
Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Electromagnetic power flow and Poynting vector, Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary

COURSE OUTCOMES:
At the end of the course the students will be able to
- CO1: Relate the fundamentals of vector, coordinate system to electromagnetic concepts
- CO2: Analyze the characteristics of Electrostatic field
- CO3: Interpret the concepts of Electric field in material space and solve the boundary conditions
- CO4: Explain the concepts and characteristics of Magneto Static field in material space and solve boundary conditions.
- CO5: Determine the significance of time varying fields

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

CO’s-PO’s & PSO’s MAPPING

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EC3401 NETWORKS AND SECURITY

L T P C 3 0 2 4

COURSE OBJECTIVES:
- To learn the Network Models and datalink layer functions.
- To understand routing in the Network Layer.
- To explore methods of communication and congestion control by the Transport Layer.
- To study the Network Security Mechanisms.
- To learn various hardware security attacks and their countermeasures.

UNIT I NETWORK MODELS AND DATALINK LAYER

UNIT II NETWORK LAYER PROTOCOLS

UNIT III TRANSPORT AND APPLICATION LAYERS

UNIT IV NETWORK SECURITY
UNIT V       HARDWARE SECURITY


45 PERIODS

PRACTICAL EXERCISES:

30 PERIODS

Experiments using C

1. Implement the Data Link Layer framing methods,
   i) Bit stuffing, (ii) Character stuffing
2. Implementation of Error Detection / Correction Techniques
   i) LRC, (ii) CRC, (iii) Hamming code
3. Implementation of Stop and Wait, and Sliding Window Protocols
5. Implementation of Distance Vector Routing algorithm (Routing Information Protocol) (Bellman-Ford).
6. Implementation of Link State Routing algorithm (Open Shortest Path First) with 5 nodes (Dijkstra’s).
7. Data encryption and decryption using Data Encryption Standard algorithm.
8. Data encryption and decryption using RSA (Rivest, Shamir and Adleman) algorithm.

Experiments using Tool Command Language

1. Implement and realize the Network Topology - Star, Bus and Ring using NS2.
2. Implement and perform the operation of CSMA/CD and CSMA/CA using NS2.

COURSE OUTCOMES:

Upon successful completion of the course the student will be able to

CO1: Explain the Network Models, layers and functions.
CO2: Categorize and classify the routing protocols.
CO3: List the functions of the transport and application layer.
CO4: Evaluate and choose the network security mechanisms.
CO5: Discuss the hardware security attacks and countermeasures.

TOTAL:75 PERIODS

TEXTBOOKS


REFERENCES

COURSE OBJECTIVES:
- To introduce the basic building blocks of linear integrated circuits
- To learn the linear and non-linear applications of operational amplifiers
- To introduce the theory and applications of analog multipliers and PLL
- To learn the theory of ADC and DAC
- To introduce the concepts of waveform generation and introduce some special function ICs

UNIT I  BASICS OF OPERATIONAL AMPLIFIERS  9
Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages - and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations – MOSFET Operational Amplifiers – LF155 and TL082.

UNIT II  APPLICATIONS OF OPERATIONAL AMPLIFIERS  9
Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

UNIT III  ANALOG MULTIPLIER AND PLL  9
Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronization

UNIT IV  ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS  9

UNIT V  WAVEFORM GENERATORS AND SPECIAL FUNCTION ICs  9
Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out(LDO) Regulators - Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC

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

CO1 : Design linear and nonlinear applications of OP – AMPS
CO2 : Design applications using analog multiplier and PLL
CO3 : Design ADC and DAC using OP – AMPS
CO4: Generate waveforms using OP – AMP Circuits
CO5: Analyze special function ICs

TOTAL: 45 PERIODS

TEXT BOOK

REFERENCES

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EC3492 DIGITAL SIGNAL PROCESSING

COURSE OBJECTIVES:
- To learn discrete fourier transform, properties of DFT and its application to linear filtering
- To understand the characteristics of digital filters, design digital IIR and FIR filters and apply these filters to filter undesirable signals in various frequency bands
- To understand the effects of finite precision representation on digital filters
- To understand the fundamental concepts of multi rate signal processing and its applications
- To introduce the concepts of adaptive filters and its application to communication engineering

UNIT I DISCRETE FOURIER TRANSFORM

UNIT II INFINITE IMPULSE RESPONSE FILTERS
Characteristics of practical frequency selective filters. characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency
transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

UNIT III  
FINITE IMPULSE RESPONSE FILTERS  
Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.

UNIT IV  
FINITE WORD LENGTH EFFECTS  
Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.

UNIT V  
DSP APPLICATIONS  
Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor – Adaptive Filters: Introduction, Applications of adaptive filtering to equalization-DSP Architecture-Fixed and Floating point architecture principles.

PRACTICAL EXERCISES:  
MATLAB / EQUIVALENT SOFTWARE PACKAGE/ DSP PROCESSOR BASED IMPLEMENTATION
1. Generation of elementary Discrete-Time sequences
2. Linear and Circular convolutions
3. Auto correlation and Cross Correlation
4. Frequency Analysis using DFT
5. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation
6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations
7. Study of architecture of Digital Signal Processor
8. Perform MAC operation using various addressing modes
9. Generation of various signals and random noise
10. Design and demonstration of FIR Filter for Low pass, High pass, Band pass and Band stop filtering
11. Design and demonstration of Butter worth and Chebyshev IIR Filters for Low pass, High pass, Band pass and Band stop filtering
12. Implement an Up-sampling and Down-sampling operation in DSP Processor

COURSE OUTCOMES:
At the end of the course students will be able to:
CO1: Apply DFT for the analysis of digital signals and systems
CO2: Design IIR and FIR filters
CO3: Characterize the effects of finite precision representation on digital filters
CO4: Design multirate filters
CO5: Apply adaptive filters appropriately in communication systems

TOTAL: 75 PERIODS
TEXT BOOKS:

REFERENCES

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EC3491   COMMUNICATION SYSTEMS   L T P C
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COURSE OBJECTIVES:
- To introduce Analog Modulation Schemes
- To impart knowledge in random process
- To study various Digital techniques
- To introduce the importance of sampling & quantization
- To impart knowledge in demodulation techniques
- To enhance the class room teaching using smart connectivity instruments

UNIT I   AMPLITUDE MODULATION
9

UNIT II   RANDOM PROCESS & SAMPLING
9
Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.
Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Nyquist criterion- Logarithmic Companding –PAM, PPM, PWM, PCM – TDM, FDM

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

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

UNIT V DEMODULATION TECHNIQUES

TOTAL: 45 PERIODS

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

TEXTBOOKS :

REFERENCES :
5. H P Hsu, Schaum Outline Series - “Analog and Digital Communications" TMH 2006

CO’s-PO’s & PSO’s MAPPING

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GE3451 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY

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


UNIT II ENVIRONMENTAL POLLUTION


UNIT III RENEWABLE SOURCES OF ENERGY

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of: Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT

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

UNIT V SUSTAINABILITY PRACTICES

COURSE OUTCOMES:
CO1: To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
CO2: To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
CO3: To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
CO4: To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
CO5: 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:

CO’s-PO’s & PSO’s MAPPING

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

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

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

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

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

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

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

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

### TOTAL: 45 PERIODS
### DISASTER MANAGEMENT

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### GENERAL AWARENESS

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**Total: 45 Periods**

**NCC Credit Course Level 2**

**NX3453**

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

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EC3461 COMMUNICATION SYSTEMS LABORATORY

COURSE OBJECTIVES:
- To study the AM & FM Modulation and Demodulation.
- To learn and realize the effects of sampling and TDM.
- To understand the PCM & Digital Modulation.
- To Simulate Digital Modulation Schemes.
- To Implement Equalization Algorithms and Error Control Coding Schemes.

LIST OF EXPERIMENTS
1. AM- Modulator and Demodulator
2. FM - Modulator and Demodulator
4. Signal sampling and TDM.
5. Pulse Code Modulation and Demodulation.
6. Pulse Amplitude Modulation and Demodulation.
7. Pulse Position Modulation and Demodulation and Pulse Width Modulation and Demodulation.
8. Digital Modulation – ASK, PSK, FSK.
10. Simulation of ASK, FSK, and BPSK Generation and Detection Schemes.
12. Simulation of Linear Block and Cyclic Error Control coding Schemes.

COURSE OUTCOMES:
At the end of the laboratory course, the student will be able to understand the:
CO1: Design AM, FM & Digital Modulators for specific applications.
CO2: Compute the sampling frequency for digital modulation.
CO3: Simulate & validate the various functional modules of Communication system.
CO4: Demonstrate their knowledge in base band signaling schemes through implementation of digital modulation schemes.
CO5: Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of Communication system.
CO’s-PO’s & PSO’s MAPPING

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EC3462 LINEAR INTEGRATED CIRCUITS LABORATORY

COURSE OBJECTIVES:
- To gain hands on experience in designing electronic circuits
- To learn simulation software used in circuit design
- To learn the fundamental principles of amplifier circuits
- To differentiate feedback amplifiers and oscillators.
- To differentiate the operation of various multivibrators

LIST OF EXPERIMENTS:

DESIGN AND ANALYSIS OF THE FOLLOWING CIRCUITS
1. Series and Shunt feedback amplifiers-Frequency response, Input and output impedance
2. RC Phase shift oscillator and Wien Bridge Oscillator
3. Hartley Oscillator and Colpitts Oscillator
4. RC Integrator and Differentiator circuits using Op-Amp
5. Clippers and Clampers
6. Instrumentation amplifier
7. Active low-pass, High pass & Band pass filters
8. PLL Characteristics and its use as frequency multiplier, clock synchronization
9. R-2R ladder type D-A converter using Op-Amp

SIMULATION USING SPICE (Using Transistor):
1. Tuned Collector Oscillator
2. Twin -T Oscillator / Wein Bridge Oscillator
3. Double and Stagger tuned Amplifiers
4. Bistable Multivibrator
5. Schmitt Trigger circuit with Predictable hysteresis
6. Analysis of power amplifier

Components and Accessories:
- Transistors, Resistors, Capacitors, Inductors, diodes, Zener Diodes, Bread Boards, Transformers.
- SPICE Circuit Simulation Software: (any public domain or commercial software)

Note: Op-Amps uA741, LM 301, LM311, LM 324, LM317, LM723, 7805, 7812, 2N3524, 2N3525, 2N3391, AD 633, LM 555, LM 565 may be used

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course the students will be able to
CO1: Analyze various types of feedback amplifiers
CO2: Design oscillators, tuned amplifiers, wave-shaping circuits and multivibrators
CO3: Design and simulate feedback amplifiers, oscillators, tuned amplifiers, wave-shaping circuits and multivibrators, filters using SPICE Tool.
CO4: Design amplifiers, oscillators, D-A converters using operational amplifiers.
CO5: Design filters using op-amp and perform an experiment on frequency response

CO’s-PO’s & PSO’s MAPPING

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EC3501 WIRELESS COMMUNICATION  
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COURSE OBJECTIVES:
- To study and understand the concepts and design of a Cellular System.
- To Study And Understand Mobile Radio Propagation And Various Digital Modulation Techniques.
- To Understand The Concepts Of Multiple Access Techniques And Wireless Networks

UNIT-I THE CELLULAR CONCEPT-SYSTEM DESIGN FUNDAMENTALS

UNIT-II MOBILE RADIO PROPAGATION

UNIT-III MODULATION TECHNIQUES AND EQUALIZATION AND DIVERSITY

UNIT- IV MULTIPLE ACCESS TECHNIQUES


UNIT- V WIRELESS NETWORKING


PRACTICAL EXERCISES:

1. Modeling of wireless communication systems using Matlab(Two ray channel and Okumura –Hata model)
2. Modeling and simulation of Multipath fading channel
3. Design, analyze and test Wireless standards and evaluate the performance measurements such as BER, PER, BLER, throughput, capacity, ACLR, EVM for 4G and 5G using Matlab
5. Wireless Channel equalization: Zero-Forcing Equalizer (ZFE),MMSE Equalizer(MMSEE),Adaptive Equalizer (ADE),Decision Feedback Equalizer (DFE)
6. Modeling and simulation of TDMA, FDMA and CDMA for wireless communication

TOTAL:75 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course the student will be able to:

CO1:Understand The Concept And Design Of A Cellular System.
CO3:Understand The Concepts Of Multiple Access Techniques And Wireless Networks
CO4:Characterize a wireless channel and evolve the system design specifications
CO5:Design a cellular system based on resource availability and traffic demands.

TEXT BOOK:


REFERENCES:

EC3552 VLSI AND CHIP DESIGN

COURSE OBJECTIVES:
- Understand the fundamentals of IC technology components and their characteristics.
- Understand combinational logic circuits and design principles.
- Understand sequential logic circuits and clocking strategies.
- Understand ASIC Design functioning and design.
- Understand Memory Architecture and building blocks

UNIT I MOS TRANSISTOR PRINCIPLES
MOS logic families (NMOS and CMOS), Ideal and Non Ideal IV Characteristics, CMOS devices. 
MOS(FET) Transistor Characteristic under Static and Dynamic Conditions, Technology Scaling, 
power consumption

UNIT II COMBINATIONAL LOGIC CIRCUITS
Propagation Delays, stick diagram, Layout diagrams, Examples of combinational logic design, 
Elmore’s constant, Static Logic Gates, Dynamic Logic Gates, Pass Transistor Logic, Power 
Dissipation, Low Power Design principles.

UNIT III SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES
Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Nonbistable Sequential 

UNIT IV INTERCONNECT, MEMORY ARCHITECTURE AND ARITHMETIC CIRCUITS
Interconnect Parameters – Capacitance, Resistance, and Inductance, Electrical WireModels, 
Sequential digital circuits: adders, multipliers, comparators, shift registers. Logic Implementation 
using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks, 
Memory Core and Memory Peripherals Circuitry

UNIT V ASIC DESIGN AND TESTING
Introduction to wafer to chip fabrication process flow. Microchip design process & issues in test 
and verification of complex chips, embedded cores and SOCs, Fault models. Test coding. ASIC 
Design Flow, Introduction to ASICs, Introduction to test benches, Writing test benches in Verilog HDL,
Automatic test pattern generation, Design for testability, Scan design: Test interface and boundary scan.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**
Upon successful completion of the course the student will be able to
CO1: In depth knowledge of MOS technology
CO2: Understand Combinational Logic Circuits and Design Principles
CO3: Understand Sequential Logic Circuits and Clocking Strategies
CO4: Understand Memory architecture and building blocks
CO5: Understand the ASIC Design Process and Testing.

**TEXTBOOKS**
3. Michael J Smith,Application Specific Integrated Circuits, Addison Wesley, (Unit - V)

**REFERENCES**

**COURSE OBJECTIVES:**
- To introduce the various types of transmission lines and its characteristics
- To understand high frequency line, power and impedance measurements
- To impart technical knowledge in impedance matching using Smith Chart.
- To introduce passive filters and basic knowledge of active RF components
- To learn the concepts of a RF system transceiver design.

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**EC3551 TRANSMISSION LINES AND RF SYSTEMS**

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**COURSE OBJECTIVES:**
- To introduce the various types of transmission lines and its characteristics
- To understand high frequency line, power and impedance measurements
- To impart technical knowledge in impedance matching using Smith Chart.
- To introduce passive filters and basic knowledge of active RF components
- To learn the concepts of a RF system transceiver design.
UNIT I TRANSMISSION LINE THEORY
General theory of Transmission lines - the transmission line - general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion less line - Loading and different methods of loading - Line not terminated in $Z_0$ - Reflection coefficient - calculation of current, voltage, power delivered and efficiency of transmission - Input and transfer impedance - Open and short circuited lines - reflection factor and reflection loss.

UNIT II HIGH FREQUENCY TRANSMISSION LINES
Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation less line - Open and short circuited lines - Power and impedance measurement on lines - Reflection losses - Measurement of VSWR and wavelength.

UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINE
Impedance matching: Quarter wave transformer , One Eighth wave line, Half wave line - Impedance matching by stubs- Single stub and double stub matching - Smith chart – Application of Smith chart, Solutions of problems using Smith chart - Single and double stub matching using Smith chart.

UNIT IV WAVEGUIDES
Waves between parallel planes of perfect conductors- Transverse Electric waves and Transverse Magnetic waves, Characteristics of TE and TM waves, Transverse Electromagnetic waves, TM and TE waves in Rectangular waveguides, TM and TE waves in Circular waveguides.

UNIT V RF SYSTEM DESIGN CONCEPTS
Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, High electron mobility transistors, Fundamentals of MMIC, Basic concepts of RF design: Filters, couplers, power dividers, Amplifier power relations, Low noise amplifiers, Power amplifiers.

COURSE OUTCOMES:
CO1: Explain the characteristics of transmission lines and its losses.
CO2: Calculate the standing wave ratio and input impedance in high frequency transmission lines.
CO3: Analyze impedance matching by stubs using Smith Charts.
CO4: Comprehend the characteristics of TE and TM waves.
CO5: Design a RF transceiver system for wireless communication

TOTAL: 45 PERIODS

TEXTBOOKS
1. John D Ryder, “Networks lines and fields”, Prentice Hall of India, New Delhi, 2005. (Unit I–IV)

REFERENCES
CO’s-PO’s & PSO’s MAPPING

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EC3561 VLSI LABORATORY

COURSE OBJECTIVES:
- To learn Hardware Descriptive Language (Verilog/VHDL).
- To learn the fundamental principles of Digital System Design using HDL and FPGA.
- To learn the fundamental principles of VLSI circuit design in digital domain
- To learn the fundamental principles of VLSI circuit design in analog domain
- To provide hands on design experience with EDA platforms.

LIST OF EXPERIMENTS:
1. Design of basic combinational and sequential (Flip-flops) circuits using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
2. Design an Adder ; Multiplier (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
3. Design and implement Universal Shift Register using HDL. Simulate it using Xilinx/Altera Software
4. Design Memories using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
5. Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
6. Design 3-bit synchronous up/down counter using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
7. Design 4-bit Asynchronous up/down counter using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
9. Design and simulate a 4-bit synchronous counter using a Flip-Flops. Generate Manual/Automatic Layout
10. Design and Simulate a CMOS Inverting Amplifier.
11. Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers.
12. Design and simulate simple 5 transistor differential amplifier.

COURSE OUTCOMES:
On completion of the course, students will be able to:
- CO1: Write HDL code for basic as well as advanced digital integrated circuit
- CO2: Import the logic modules into FPGA Boards
- CO3: Synthesize Place and Route the digital IPs
CO4: Design, Simulate and Extract the layouts of Digital & Analog IC Blocks using EDA tools
CO5: Test and Verification of IC design

TOTAL: 60 PERIODS

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ET3491 EMBEDDED SYSTEMS AND IOT DESIGN  L T P C
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COURSE OBJECTIVES:
- Learn the architecture and features of 8051.
- Study the design process of an embedded system.
- Understand the real-time processing in an embedded system.
- Learn the architecture and design flow of IoT.
- Build an IoT based system.

UNIT I  8051 MICROCONTROLLER  9

UNIT II  EMBEDDED SYSTEMS  9

UNIT III  PROCESSES AND OPERATING SYSTEMS  9

UNIT IV  IOT ARCHITECTURE AND PROTOCOLS  9
UNIT V  IOT SYSTEM DESIGN


45 PERIODS

PRACTICAL EXERCISES

Experiments using 8051.
2. Generation of Square waveform using 8051.
5. Design of a Digital Clock using Timers/Counters in 8051.

Experiments using ARM
Interfacing ADC and DAC
Blinking of LEDs and LCD
Interfacing keyboard and Stepper Motor.
Miniprojects for IoT
Garbage Segregator and Bin Level Indicator
Colour based Product Sorting
Image Processing based Fire Detection
Vehicle Number Plate Detection
Smart Lock System

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO1: Explain the architecture and features of 8051.
CO2: Develop a model of an embedded system.
CO3: List the concepts of real time operating systems.
CO4: Learn the architecture and protocols of IoT.
CO5: Design an IoT based system for any application.

TEXTBOOKS:


REFERENCES:


CO’s-PO’s & PSO’s MAPPING

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CS3491  ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING  L T P C
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COURSE OBJECTIVES:
The main objectives of this course are to:
- Study about uninformed and Heuristic search techniques.
- Learn techniques for reasoning under uncertainty
- Introduce Machine Learning and supervised learning algorithms
- Study about ensembling and unsupervised learning algorithms
- Learn the basics of deep learning using neural networks

UNIT I  PROBLEM SOLVING

UNIT II  PROBABILISTIC REASONING

UNIT III  SUPERVISED LEARNING

UNIT IV  ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING
Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization

UNIT V  NEURAL NETWORKS
Perceptron - Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

PRACTICAL EXERCISES:
1. Implementation of Uninformed search algorithms (BFS, DFS)
2. Implementation of Informed search algorithms (A*, memory-bounded A*)
3. Implement naive Bayes models
4. Implement Bayesian Networks
5. Build Regression models
6. Build decision trees and random forests
7. Build SVM models
8. Implement ensembling techniques
1. Implement clustering algorithms
2. Implement EM for Bayesian networks
3. Build simple NN models
4. Build deep learning NN models

OUTCOMES:
At the end of this course, the students will be able to:
CO1: Use appropriate search algorithms for problem solving
CO2: Apply reasoning under uncertainty
CO3: Build supervised learning models
CO4: Build ensembling and unsupervised models
CO5: Build deep learning neural network models

TOTAL:75 PERIODS

TEXT BOOKS:

REFERENCES

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

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

### ARMED FORCES
- AF 2: Modes of Entry to Army, CAPF, Police (3)

### COMMUNICATION
- C 1: Introduction to Communication & Latest Trends (3)

### INFANTRY
- INF 1: Organisation of Infantry Battalion & its weapons (3)

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

**TOTAL: 45 PERIODS**

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

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

### 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)
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**TOTAL : 45 PERIODS**

**NCC Credit Course Level 3**

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GE3791 HUMAN VALUES AND ETHICS

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

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

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

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

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

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

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


TOTAL: 30 PERIODS

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

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

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

The students individually undergo training in reputed firms/ research institutes / laboratories for the specified duration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester. The students will be evaluated as per the Regulations.

No. of Weeks: 04

COURSE OUTCOMES:
On completion of the course, the student will know about
CO1: System-level design processes, verification and validation techniques, manufacturing and production processes in the firm or research facilities in the laboratory/research institute
CO2: Analysis of industrial / research problems and their solutions
CO3: Documentation of system specifications, design methodologies, process parameters, testing parameters and results
CO4: Preparing of technical report and presentation

EC3811 PROJECT WORK/ INTERNSHIP L T P C
0 0 20 10

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

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

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

TOTAL: 300 PERIODS
COURSE OBJECTIVES:

- Introduce the concept of wide band gap (WBG) devices and its application in real world
- Advantages and disadvantages of WBG devices
- Provide an introduction to basic operation of WBG power devices
- Learn Design principles of modern power devices
- Ability to deal high frequency design complexity

UNIT I  WBG DEVICES AND THEIR APPLICATION IN REAL WORLD  6
Review of semiconductor basics, Operation and characteristics of the SiC Schottky Barrier Diode, SiC DMOSFET and GaN HEMT, Review of Wide bandgap semiconductor technology -Advantages and disadvantages

UNIT II  SWITCHING CHARACTERIZATION OF WBG  6
Turn-on and Turn-off characteristics of the device, Hard switching loss analysis, Double pulse test set-up

UNIT III  DRIVERS FOR WIDE BAND GAP DEVICES  6
Gate driver, Impact of gate resistance, Gate drivers for wide bandgap power devices , Transient immunity integrated gate drivers

UNIT IV  HIGH FREQUENCY DESIGN COMPLEXITY AND PCB DESIGNING  6
Effects of parasitic inductance, Effects of parasitic capacitance , EMI filter design for high frequency power converters High frequency PCB design, Conventional power loop design, High frequency power loop optimization, Separation of power from signal PCB

UNIT V  APPLICATIONS OF WIDE BANDGAP DEVICES  6
Consumer electronics applications, Wireless power transfer applications, Electric vehicle applications , Renewable energy sources applications

30 PERIODS

PRACTICAL EXERCISES:

1. Conduct switching loss and Magnetic loss on Low side
2. Conduct Double pulse test (DPT) and learn IEC 60747 -8/9 standards
3. Conduct experiments for Diode reverse recovery on High side
4. Conduct Power analysis and harmonic measurement
5. Measure Turn on /off delay , Calculate recovery softness factor , measure reverse recovery energy.

List of Equipments needed for 30 students in a batch (6 students in bench)

1. 1GHz Flexi channel oscilloscope with 6 channels - #5
2. 2ch AFG with 9inch touchscreen and built-in Double Pulse Test application to generate atleast 2 varying pulse widths, 16Mpts memory - #1
3. Power supplies - Programmable DC Power Supply, 720W (for High Voltage side) and Programmable Single Channel DC Power Supply, 192W (to drive Gate drive circuit) - #1
4. Voltage Probes to measure Vgs (low side) – passive probe or differential probe 200MHz - #15
5. Voltage Probes to measure Vgs (high side) – 1GHz, isolated probes with MMCX adapter tips – #1 nos
6. Current Probes to measure drain current – 30A with 120Mz BW - #5

COURSE OUTCOMES:
Upon successful completion of the course the student will be able to
CO1: Students master design principles of power devices
CO2: Students become familiar with reliability issues and testing methods
CO3: An ability to design and conduct experiments, as well as to analyze and interpret data
CO4: Student to get real life experience and to know practical applications of WBG
CO5: Indepth knowledge on practical usage of this technology

TOTAL: 60 PERIODS

TEXT BOOKS

REFERENCES

CO’s-PO’s & PSO’s MAPPING

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CEC361 VALIDATION AND TESTING TECHNOLOGY L T P C
2 0 2 3

COURSE OBJECTIVES:
- Getting familiar with various IC technology.
- Learn MOS theory and testing
- Learn CMOS circuit theory and testing
- Getting expertise on CMOS characterization.
- Explore circuit and device level testing methods
UNIT I TECHNOLOGY INTRODUCTION: 6

UNIT II MOS THEORY ANALYSIS-I 6
Basic Electrical Properties of MOS Circuits: Ids-Vds Relationships, MOS Transistor Threshold Voltage Vth, gm, gds, Figure of Merit wo, Short Channel and Narrow Channel Width Effects.

UNIT III MOS THEORY ANALYSIS-II 6
Pass Transistor, Transmission Gate, NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits.

UNIT IV CMOS CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION 6
Sheet Resitance RS, conductivity and its Concept to MOS, Area Capacitance Units, Calculations - Delays, Driving Large Capacitive Loads, Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Reliability.

UNIT V BASIC OF SILICON VALIDATION 6

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS
1. MOS TESTING for Ids-Vds Relationships
2. MOSFET testing for threshold voltage like Vth, gate breakdown voltage.
3. Sheet resistivity measurement.
4. Conductivity measurement.
5. Inverter testing
6. Designing of CMOS inverter/ logic gate and testing of delay estimation.

List of equipment needed for a batch of 30 students (3 in a bench):
- Dual channel SMU for MOSFET testing with Test script processor and IV software: 2 nos (one setup for three students)
- Resistivity and Conductivity Setup – #2 setups
- I-V SMU analyser
- Four Point Collinear Resistivity Measurement Setup
- Resistivity samples #2
- Conductivity Samples #2
- Inverter testing setup: power suppy #1, Scope with AFG and power application: #1no
- Xilinx /CAD: 5 no.

COURSE OUTCOMES:
Upon successful completion of the course the student will be able to
CO1: Complete overview to CMOS fabrication process.
CO2: Understand the fundamental concept of MOS FET and testing.
CO3: Explain the concept of MOS theory and analysis.
CO4: To give the student an understanding of CMOS performance testing and estimation.
CO5: Explain the basics of Testing and Fault Modeling.
TEXT BOOKS:

REFERENCES

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CEC370  LOW POWER IC DESIGN  L T P C
2 0 2 3

COURSE OBJECTIVES:
- To learn the fundamentals of low power low voltage VLSI design.
- To understand the impact of power on system performances.
- To understand the different design approaches.
- To develop the low power low voltage memories

UNIT I  FUNDAMENTALS OF LOW POWER CIRCUITS  6

UNIT II  LOW-POWER DESIGN APPROACHES  6

UNIT III  LOW-VOLTAGE LOW-POWER ADDERS  6
UNIT IV LOW-VOLTAGE LOW-POWER MULTIPLIERS 6
Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh-Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier

UNIT V LOW-VOLTAGE LOW-POWER MEMORIES 6

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS
1. Modeling and sources of power consumption
2. Power estimation at different design levels (mainly circuit, transistor, and gate)
3. Power optimization for combinational circuits
4. Power optimization for sequential circuits
5. Power optimization for RT and algorithmic levels.

TOTAL:60 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course the student will be able to
CO1: Understand the fundamentals of Low power circuit design.
CO2: Attain the knowledge of architectural approaches.
CO3: Analyze and design Low-Voltage Low-Power combinational circuits.
CO4: Learn the design of Low-Voltage Low-Power Memories
CO5: Design and develop Low Power, Low Voltage Circuits

TEXT BOOKS:

REFERENCES
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### CEC362 VLSI TESTING AND DESIGN FOR TESTABILITY

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#### COURSE OBJECTIVES:
- To introduce logic and fault simulation and testability measures.
- To study the design for testability.
- To know about interfacing and testing of memory
- To introduce power management techniques in testing
- To study testability in analog circuits

#### UNIT I TEST REQUIREMENTS AND METRICS
9
Validation platforms- SOC design methodology, IP components, Integration, Clocking, I/Os and interfaces, Device modes, Logic, memories, analog, I/Os, power management; Test requirements- Test handoffs, Testers Where DUT and DFT fit into design / framework; Test: ATPG, DFT, BIST, COF, TTR; Test cost metrics and test economics; Logic fault models- SAF, TDF, PDF, Iddq, St-BDG, Dy-BDG, SDD; Basics of test generation and fault simulation- Combinational circuits, Sequential; Specific algorithmic approaches, CAD framework; Optimisations.

#### UNIT II SCAN DESIGN AND BIST
9
Scan Design- Scan design requirements, Types of scan and control mechanisms, Test pattern construction for scan, Managing scan in IPs and SOCs, Scan design optimisations, Partitioning, Clocking requirements for scan and delay fault testing, Speed of operation; BIST – Framework, Controller configurations, FSMs, LFSRs, STUMPS architecture, Scan compression and bounds, Test per cycle, Test per scan, Self-testing and self-checking circuits, Online test.

#### UNIT III MEMORY TEST AND TEST INTERFACES
9
Memory Test -Memory fault models, Functional architecture as applicable to test, Test of memories, Test of logic around memories, BIST controller configuration, Test of logic around memories, DFT and architecture enhancements, Algorithmic optimisations; Test Interfaces-Test control requirements, Test interfaces - 1500, JTAG, Hierarchical, serial control, Module / IP test, SOC test, Board test, System test, Boundary scan.

#### UNIT IV DESIGN CONSIDERATIONS AND POWER MANAGEMENT DURING TEST
9
Design Considerations- Design considerations, Physical design congestion, Partitioning, Clocks, Test modes, Pins, Test scheduling, Embedded test, Architecture improvements, Test in the
presence of security; Power management during test- Methods for low power test, ATPG methods, DFT methods, Scan methods, Low power compression, Test of power management, Implications of power excursions, Optimisations.

UNIT V ANALOG TEST
Test requirements. DFT methods. BIST methods. Test versus measurement. Defect tests versus performance tests. Tests for specific modules - PLL, I/Os, ADC, DAC, SerDes, etc. RF test requirements.

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1: Understand logic and fault simulation requirements and testability measures.
CO2: Understand the Design for Testability.
CO3: Develop interfacing and memory testing.
CO4: Perform testing with power management techniques.
CO5: Carry-out fault Detection in analog circuits.

TEXT BOOK:
UNIT IV ADC TESTING


UNIT V CLOCK AND SERIAL DATA COMMUNICATIONS CHANNEL MEASUREMENTS


30 PERIODS

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

CO1: Learn the fundamentals of mixed signal circuits.
CO2: Define the various measurement terminologies.
CO3: Acquire knowledge of Analog to Digital Converters.
CO4: Learn testing of Analog to Digital Converters.
CO5: Comprehend the attributes of a clock signal.

TEXTBOOK:

PRACTICAL EXERCISES:

DESIGN AND TESTING OF THE FOLLOWING CIRCUITS

1. PLL characteristics and its use as Frequency Multiplier, Clock synchronization
2. R-2R Ladder Type and Flash Type ADC.
3. DC power supply using LM317 and LM723.
4. Design of asynchronous counter
5. Design of synchronous counter
6. Implementation and Testing of RS Latch and Flip-flops

TOTAL: 60 PERIODS

CO’s-PO’s & PSO’s MAPPING

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COURSE OBJECTIVES:
- To study the basics of MOS Circuits.
- To analyse the noise characteristics of amplifiers.
- To study the performance parameters of amplifiers.
- To comprehend the compensation techniques
- To understand the detection and testing of faults.

UNIT I  SINGLE STAGE AMPLIFIERS  6
Basic MOS physics and equivalent circuits and models, CS, CG and Source Follower, differential amplifier with active load, Cascode and Folded Cascode configurations with active load, design of Differential and Cascode Amplifiers – to meet specified SR, noise, gain, BW, ICMR and power dissipation, voltage swing, high gain amplifier structures.

UNIT II  HIGH FREQUENCY AND NOISE CHARACTERISTICS OF AMPLIFIERS  6
Miller effect, association of poles with nodes, frequency response of CS, CG and Source Follower, Cascode and Differential Amplifier stages, statistical characteristics of noise, noise in Single Stage amplifiers, noise in Differential Amplifiers.

UNIT III  FEEDBACK AND SINGLE STAGE OPERATIONAL AMPLIFIERS  6
Properties and types of negative feedback circuits, effect of loading in feedback networks, operational amplifier performance parameters, single stage Op Amps, two-stage Op Amps, input range limitations, gain boosting, slew rate, power supply rejection, noise in Op Amps.

UNIT IV  STABILITY , FREQUENCY COMPENSATION  6
Multipole Systems, Phase Margin, Frequency Compensation, Compensation Of Two Stage Op Amps, Slewing In Two Stage Op Amps, Other Compensation Techniques.

UNIT V  LOGIC CIRCUIT TESTING  6

PRACTICAL EXERCISES:  30 PERIODS
1. Design a CMOS inverter and analyze its characteristics.
2. Design a Common source amplifier and analyze its performance.
3. Design a Common drain amplifier and analyze its performance.
4. Design a Common gate amplifier and analyze its performance.
5. Design a differential amplifier with resistive load using transistors.
6. Design three stage and five stage ring oscillator circuit and compare its frequencies.

List of equipment needed for a batch of 30 students (3 in a bench):
- Cadence/Tanner/equivalent EDA Tools -10 User License

COURSE OUTCOMES:
Upon successful completion of the course the student will be able to
CO1: Design amplifiers to meet user specifications.
CO2: Analyse the frequency and noise performance of amplifiers.
CO3: Design and analyse feedback amplifiers and one stage op amps.
CO4: Analyse stability of op amp.
CO5: Testing experience of logic circuits.

TOTAL: 60 PERIODS

TEXTBOOKS:

REFERENCES:
3. Recorded Lecture Available at http://www.ee.iitm.ac.in/vlsi/courses/ee5320_2021/start

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CEC332 ADVANCED DIGITAL SIGNAL PROCESSING

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COURSE OBJECTIVES:
- To introduce the concepts of discrete time random signal processing
- To know about multirate signal processing and its applications
- To understand the spectrum estimation techniques
- To learn the concept of prediction theory and filtering

UNIT I MULTIRATE SIGNAL PROCESSING 6

UNIT II DISCRETE TIME RANDOM PROCESSES 6

UNIT III LINEAR PREDICTION AND FILTERING 6

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UNIT IV ADAPTIVE FILTERING

UNIT V SPECTRUM ESTIMATION
Estimation of power spectra from finite duration observations of signals – Non parametric methods of spectrum estimation – the Bartlett and the Welch method – Parametric spectrum estimation – AR, MA and ARMA.

PRACTICAL EXERCISES:
1. Study of autocorrelation and Cross Correlation of random signals
3. Design and Implementation of Wiener Filter
4. Design and Implementation of FIR Linear Predictor
5. Design of adaptive filters using LMS algorithm
6. Spectrum Estimation using Bartlett and Welch Methods

30 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course the student will be able to
CO1: Comprehend multirate signal processing and demonstrate its applications
CO2: Demonstrate an understanding of the power spectral density and apply to discrete random signals and systems
CO3: Apply linear prediction and filtering techniques to discrete random signals for signal detection and estimation.
CO4: Analyze adaptive filtering problems and demonstrate its application
CO5: Apply power spectrum estimation techniques to random signals.

TOTAL: 60 PERIODS

TEXT BOOKS:

REFERENCES:

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COURSE OBJECTIVES:

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods

UNIT I DIGITAL IMAGE FUNDAMENTALS


UNIT II IMAGE ENHANCEMENT


UNIT III IMAGE RESTORATION


UNIT IV IMAGE SEGMENTATION


UNIT V IMAGE COMPRESSION AND RECOGNITION

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL :45 PERIODS

COURSE OUTCOMES

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

CO1: Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.

CO2: Operate on images using the techniques of smoothing, sharpening and enhancement.

CO3: Understand the restoration concepts and filtering techniques.
CO4: Learn the basics of segmentation, features extraction, compression and recognition methods for color models.

CO5: Comprehend image compression concepts.

TEXT BOOKS:

REFERENCES

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CEC356 SPEECH PROCESSING

COURSE OBJECTIVES:
- Study the fundamentals of speech signal and extracts various speech features
- Understand different speech coding techniques for speech compression applications
- Learn to build speech enhancement, text-to-speech synthesis system

UNIT I
FUNDAMENTALS OF SPEECH
The Human speech production mechanism, Discrete-Time model of speech production, Speech perception - human auditory system, Phonetics - articulatory phonetics, acoustic phonetics, and auditory phonetics, Categorization of speech sounds, Spectrographic analysis of speech sounds, Pitch frequency, Pitch period measurement using spectral and cepstral domain, Formants, Evaluation of Formants for voiced and unvoiced speech.

UNIT II
SPEECH FEATURES AND DISTORTION MEASURES
Significance of speech features in speech-based applications, Speech Features – Cepstral Coefficients, Mel Frequency Cepstral Coefficients (MFCCs), Perceptual Linear Prediction (PLP), Log Frequency Power Coefficients (LFPCs), Speech distortion measures–Simplified distance measure, LPC-based distance measure, Spectral distortion measure, Perceptual distortion measure.
UNIT III SPEECH CODING

UNIT IV SPEECH ENHANCEMENT

UNIT V SPEECH SYNTHESIS AND APPLICATION
A Text-to-Speech systems (TTS), Synthesizers technologies – Concatenative synthesis, Use of Formants for concatenative synthesis, Use of LPC for concatenative synthesis, HMM-based synthesis, Sinewave synthesis, Speech transformations, Watermarking for authentication of a speech, Emotion recognition from speech.

PRACTICAL EXERCISES:
1. Write a MATLAB Program to classify voiced and unvoiced segment of speech using various time-domain measures
2. Write a MATLAB Program to calculate the MFCC for a speech signal
3. Implement ITU-T G.722 Speech encoder in MATLAB
4. Write a MATLAB Program to implement Wiener Filters for Noise Reduction
5. Design a speech emotion recognition system using DCT and WPT in MATLAB

HARDWARE & SOFTWARE SUPPORT TOOLS:
• Personal Computer with MATLAB
• Microphone and Speakers

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1: Understand the fundamentals of speech.
CO2: Extract various speech features for speech related applications
CO3: Choose an appropriate speech coder for a given application.
CO4: Build a speech enhancement system.
CO5: Build a text-to-speech synthesis system for various applications

TEXT BOOKS:
1. Shaila D. Apte, Speech and Audio Processing, Wiley India (P) Ltd, New Delhi, 2012
REFERENCES:


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CEC355 SOFTWARE DEFINED RADIO L T P C

COURSE OBJECTIVES:

- To introduce the concepts of software radios
- To know about RF implementation challenges for software defined radios
- To understand the digital generation of signals
- To learn the software and hardware requirements for software defined radios.

UNIT I INTRODUCTION TO SOFTWARE RADIO 6


UNIT II RF IMPLEMENTATION 6

Purpose of RF front–end, Dynamic range, RF receiver front–end topologies, Enhanced flexibility of the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues, Noise and distortion in the RF chain, Hybrid DDS – PLL systems, Applications of Direct Digital Synthesis.

UNIT III DIGITAL GENERATION OF SIGNALS 6

Comparison of direct digital synthesis with analog signal synthesis, Approaches to direct digital synthesis, Analysis of spurious signals, Performance of direct digital synthesis systems, Applications of direct digital synthesis.

UNIT IV SMART ANTENNAS 6

Benefits of smart antennas, Structures for beamforming systems, Smart antenna algorithms, Hardware implementation of smart antennas, Digital Hardware Choices-Key hardware elements.

UNIT V HARDWARE AND SOFTWARE FOR SDR & CASE STUDIES 6

DSP Processors, FPGA, ASICs. Trade-offs, Object oriented programming, Object Brokers, GNU Radio-USRP. Case Studies: SPEAK easy, JRTS, SDR-3000.

30 PERIODS
PRACTICAL EXERCISES: 30 PERIODS
1. Study of SDR hardware kit
2. Design and Implementation of digital modulation schemes using SDR
3. Implementation of synchronization techniques using SDR
4. Channel Coding Techniques using SDR
5. Study of channel estimation techniques using SDR
6. Study of MIMO concepts using SDR

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1: Demonstrate an understanding in the evolving paradigm of Software defined radio and technologies for its implementation.
CO2: Analyse Radio frequency implementation issues
CO3: Implement Smart antenna techniques for software defined radio.
CO4: Compare various digital synthesis procedures.
CO5: Comprehend various hardware and software requirements for software defined radios.

TOTAL: 60 PERIODS

TEXT BOOKS:

REFERENCES:

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CEC337 DSP ARCHITECTURE AND PROGRAMMING L T P C
2 0 2 3

COURSE OBJECTIVES:
- Study the architecture of programmable DSP processors
- Learn to implement various standard DSP algorithms in DSP Processors
- Use the Programmable DSP Processors to build real-time DSP systems
UNIT I ARCHITECTURES FOR PROGRAMMABLE DSP PROCESSORS 6

Basic Architectural features, DSP Computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation Unit, Programmability and program execution, Speed issues, Features for external interfacing

UNIT II TMS320C5X PROGRAMMABLE DSP PROCESSOR 6

Architecture of TMS320C54xx DSP processors, Addressing modes – Assembly language Instructions -Memory space, interrupts, and pipeline operation of TMS320C54xx DSP Processor, On-Chip peripherals, Block Diagram of TMS320C54xx DSP starter kit

UNIT III TMS320C6X PROGRAMMABLE DSP PROCESSOR 6

Commercial TI DSP processors, Architecture of TMS320C6x DSP Processor, Linear and Circular addressing modes, TMS320C6x Instruction Set, Assembler directives, Linear Assembly, Interrupts, Multichannel buffered serial ports, Block diagram of TMS320C67xx DSP Starter Kit and Support Tools

UNIT IV IMPLEMENTATION OF DSP ALGORITHMS 6


UNIT V APPLICATIONS OF DSP PROCESSORS 6


PRACTICAL EXERCISES: 30 PERIODS

1. Real-Time Sine Wave Generation
2. Programming examples using C, Assembly and linear assembly
3. Implementation of moving average filter
4. FIR implementation with a Pseudorandom noise sequence as input to a filter
5. Fixed point implementation of IIR filter
6. FFT of Real-Time input signal

HARDWARE & SOFTWARE SUPPORT TOOLS:

- TMS320C54xx/TMS320C67xx DSP Development board
- Code Composer Studio (CCS)
- Function Generator and Digital Storage Oscilloscope
- Microphone and speaker

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1: Understand the architectural features of DSP Processors.
CO2: Comprehend the organization of TMS320C54xx DSP processors
CO3: Build solutions using TMS320C6x DSP Processor
CO4: Implement DSP Algorithms
CO5: Study the applications of DSP Processors.
TEXT BOOKS

REFERENCES
2. TMS320C5416/6713 DSK user manual at https://www.ti.com

CO’s-PO’s & PSO’s MAPPING

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CCS338 COMPUTER VISION L T P C
2 0 2 3

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

UNIT I INTRODUCTION TO IMAGE FORMATION AND PROCESSING 6

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

UNIT III FEATURE-BASED ALIGNMENT & MOTION ESTIMATION 6
UNIT IV 3D RECONSTRUCTION 6
Shape from X - Active rangefinding - Surface representations - Point-based representations - Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.

UNIT V IMAGE-BASED RENDERING AND RECOGNITION 6

PRACTICAL EXERCISES: 30 PERIODS
LABORATORY EXPERIMENTS: 30 PERIODS
Software needed:
OpenCV computer vision Library for OpenCV in Python / PyCharm or C++ / Visual Studio or or equivalent

- OpenCV Installation and working with Python
- Basic Image Processing - loading images, Cropping, Resizing, Thresholding, Contour analysis, Blob detection
- Image Annotatation – Drawing lines, text circle, rectangle, ellipse on images
- Image Enhancement - Understanding Color spaces, color space conversion, Histogram equalization, Convolution, Image smoothing, Gradients, Edge Detection
- Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB Image features, Feature matching, cloning, Feature matching based image alignment
- Image segmentation using Graphcut / Grabcut
- Camera Calibration with circular grid
- Pose Estimation
- 3D Reconstruction – Creating Depth map from stereo images
- Object Detection and Tracking using Kalman Filter, Camshift

1. docs.opencv.org
2. https://opencv.org/opencv-free-course/

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1: To understand basic knowledge, theories and methods in image processing and computer vision.
CO2: To implement basic and some advanced image processing techniques in OpenCV.
CO3: To apply 2D a feature-based based image alignment, segmentation and motion estimations.
CO4: To apply 3D image reconstruction techniques
CO5: To design and develop innovative image processing and computer vision applications.

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

CO’s- PO’s & PSO’s MAPPING

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CEC350 RF TRANSCEIVERS

COURSE OBJECTIVES:
- To understand the fundamentals of RF system design
- To acquaint with the various components of RF system for wireless communications
- To know the basic techniques needed for analysis of RF systems
- To enable the students to verify the basic principles and design aspects involved in RF systems components
- To conduct experiments to analyze and interpret data to produce meaningful conclusion and match with theoretical concepts

UNIT I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES
CMOS: Introduction to MOSFET Physics - Noise: Thermal, shot, flicker, popcorn noise - Transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR - Phase noise - Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low-IF Architectures - Transmitter: Direct-up conversion, Two-step up conversion schemes

UNIT II IMPEDANCE MATCHING NETWORKS AND AMPLIFIERS
Review of S-parameters and Smith chart - Passive IC components - Impedance matching networks - Amplifiers: Common Gate, Common Source Amplifiers - OC Time constants in bandwidth estimation and enhancement - High frequency amplifier design - Low Noise Amplifiers: Power match and Noise match, single-ended and differential LNAs

UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS
UNIT IV FILTERS, OSCILLATORS AND MIXERS 6
Overview - basic resonator and filter configuration, special filter realizations, filter implementation -
Basic oscillator model, high-frequency oscillator configuration, Colpitt’s oscillator - basic characteristics of mixers, single and double-balanced mixers

UNIT V PLL AND FREQUENCY SYNTHESIZERS 6
PLL: Linearized Model, Noise properties, Phase detectors, Loop filters and Charge pumps-
Frequency Synthesizers: Integer-N frequency synthesizers - Direct Digital Frequency Synthesizers

PRACTICAL EXERCISES: 30 PERIODS
1. Measurement of S-parameters for impedance matching circuits, and RF filters using network analyzer
2. Design of RF inductor and capacitor
3. Design and characterization of LNA
4. Design of impedance matching network
5. Design of low-pass and band-pass filter at RF
6. Design and characterization of mixer

TOTAL:60 PERIODS

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

CO1: Interpret the nonlinear effects in RF circuits
CO2: Design RF circuits
CO3: Analyze the performance of RF circuits
CO4: Apply knowledge to identify a suitable architecture and systematically design an RF System
CO5: Comprehensively record and report the measured data, and would be capable analyzing, interpreting the experimentally measured data and produce the conclusions

TEXTBOOKS

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COURSE OBJECTIVES:
- Understand characteristic impedance of transmission line and impedance matching techniques.
- Understand plain signal reflection and cross talk noise in the transmission line, and also explain the mathematical analysis method.
- Understand Eye diagram and related measurement to test quality of Signal
- Learn Jitter analysis and jitter decomposition
- Work with high frequency differential signal and its applications

UNIT I SIGNAL REFLECTION AND IMPEDANCE MATCHING TECHNIQUE 6
Phenomenon of signal reflection. Signal reflection at transmitting end.
Signal reflection at branch point. Multiple reflection in transmission line.
Prevention of signal reflection by using impedance matching technique.

UNIT II CROSSTALK NOISE 6
Crosstalk definition and classification. Crosstalk mechanism. Analysis of crosstalk noise in transmission line. Main factor of causing crosstalk noise.

UNIT III DIFFERENTIAL SIGNAL TRANSMISSION CIRCUIT. 6
Pros and cons of using differential signaling compared with that of single-ended signaling.
Differential signal termination techniques.

UNIT IV FREQUENCY RESPONSE OF A CIRCUIT 6
Frequency response of transmission line and circuit. Inter-symbol interference (ISI) and eye-pattern.
Deterioration of a signal waveform due to ISI. Circuit techniques to prevent the deterioration. Linear time-invariant systems. Frequency response of pulse.

UNIT V EYE DIAGRAM AND JITTER 6
Jitter Definition and Types of Jitter; Jitter decomposition; Eye diagram analysis and related measurement

PRACTICAL EXERCISES: 30 PERIODS
1. Generating 1GHz Differential signal from AWG
2. Getting Eye on oscilloscope and conduct various measurement on Eye as well Timing parametric such as rise/fall times, pulse width, and duty cycle Programmable software clock recovery including software PLL.
3. Accurate jitter analysis using the spectral and Q-scale methods for detailed decomposition of jitter components, including the extraction of industry standard dual-dirac model parameters
4. Generate LVDS signal and conduct signal integrity measurement

List of Equipments needed:
- 2Ch 1 GHz Arbitrary waveform generator
- 2GHz 4 flex channel scope with automated jitter and eye diagram measurement
- LVDS measurement suite
COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1: Familiarity with High speed design and related issues
CO2: Understanding on critical design aspect
CO3: Know about Jitter and related measurements which is critical for design
CO4: Practical application of high speed differential signals
CO5: Measurement expertise up to industry expectations

TOTAL: 60 PERIODS

TEXT BOOKS
2. High Speed Digital Design by Howard Johnson and Martin Graham, Prentice Hall, 1st Edition

REFERENCES

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CEC335 ANTENNA DESIGN L T P C 2 0 2 3

COURSE OBJECTIVES:
- To introduce the basic concepts of antenna arrays for smart antenna design
- To discuss the random variables and processes for angle of arrival (AOA) estimation
- To describe different algorithms used for AOA estimation
- To introduce the concepts of fixed weight beamforming
- To introduce the concept of adaptive beamforming

UNIT I ANTENNA ARRAY FUNDAMENTALS 6

UNIT II PRINCIPLES OF RANDOM VARIABLES AND PROCESSES 6

UNIT III ANGLE OF ARRIVAL ESTIMATION 6
Fundamentals of Matrix Algebra: Vector basics - Matrix basics - Array Correlation Matrix - AOA Estimation Methods: Bartlett AOA estimate, Capon AOA estimate, Linear prediction AOA estimate,
Maximum entropy AOA estimate, Pisarenko harmonic decomposition AOA estimate, Min-norm AOA estimate, MUSIC AOA estimate, Root-MUSIC AOA estimate, ESPRIT AOA estimate

UNIT IV SMART ANTENNAS: FIXED WEIGHT BEAMFORMING 6
Introduction - Historical Development of Smart Antennas - Fixed Weight Beamforming Basics: Maximum signal-to-interference ratio, Minimum mean-square error, Maximum likelihood, Minimum variance

UNIT V SMART ANTENNAS: ADAPTIVE BEAMFORMING 6
Adaptive Beamforming: Least mean squares, Sample matrix inversion, Recursive least squares, Constant modulus, Least squares constant modulus, Conjugate gradient method, Spreading sequence array weights, Description of the new SDMA receiver.

PRACTICAL EXERCISES: 30 PERIODS
1. Write a MATLAB code to estimate the radiation pattern of a linear array and N element uniform array
2. Write a MATLAB code to estimate the AOA using MUSIC and ESPRIT algorithm
3. Write a MATLAB code to estimate the weights of the array. Using the final weights estimate the array factor and the mean square error.
4. Write a MATLAB code to dynamically alter the main lobe direction based on the information of AOA.

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1: Describe the basics of phased array antennas
CO2: Understand random process and its application in Smart antennas
CO3: Estimate the weights of the antenna array based on the angle of arrival
CO4: Analyze the fixed weight beamforming in smart antennas
CO5: Analyze adaptive beamforming in smart antennas

TOTAL 60 PERIODS

TEXT BOOKS

REFERENCES
3. Thomas Kaiser, Smart Antennas: State of the Art, Hindawi, 2005

CO’s-PO’s & PSO’s MAPPING

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COURSE OBJECTIVES:
- To study the characteristics of Active components and applications.
- To design the RF filter and analyze the circuits operated at millimeter wavelength.
- To understand the basics of Microwave integrated circuits.
- To learn the concepts of non reciprocal components for MICs.
- To design the antenna and analyze its performance using measurement techniques.

UNIT I  ACTIVE RF COMPONENTS AND APPLICATIONS  6
RF diodes, BJT, RF FET’S, High electron mobility transistors, matching and biasing networks-
impedance matching using discrete components, microstripline matching networks, amplifier-
classes of operation and biasing networks.

UNIT II  RF FILTER DESIGN  6
Overview, Basic resonator and filter configuration, special filter realizations, smith chart based filter-
design, coupled filter.

UNIT III  INTRODUCTION TO MICROWAVE INTEGRATED CIRCUITS  6
Overview of ABCD and S parameters - Overview of Planar transmission lines (Stripline,
Microstripline, Slotline, CPW, Finline)-Design Parameters for Strip Line And Microstripline- Active
Device Technologies- Design Approaches-Multichip Module Technology- Substrates

UNIT IV  NON RECIPROCAL COMPONENTS FOR MICs  6
Microstrip on Ferrimagnetic substrates, Microstrip circulators. Isolators and phase shifters, Design of
microstrip circuits – high power and low power circuits.

UNIT V  INTEGRATED ANTENNA DESIGN AND MEASUREMENTS  6
Integrated Antenna Design- Photonic Band Gap Antennas - Micro Machined Antenna - Micro
Electro Mechanical System Antennas - Test Fixture Measurements - Probe Station Measurements -
Thermal and Cryogenic Measurements- Experimental Field Probing Techniques

PRACTICAL EXERCISES:
1. Design of low pass, high pass, band pass and band stop filter at RF using any software
   tool
2. Design of low pass, high pass, band pass and band stop filter at RF
3. Design of low pass, high pass, band pass and band stop filter at RF
4. Design of low pass, high pass, band pass and band stop filter at RF
5. Measurement of S parameters for a) Inductor b) Capacitor c) impedance matching
circuits, filters using network analyzer
6. Design a microstrip circuits

COURSE OUTCOMES:
Upon successful completion of the course the student will be able to
CO1: Apply knowledge of S parameter theory to any RF active component design circuit for
obtaining performance measure.
CO2: Analyze microwave circuits for filters design.
CO3: Evaluate the performance of any practical Microwave integrated circuits.
CO4: Create communication circuits and subsystems with practical design parameters for non-reciprocal components in MICs.

CO5: Design microwave integrated antenna design circuit for the required Performance using professional software tools.

TOTAL: 60 PERIODS

TEXTBOOKS

REFERENCES
4. David Pozar, Microwave Engineering, Addison Wesley 3rd Edition

CO’s-PO’s & PSO’s MAPPING

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CEC338 EMI / EMC PRE COMPLIANCE TESTING

COURSE OBJECTIVES:
- To introduce the basic concepts of Electromagnetic Interference
- To teach the importance of measurement device for EMI.
- To explain the EMI coupling & control principles
- To understand receivers & Analyzer functionalities
- To impart knowledge on design issues in EMI/EMC

UNIT I NATURE AND ORIGINS OF ELECTROMAGNETIC COMPATIBILITY

Introduction-Visualising the EMI problem-Source of EMI, EMI coupling to victim equipment, Intersystem and Intrasystem EMI, EMC standards and specifications

TOTAL: 60 PERIODS

TEXTBOOKS

REFERENCES
4. David Pozar, Microwave Engineering, Addison Wesley 3rd Edition
UNIT II  TYPES of EMI COUPLING  6
Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode
and ground loop coupling; Differential mode coupling, Near field cable to cable coupling; Field to
cable coupling, Power mains and Power supply coupling; Transient EMI

UNIT III  MEASUREMENT DEVICES FOR EMI  6
Introduction – Measurement by direct connection, Inductively coupled devices, EMC antennas –
Basic antenna parameters, Antennas for radiated emission testing, Wideband antennas - Magnetic
field antennas, Type of antennas used in susceptibility testing

UNIT IV  RECEIVERS, ANALYSERS AND MEASUREMENT EQUIPMENT  6
EMI receiver, Spectrum Analyzers, RF power meter Frequency meters. Standards requiring
immunity tests, Automatic EMC tests, Electromagnetic transient testing, Transient types,
Continuous and transient signal, ESD-electrostatic discharge

UNIT V  PRE-COMPLIANCE TESTING TO AVOID EMC PROBLEMS  6
Need for Pre-Compliance Testing; Intersystem and Intracystem EMC - Developing an approach to
EMC design - Process flow chart, - EMC strategy – Self certification; Solutions to avoid EMC: ESD
Shielding, EMI Filters; Grounding; Bonding, Isolation transformer, Transient suppressors; EMI
Suppression Cables.

PRACTICAL EXERCISES:
1. Basic spectrum measurement and power measurement with markers
2. Perform environment scan and detect various signals available
3. DPX, Spectrogram and transient capture with mask test and act on violation
4. EMI spurious detection and measurement against EMI limit lines
5. Use of LISN and measurement concept of Conducted emission

List of equipments for needed for a batch of 30 students (3 in a bench):
1. Real Time Spectrum Analyser upto atleast 6.2GHz and 40MHz BW – 10 nos
2. Near Field Probes kit – 10 nos
3. 25MHz to 300 MHz Biconical antenna – 10 nos
4. 300 MHz to 1GHz Compact Log Periodic Antenna – 10 nos
5. line impedance stabilization network (LISN) - 3
6. EMI EMC Test Software – 10 nos
7. Tripod Stand – 10 nos

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

CO1: Perceive the various types and mechanisms of Electromagnetic Interference
CO2: Propose a suitable EMI mitigation technique.
CO3: Evaluate EMI coupling & control principles
CO4: Explain the importance receivers & Analyzer functionalities
CO5: Inspect the design issues in EMI/EMC

TOTAL:60 PERIODS

TEXTBOOKS
   Measurement, 2012
REFERENCES

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CEC349 RFID SYSTEM DESIGN AND TESTING

L T P C 2 0 2 3

COURSE OBJECTIVES:
- To discuss the fundamentals of near field and far field RFID communications
- To articulate the standards and protocols used in RFID systems
- To describe the operating principles of RFID tag and reader
- To introduce the security aspects and system architecture of RFID systems
- To illustrate the industrial and scientific applications of RFID systems

UNIT I INTRODUCTION

UNIT II RFID STANDARDS AND PROTOCOLS

UNIT III OPERATING PRINCIPLES
RFID Tag components: RFID tag types – the 1-Bit Transponder and Chipless Tags – RFID readers and middleware component – Communication fundamentals: Coupling, Data encoding, multi-path effect – Tag, Reader and sensor communication.

UNIT IV DATA INTEGRITY AND SECURITY
The checksum procedure – Multiaccess procedures – Attacks on RFID Systems – Protection by Cryptographic measures

UNIT V RFID ENABLED SENSORS AND APPLICATIONS
RFID enabled Sensors: Antenna design challenges – IC design – Integration of sensors and RFID – Power consumption and Link budget.

30 PERIODS

PRACTICAL EXERCISES:
1. Design of a passive RFID Tag Antenna
2. Design of an RFID reader antenna
3. Determination of read range of the RFID tag at UHF and Microwave frequencies
4. Determination of RFID tag performance for different standards

30 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1: Classify RFID systems based on frequency, architecture and performance
CO2: Define standards for RFID technology
CO3: Illustrate the operation of various components of RFID systems
CO4: Describe the privacy and security issues in RFID Systems
CO5: Discuss the construction and applications of RFID enabled sensor

TOTAL: 60 PERIODS

TEXTBOOKS

REFERENCES

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CBM370  WEARABLE DEVICES  L T P C
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OBJECTIVES:
The student should be made to:
- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT I  INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS
UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES

Wearability issues - physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS


UNIT IV SMART TEXTILE


UNIT V APPLICATIONS OF WEARABLE SYSTEMS

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Describe the concepts of wearable system.
CO2: Explain the energy harvestings in wearable device.
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile
CO5: Compare the various wearable devices in healthcare system

TOTAL PERIODS: 45

TEXT BOOKS

REFERENCES

CO’s- PO’s & PSO’s MAPPING

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CBM352  HUMAN ASSIST DEVICES  L T P C
3 0 0 3

COURSE OBJECTIVES:
- To study the role and importance of machines that takes over the functions of the heart and lungs,
- To study various mechanical techniques that help a non-functioning heart.
- To learn the functioning of the unit which does the clearance of urea from the blood.
- To understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- To study about recent techniques used in modern clinical applications.

UNIT I  HEART LUNG MACHINE AND ARTIFICIAL HEART
Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for temporary bypass of left ventricle.

UNIT II  CARDIAC ASSIST DEVICES
Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques.

UNIT III  ARTIFICIAL KIDNEY
Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT IV  RESPIRATORY AND HEARING AIDS
Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction.

UNIT V  RECENT TRENDS
Transcutaneous electrical nerve stimulator, bio-feedback, Diagnostic and point-of-care platforms.

COURSE OUTCOMES:
At the end of this course the students will be able to:
CO1: Explain the principles and construction of artificial heart
CO2: Understand various mechanical techniques that improve therapeutic technology
CO3: Explain the functioning of the membrane or filter that cleanses the blood.
CO4: Describe the tests to assess the hearing loss and development of wearable devices for the same.
CO5: Analyze and research on electrical stimulation and biofeedback techniques in rehabilitation and physiotherapy.
TEXT BOOKS:

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CBM368 THERAPEUTIC EQUIPMENT L T P C

3 0 0 3

COURSE OBJECTIVES:
- To learn the principles of cardiac assist devices.
- To understand the need and use of extracorporeal devices, and the use of lasers in medicine.
- To enable the students to gain knowledge on the working of therapeutic clinical equipment.

UNIT I CARDIAC AND RESPIRATORY THERAPY EQUIPMENT
Cardiac Pacemaker: Internal and External Pacemaker – Programmable pacemakers. Cardiac Defibrillators: AC and DC Defibrillator- Internal and External Defibrillators - Protection Circuit, Defibrillator analyzers. Cardiac ablation catheter.

UNIT II BIOMECHANICAL THERAPEUTIC EQUIPMENT
Electrodiagnosis, Therapeutic radiation, Electrotherapy, Electrodes, Stimulators for Nerve and Muscle, Functional Electrical Stimulation. peripheral nerve stimulator, ultrasonic stimulators, Stimulators for pain and relief - Inferential Therapy Unit, TENS. GAIT Assessment and Therapy. Continuous Passive Motion unit, Cervical / Lumber Traction Machine - Traction Table.

UNIT III BODY CARE EQUIPMENT
UNIT IV  DENTAL CARE EQUIPMENT  

UNIT V  HEAT & PHOTON THERAPY EQUIPMENT  
High frequency heat therapy, Principle, Short wave diathermy, Microwave diathermy, Ultrasonic therapy, Lithotripsy. Therapeutic UV and IR Lamps. Basic principles of Biomedical LASERS: Applications of lasers in medicine, CO2 laser, He-Ne laser, Nd-YAG and Ruby laser.

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Suggest suitable therapeutic devices for ailments related to cardiology, pulmonology, neurology, etc
CO2: Comprehend the principles of bodycare equipment
CO3: Understand the operation of dental care equipment.
CO4: Analyze the different types of therapies for suitable applications.
CO5: Appreciate the application of lasers in biomedical applications.

TOTAL:45 PERIODS

TEXT BOOKS

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CBM355  MEDICAL IMAGING SYSTEMS  L T P C
            3 0 0 3

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

**UNIT I**
**X RAYS**


**UNIT II**
**COMPUTED TOMOGRAPHY**


**UNIT III**
**MAGNETIC RESONANCE IMAGING**

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

**UNIT IV**
**NUCLEAR IMAGING**


**UNIT V**
**RADIATION THERAPY AND RADIATION SAFETY**


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

**TEXT BOOKS:**
2. Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis, SPIE Press 2000

REFERENCE BOOKS

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CBM342 BRAIN COMPUTER INTERFACE AND APPLICATIONS L T P C
3 0 0 3

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

UNIT I INTRODUCTION TO BCI 9

UNIT II ELECTROPHYSIOLOGICAL SOURCES 9

UNIT III FEATURE EXTRACTION METHODS 9

UNIT IV FEATURE TRANSLATION METHODS 9

UNIT V APPLICATIONS OF BCI 9
COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Describe BCI system and its potential applications.
CO2: Analyze event related potentials and sensory motor rhythms.
CO3: Compute features suitable for BCI.
CO4: Design classifier for a BCI system.
CO5: Implement BCI for various applications.

TEXTBOOKS

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CBM341 BODY AREA NETWORKS

COURSE OBJECTIVES:
The student should be made to:
- To know the hardware requirement of BAN
- To understand the communication and security aspects in the BAN
- To know the applications of BAN in the field of medicine

UNIT I INTRODUCTION

UNIT II HARDWARE FOR BAN
UNIT III   WIRELESS COMMUNICATION AND NETWORK
RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee.

UNIT IV   COEXISTENCE ISSUES WITH BAN
Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.

UNIT V   APPLICATIONS OF BAN
Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2: Design a BAN for appropriate application in medicine.
CO3: Assess the efficiency of communication and the security parameters.
CO4: Understand the need for medical device regulation and regulations followed in various regions
CO5: Extend the concepts of BAN for medical applications.

TOTAL:45 PERIODS

TEXT BOOKS

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COURSE OBJECTIVES:

- To learn basics of underwater vehicle control system
- To know the basic sensors and transducers used in underwater vehicles
- To learn the types of communication systems
- To learn different types of underwater vehicles and their applications.
- To learn about subsea battery and power management system

UNIT I  INTRODUCTION ON DATA ACQUISITION AND CONTROL SYSTEM  9
Introduction on PLC& various Input / Output modules, SCADA and HMI, Real time Controller, Signal conditioning circuits and associated components: Ethernet Modem, SMPS, Media converters, Ethernet switches, Fuses & Fuse holders, Power supply units, Power management system, Pressure Compensator, Pressure compensated batteries, Volve amplifiers, Actuators, Types of valves- proportional valves and solenoid valves, Types of relays- Solid State Relay and Electromagnetic relay, Pressure casing for underwater DACS.

UNIT II  UNDERWATER SENSORS AND TRANSDUCERS  9
Navigation and Auxiliary sensors and Transducers
Inertial Navigation System, FOG/RLG, GPS, DGPS, Gyroscope, Motion Reference Unit, Doppler Velocity Log, Acoustic Transponder, Beacon, Positioning System- LBL, SBL, SSBL, Underwater Encoder, Proximity switches, Conductivity sensor, Temperature sensor, Depth sensor, Accelerometer, Tilt sensor, LVDT, Vaccum sensor, Current meters.

Scientific Instruments
Acoustic Doppler Current Profiler, Echosounder, Hydrophones, SONAR- Forward looking SONAR, Bottom Looking SONAR, Altimeter, Swell and wave sensor, PH sensor, Turbidity sensor, Oxygen sensor, Water samplers, Nitrogen sensor, CTD

UNIT III  TELEMETRY SYSTEM  9
Telemetry system for tethered vehicles, Fiber optic communication, Single mode fiber, Multimode fiber, Fiber optics in oceanographic applications, Basis of optical fiber transmission, Fiber losses and signal attenuation, Slip rings, Umbilical cables, Underwater cables and connectors, Field installable Termination Assembly.
Acoustic communication: Acoustic wave propagation, Optical communication, Satellite communication- Iridium, Inmarsat, Argos for surface Tracking.

UNIT IV  TYPES OF UNDERWATER VEHICLES  9
Type of vehicles, manned and unmanned vehicles, Tethered and untethered vehicles, Remotely Operable Vehicle (ROV), Autonomous Underwater vehicle (AUV), Gliders, Solar powered Gliders, Manned submersible, Submarines, Deep Sea Rescue vehicle (DSRV), Various Propulsion systems.

UNIT V  CASE STUDY  9
Design of low power DAC system for portable instrument,
Design of power module for autonomous system,
Design consideration on wireless sensor network and its important,
MEMS systems used in underwater systems and its merits and demerits.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Design of DAC system for various underwater Applications
CO2: Knowledge about sensors used underwater and their working principle
CO3: Underwater communication system and their application
CO4: Knowledge about different types of underwater vehicles
CO5: Subsea battery and Battery Management System

BOOK REFERENCES
1. The Ocean engineering Handbook, Ferial El- Hawary
2. Guidance and control of Ocean Vehicles, Thor I  Fossen
3. Instrumentation and metrology in Oceanography by Marc Le mann
4. Jane’s Underwater technology,, Technology and applications of AUV by Gwyn Griffiths
5. Fundamentals of Marine Vehicle Control, Karl Von Ellenrieder
6. Instrumentation & control G J Roy
7. Handbook of ocean and underwater engineering, Myers, J J; Holm, C H; McAllister, R F
8. Underwater communication and Network, Yi Lou, Niaz Ahmed

CO’s-PO’s & PSO’s MAPPING

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CEC358 UNDERWATER IMAGING SYSTEMS AND IMAGE PROCESSING L T P C 2 0 2 3

COURSE OBJECTIVES:
- To learn the fundamental components of optical imaging
- To understand the challenges involved in Underwater imaging
- To understand the fundamental of Ocean Acoustics
- To Understand the principle of image processing techniques
- To Learn the SONAR Systems and various applications

UNIT I FUNDAMENTAL COMPONENTS OF OPTICAL IMAGE PROCESSING SYSTEM6

UNIT II OPTICAL IMAGE PROCESSING 6
Image Formation, Digitization, Sampling and Quantization, Geometric Transformation, Interpolation, Image Reconstruction, Spatial Filtering, Histogram, Binary Image, Color Fundamentals, Color transformations, Color Interpolation, Morphology, Image segmentation, Pattern Recognition. Challenges involved in underwater optical imaging

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UNIT III
FUNDAMENTALS OF UNDERWATER ACOUSTICS

Acoustic waves, Acoustic pressure, Velocity and density, Frequency and wavelength, Intensity and power, Logarithmic notation- Decibels, absolute references and levels, Source Level, Basics of propagation losses, Target Strength, Back scattering, Acoustic noise, Multiple paths, Doppler effect, Time characteristics of echoes, Active and passive sonar equations, Underwater electro acoustic transducers- projectors and hydrophones, General Structure of SONAR systems

UNIT IV
SONAR SIGNAL PROCESSING

Spatial signals-Signals in space and time, Co-ordinate systems, Propagating waves, Wave number- frequency space, Finite continuous apertures, Spatial sampling, Directivity, Beamforming, Time and frequency domain beamforming, Array gain, Angular resolution, Transmitting signals-Narrowband Vs Chirp, Matched filtering, Range resolution, Time Varying Gain (TVG), Signal intensity to image conversion

UNIT V
DIFFERENT TYPES OF SONAR SYSTEMS

Passive and active sonars, Single beam echo sounder, Multi beam echo sounder, Sub-bottom profiler, Sediment profiler, Side scan sonar, Synthetic aperture sonar, Forward looking sonar.

PRACTICAL EXERCISES:
1. Generation of discrete time signals and finding its frequency components
2. Generation of Chirp signals and understanding its time-frequency characteristics
3. Delaying and summing of signals in time and frequency domain for narrow band signals
4. Delaying and summing of signals in time and frequency domain for wide band signals
5. Matched filtering

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

CO1: Understand the techniques for underwater imaging
CO2: Understand the fundamentals of underwater acoustics and ambient noise
CO3: Exposer for array processing techniques for underwater imaging applications
CO4: Design of Filter and impedance matching circuits
CO5: Know about SONAR system and its applications

TOTAL: 60 PERIODS

TEXT BOOKS

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CEC357 UNDERWATER COMMUNICATION L T P C
2 0 2 3

COURSE OBJECTIVES:
- To learn about fiber optic communication for underwater application
- To learn underwater MI communication and sensor networking
- To understand underwater acoustic communication
- To understand the challenges in underwater communication
- To learn underwater cables and handing system for various application

UNIT I UNDERWATER FIBRE OPTICS COMMUNICATION

UNIT II UNDERWATER OPTICAL COMMUNICATION

UNIT III UNDERWATER MI COMMUNICATION & SENSOR NETWORKS

UNIT IV BASIC PRINCIPLES OF UNDERWATER ACOUSTIC COMMUNICATION
Ocean Acoustic environment; Measuring sound levels and relevant units; Sound propagation in the ocean – sound velocity profiles in the deep water and shallow water Speed of underwater sound, Underwater Sound Transmission Loss, Acoustic Field Model: Ray Theory Model, Structure and Performance of UWAC System: Basic Structure of UWAC System, Performance Indicators of UWAC System, Characteristics of the UWA Channel.
UNIT V  UNDERWATER ACOUSTIC NETWORK TECHNOLOGY  6

PRACTICAL EXERCISES:  
30 PERIODS

1. Conducting an experiment for testing of optical communication in water tank with clear and turbid water.
2. Measure the insertion loss of different FO connectors, bending loos using optical power meter.
3. Testing of MI communication and Sensor network
4. Testing of hydrophone and acoustic communication with different operating frequency and
5. Design a MI coil and testing it for Inductive communication

COURSE OUTCOMES:  
On successful completion of this course, the student will be able to
CO1: To get an explore to different underwater communication system
CO2: Design of MI coil for
CO3: To know the important of underwater communication and its challenges
CO4: To understand the strength of Underwater acoustic communication
CO5: To understand the sensor network concepts and its application

TOTAL:60 PERIODS

TEXTBOOKS

REFERENCES

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COURSE OBJECTIVES:
- To learn the important variables of ocean
- To learn the sensors used for ocean observation and its interfaces
- To study about various platforms used for ocean observation
- To understand data telemetry system for real time observation of Ocean.
- To study about data handling and processing techniques.

UNIT I  INTRODUCTION TO ESSENTIAL OCEAN VARIABLES  6

UNIT II  INSTRUMENTATION AND OBSERVATION SYSTEMS  6

UNIT III  OCEAN OBSERVATION PLATFORMS  6

UNIT IV  OCEAN DATA TELEMETRY  6
Data telemetry, Wire telemetry, Modems, Wireless telemetry- Acoustic communications- Underwater Optic communication - Satellite Telemetry-LEO-GEO-MEO, GSM-GPRS, Inmarsat, INSAT, Iridium. ARGOS.

UNIT V  OCEAN DATA PROCESSING  6
Data processing and storage: Raw and processed data. Storage systems and methods- Data presentation, charts, electronic and graphic presentation, Data exchange, data formats.

PRACTICALEXERCISES:  30 PERIODS
1. Interface of Analog /Serial sensor with Data Acquisition System
2. Calculating co-efficients, Drift for sensors
3. Data plotting and presentation exercise
4. Experiment on rail fall sensor interface and data telemetry through IoT
5. Circuit design for RS232/RS485/RS422/TTL Interface and testing of half and full duplex communication and sensor network

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Get an Explore on Ocean Dynamics and parameters
CO2: Different sensor interface for marine applications
CO3: Identification of suitable platform for various measurement & applications
CO4: To Know about various telemetries for ocean data transfer
CO5: Apply data processing and plotting methods for ocean parameters

TOTAL: 60 PERIODS

TEXT BOOKS

REFERENCES

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CEC360 UNDERWATER NAVIGATION SYSTEMS

COURSE OBJECTIVES:
- To Understand the relationship between autonomy, sensing, navigation and control on an un-manned marine subsea vehicle.
- To understand about various types of navigational equipment & sensors
- To understand the basic communication methods and signal losses, attenuation.
- To understand the types of Acoustic transponders, Beacon and Responder

UNIT I BASICS OF UNDERWATER COMMUNICATION
Introduction to underwater acoustics, Understanding Thermoclines in Ocean Waters, subsea communication sensors, Instruments and applications, Sound propagation in the ocean – Sound Velocity Profiles (SVP) in the deep water and shallow water; Sound attenuation in the sea – absorption, scattering, transmission loss, reverberation, Snell's law, target strength; Laser communication and limitations.

UNIT II UNDERWATER NAVIGATION & ITS AIDING SENSOR AND DEVICES
Different types of navigational sensors, Accelerometers, Fiber Optic Gyroscopes (FOGs), Ring Laser Gyroscope (RLG) types and Working principles, and their applications, Doppler Velocity Log, Error sources in subsea navigation, Calibration overview for subsea navigation. Attitude Heading and Reference Systems (AHRS) & IMU

UNIT III ACOUSTIC POSITIONING SYSTEMS
Subsea navigation possible solutions, Vehicle positioning, Acoustic Positioning systems, Short Base
Line (SBL), Super Short Base Line (SSBL), Long Base line (LBL) Configurations and Positioning overview.

UNIT IV   SUBSEA VEHICLE NAVIGATION  
Subsea navigation, Uses of subsea navigation, challenges of subsea navigation. Basics of underwater navigation, Types of underwater Navigations, Aided navigational systems, Inertial Navigational systems. role of dead-reckoning navigation in subsea navigation, Kalman filters (XKF) and Invariant extended Kalman filters for navigation.

UNIT V    CASE STUDY  
- Tethered vehicle deployment guidelines and preparedness.
- AUV /ROV based search operation requirements and planning.
- Tethered crawling vehicle sensors, data acquisition and maneuvering.
- Acoustic positioning system transponder deployment and recovery
- Aided and unaided navigation system study.
- Understand the basic tools needed to effectively develop software for robotic platforms in a group environment, and resolve conflicts and adhere to group goals in the software cycle.

COURSE OUTCOMES:
On successful completion of this course, the student will be able
CO1: To know about the Underwater Navigation System
CO2: To know about the INS and its aiding sensor
CO3: To know about the challenges involved in underwater navigation
CO4: To study about how navigation system is integrated with manned and unmanned underwater vehicles
CO5: To know about underwater positioning system

TOTAL:45 PERIODS

TEXT BOOKS
1. Fundamentals of ocean acoustics by L.M.Brekhovskikh and Yu. P. Lysanov
3. Underwater Acoustic Positioning Systems by P. H. Milne

REFERENCES BOOKS
1. Electronic and Acoustic Navigation systems for Maritime Studies by Norvald Kjerstad
2. Guidance & Control of Ocean Vehicles by TT Fossen
3. Dynamic Positioning of Offshore Vessels. By Morgan, M.

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COURSE OBJECTIVES:
- To enable the student to understand the importance of ocean acoustics for marine applications.
- To understand the physics of sound propagation and the factors affecting sound signal in the ocean.
- To study the types and characteristics of acoustic transducers and arrays.
- To understand the sources of ambient noise present in the sea and impacts of sound on marine diversity.
- To expose the student in the basics of underwater acoustic signal processing and image processing.

UNIT I      FUNDAMENTALS OF UNDERWATER ACOUSTICS  6
Ocean Acoustic environment; Measuring sound levels and relevant units; Sound propagation in the ocean – sound velocity profiles in the deep water and shallow water; Sound attenuation in the sea – absorption, scattering, transmission loss, reverberation, Snell’s law, target strength; SONAR systems- active, passive SONAR equations and system parameters.

UNIT II      UNDERWATER ACOUSTIC TRANSDUCERS AND DEVICES  6
Principles of transduction and SONAR transducer design; Electromechanical Analog circuits, coupling coefficient, efficiency, Directivity characteristics of receivers, frequency response characteristics of transducers, Transducer measurement techniques; Physical geometry of arrays - linear, planar, cylindrical, spherical, beam patterns, array gain.

UNIT III    AMBIENT NOISE IN THE OCEAN  6
Sources of noise, Natural and Physical sounds - Seismic, Wind, Wave, Rain and Turbulence; Biological sounds - Dolphin, Whales, Fishes; Man made Noises- Shipping Machinery noises, Pile driving, Wind Mills; Variability of Ambient noises; Frequency Bands, Noise levels of all above; Impacts of Sound on Marine Animals.

UNIT IV      PROCESSING OF UNDERWATER ACOUSTIC SIGNALS AND IMAGES  6
Representations of the signals – Fourier representations, Spatial filtering; Matched filters and Autocorrelations, Temporal resolution; Signal to Noise Ratio, Estimation of Auto Covariance, Cross Covariance; Power spectra of different Underwater Signals, Classification of signals; Concept and Types of beamforming techniques; Image segmentation, Filtering, Equalization and Restoration.

UNIT V      UNDERWATER ACOUSTIC INSTRUMENTS AND ITS APPLICATION  6
Principles of Sonar systems, Echosounder – single beam, multi beam; Side scan sonars – Imaging, Underwater acoustic camera; Sub bottom profilers –Sediment classification; Acoustic modem – Tsunami systems; Acoustic Positioning system- Transponders, USBL, SSBL systems, HiPAP; Underwater telephone; Underwater noise recorders; Underwater Beacons.

PRACTICAL EXERCISES:
1. Applying sonar equations in the design of ocean instruments
2. Auto correlation and Cross Correlation of underwater signals
3. Simulation of transmission loss in the ocean
4. Frequency Analysis of underwater ambient noise data
5. Comparison of sound velocity gradients for different ocean depths
6. Applying digital filters to underwater signal
7. Beamforming of vertical linear array data
8. Characterization of hydrophones for receiving and transmitting responses
9. Acoustic characterization of ship machinery noises
10. Acoustic characterization of whale / any marine animal sound
11. Underwater image enhancement - filtering
12. Underwater image enhancement – color enhancement

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

CO1: Understand the basics of underwater sound and its propagation in ocean
CO2: To simulate / design any underwater SONAR systems for ocean application
CO3: To identify different kinds of noises present in the ocean and its impacts on the marine biodiversity
CO4: Ability to get exposure in analyzing and applying suitable techniques for underwater acoustic signals and images
CO5: To recognize different types of SONAR systems used practically

TOTAL: 60 PERIODS

TEXTBOOKS

REFERENCES

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CEC369 IOT PROCESSORS

COURSE OBJECTIVES:
• Learn the architecture and features of ARM.
• Study the exception handling and interrupts in CORTEX M3
• Program the CORTEX M3
• Learn the architecture of STM 32L15XXX ARM CORTEX M3/M4 microcontroller.
• Understand the concepts of System – On – Chip(SoC)
UNIT I  OVERVIEW OF ARM AND CORTEX-M3

UNIT II  CORTEX EXCEPTION HANDLING AND INTERRUPTS
Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor Call and Pendable Service Call, NVIC: Nested Vector Interrupt Controller, Overview, Basic Interrupts, SYSTICK Time, Interrupt Behaviour, Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail – Chaining Interrupts, Late Arrivals and Interrupt Latency.

UNIT III  CORTEX M3/M4 PROGRAMMING

UNIT IV  STM32L15XXX ARM CORTEX M3/M4 MICROCONTROLLER AND DEBUGGING TOOLS

UNIT V  INTRODUCTION TO SYSTEM – ON – CHIP

PRACTICAL EXERCISES:

ARM Assembly Programming
1. Write a program to add two 32-bit numbers stored in r0 and r1 registers and write the result to r2. The result is stored to a memory location. a) Run the program with breakpoint and verify the result b) Run the program with stepping and verify the content of registers at each stage.
2. Write ARM assembly to perform the function of division. Registers r1 and r2 contain the dividend and divisor, r3 contains the quotient, and r5 contains the remainder.

Embedded C Programming on ARM Cortex M3/M4 Microcontroller
1. Write a program to turn on green LED (Port B.6) and Blue LED (Port B.7) on STM32L-Discovery by configuring GPIO.
2. Transmit a string “Programming with ARM Cortex” to PC by configuring the registers of USART2. Use polling method.

**ARM Cortex M3/M4 Programming with CMSIS**

1. Write a program to toggle the LEDs at the rate of 1 sec using standard peripheral library. Use Timer3 for Delay.
2. Transmit a string “Programming with ARM Cortex” to PC by using standard peripheral library with the help of USART3. Use polling method.

**COURSE OUTCOMES:**

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

**CO1:** Explain the architecture and features of ARM.

**CO2:** List the concepts of exception handling.

**CO3:** Write a program using ARM CORTEX M3/M4.

**CO4:** Learn the architecture of STM32L15XXX ARM CORTEX M3/M4.

**CO5:** Design an SoC for any application.

**TOTAL:** 60 PERIODS

**TEXTBOOKS**


**REFERENCES**


**CORTEX M Series ARM Reference Manual**

**CORTEX M3 Technical Reference Manual**

**STM32L152XX ARM CORTEX M3 Microcontroller Reference Manual 5/97**

**CO’s-PO’s & PSO’s MAPPING**

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**CEC368 IOT BASED SYSTEMS DESIGN**

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**COURSE OBJECTIVES:**

- To understand the basics of IoT.
- To get knowledge about the various services provided by IoT.
- To familiarize themselves with various communication techniques and networking.
- To know the implementation of IoT with different tools.
- To understand the various applications in IoT.
UNIT I INTRODUCTION TO INTERNET OF THINGS


UNIT II MIDDLEWARE AND PROTOCOLS OF IOT


UNIT III COMMUNICATION AND NETWORKING

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT - Data aggregation & dissemination.

UNIT IV IOT IMPLEMENTATION TOOLS

Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi.

UNIT V APPLICATIONS AND CASE STUDIES:


TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Articulate the main concepts, key technologies, strength and limitations of IoT.
CO2: Identify the architecture, infrastructure models of IoT.
CO3: Analyze the networking and how the sensors are communicated in IoT.
CO4: Analyze and design different models for IoT implementation.
CO5: Identify and design the new models for market strategic interaction.

TEXT BOOKS:


REFERENCES:


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CEC365 WIRELESS SENSOR NETWORK DESIGN

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COURSE OBJECTIVES:

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

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

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

UNIT III 6LOWPAN 9

UNIT IV APPLICATION 9
Design Issues, Protocol Paradigms - End-to-end, Real-time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols - Web service protocols, MQTT telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP), Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols.
UNIT V TOOLS
TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

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CEC367 INDUSTRIAL IOT AND INDUSTRY 4.0

COURSE OBJECTIVES:
- IoT Nodes & Sensors
- IoT Gateways
- IoT Cloud Systems
- IoT Cloud Dashboards
- Challenges in IoT system Design – Hardware & Software

UNIT I UNDERSTANDING IOT CONCEPT AND DEVELOPMENT PLATFORM
IOT Definition, Importance of IoT, Applications of IoT, IoT architecture, Understanding working of Sensors, Actuators, Sensor calibration, Study of Different sensors and their characteristics
UNIT II ANALYZING & DECODING OF COMMUNICATION PROTOCOL USED IN IOT DEVELOPMENT PLATFORM
UART Communication Protocol, I2C Protocol device interfacing and decoding of signal, SPI Protocol device interfacing and decoding of signal, WiFi and Router interfacing, Ethernet Configuration, Bluetooth study and analysis of data flow, Zigbee Interfacing and study of signal flow

UNIT III IOT PHYSICAL DEVICES AND ENDPOINTS AND CONTROLLING HARDWARE AND SENSORS
IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry Pi with focus on interfacing external gadgets, controlling output, reading input from pins.
Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors;

UNIT IV CLOUD SERVICES USED IN IOT DEVELOPMENT PLATFORM
Configuration of the cloud platform, Sending data from the IOT nodes to the gateways using different communication options; Transferring data from gateway to the cloud; Exploring the web services like mail, Messaging (SMS) and Twitter etc.; Tracking of cloud data as per the requirement; Google Cloud service architect; AWS cloud Services architect; Microsoft Azure cloud services Architect; OEN source Cloud Services; Initial State Iot Dashboard & Cloud Services

UNIT V CHALLENGES IN IOT SYSTEM DESIGN – HARDWARE & SOFTWARE
Antenna design and placement, Chip-package system development, Power electronics, electromagnetic interference/compatibility (EMI/EMC), Electronics reliability; Battery simulation.

PRACTICAL EXERCISES:
Study and Program different Sensors for IoT applications
- LDR sensor, IR sensor, Temperature Sensor, Ultrasound Sensor, Gas sensor
- Write a program using IR sensor for working morning alarm and night lamp
- Write a program using Temperature sensor for detecting heat / fire
- Write a program using Gas sensor for detecting LPG gas leak
- Write a program using Ultrasound sensor for range detection
- Write a program using sensors for carparking assist
- Write a program using sensors for water level indicator and overflow detection

2. Designing and debugging complex mixed signal devices (analog, digital, and RF)
- Write a program to interface Bluetooth and implement DC Motor.
- Write a program to control LEDs using Alexa Echo Dot.
- Write a program to control Buzzer using Alexa Echo Dot.
- Write a program to control DC motor using Google Assistance.
- Write a program to control Stepper motor using Google Assistance
- Studying Bluetooth analysis and measurement of Signals
- studying WLAN analysis of 802.11a/b/g/j/p, 802.11n, 802.11ac Signals
3. Understanding battery requirements
- Determining ultra-low deep sleep current of Node
- Measuring Transmit and Receive current signals of Node
- Capturing short transients and fast transients signals of node
- Recording Device(node) operations over extended states.
- Create stable low noise voltage supply for every state of your IOT devices, from sleep to transmit.
- Record and Generate Battery sources with the battery simulation options

4. Understanding Modulation techniques –
- Understanding of ASK, FSK Modulation and measurements
- Capturing the live ASK Signal and decoding it.
- Understanding the BPSK, QPSK & QAM Modulation Techniques and analysis.
- Understanding the APSK & APCO modulation & analysis.

List of equipment for a batch of 30 students (3 in a bench):
- Real time Spectrum Analyser upto atleast 6.2GHz and 40MHz bandwidth – Qty #1
- DC Power supply - 120W with Battery simulation – Qty #1
- Graphical Digital Multimeter with built-in digitizer and datalogging for 20 channels – Qty #1
- 200MHz 6 channel scope with Serial trigger & decode capability for I2C, SPI, RS-232/422/485/UART buses, and built-in 50MHz AFG and 8 digital channel analysis – Qty #1
- AI Node with pre-configured SSD, USB Camera, USB Hub, USB Mouse, and USB Keyboard. – Qty 1no
- Sensor IOT Application Board with built-in 7 sensors (LDR #2, IR #2, Temperature #1, Ultrasound #1 and LPG Gas sensors #1); Embedded uC mother board, LCD display, Buzzer, Power supply (12V,1A) with adaptor and PCB Base plate; - Qty 5 nos
- All in One General Purpose Board
- IOT Gateway – Qty 1no
- Bluetooth Module– Qty 1no
- Router – Qty 1no
- Portable Sensor Kit – Qty 1no
- IOT sensor kit – Qty 1no
- RFID Module – Qty 1no
- Finger Print Module – Qty 1no
- Stepper Motor – Qty 1no
- DC Motor – Qty 1no
- Amazon Echo device – Qty 2nos

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
CO1: Understand the building blocks of IoT technology and explore the vast spectrum of IoT applications
CO2: Use processors & peripherals to design & build IoT hardware
CO3: Assess, select and customize technologies for IoT applications
CO4: Connect numerous IOT applications with the physical world of humans and real life problem solving.
CO5: Design and implement IOT applications that manage big data

TOTAL: 60 PERIODS
TEXT BOOKS

REFERENCES

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

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CEC340 MEMS DESIGN L T P C 2 0 2 3

COURSE OBJECTIVES:
- To understand the basic electrical and mechanical concepts of MEMS design
- To understand the design aspects of electrostatic sensors and actuators
- To understand the design aspects of thermal sensors and actuators
- To understand the design aspects of piezoelectric sensors and actuators
- To understand the design aspects of magnetic sensors and actuators

UNIT I ESSENTIAL ELECTRIC AND MECHANICAL CONCEPTS 6
Conductivity of semiconductors, Crystal planes and orientations, stress and strain, flexural beam bending analysis under simple loading conditions, Dynamic system, resonant frequency and quality factor

UNIT II ELECTRO STATIC SESNING AND ACTUATION 6
Parallel plate capacitor, Applications of parallel plate capacitors- inertial sensor, pressure sensor, flow sensor, tactile sensor, parallel plate actuators, interdigitated finger capacitors, applications of comb drive devices.

UNIT III THERMAL SENSING AND ACTUATION 6
Fundamentals of thermal transfer, Sensors and actuators based on thermal expansion, Thermal couples, Thermal resistors, Applications- Infrared sensors, flow sensors, Inertial sensors, other sensors
UNIT IV  PIEZOELECTRIC SENSING AND ACTUATION  6

Mathematical description of piezoelectric effects, Cantilever piezoelectric actuator model, properties of piezoelectric materials – Quartz, PZT, PVDF, ZnO, Applications – Acoustic sensors, Tactile sensors

UNIT V  MAGNETIC SENSING AND ACTUATION  6

Concepts and principles – magnetization and nomenclatures, principles of micromagnetic actuators, fabrication of micro magnetic components- deposition, design and fabrication of magnetic coil, MEMS magnetic actuators

PRACTICAL EXERCISES:
1. Design and simulation of piezoelectric cantilever
2. Design and simulation of thermo couples
3. Design and simulation of comb drive actuators

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
CO1: Understand the basics of MEMS design aspects.
CO2: Apply the knowledge in the development of electro static sensors and actuators.
CO3: Apply the knowledge in the development of thermal sensors and actuators.
CO4: Apply the knowledge in the development of piezoelectric sensors and actuators.
CO5: Apply the knowledge in the development of magnetic sensors and actuators.

TOTAL: 60 PERIODS

TEXTBOOKS

REFERENCES
3. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata Mcgraw Hill, 2002

CO’s-PO’s & PSO’s MAPPING

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COURSE OBJECTIVES:

- To understand the concepts of nano electronics and quantum electronics
- To understand the concepts of nano electronic devices, transistors, tunneling devices and superconducting devices
- To understand the basics of nanotube devices

UNIT I INTRODUCTION TO NANO ELECTRONICS 6

Scaling to nano - Light as a wave and particle- Electrons as waves and particles- origin of quantum mechanics - General postulates of quantum mechanics - Time independent Schrodinger wave equation- Electron confinement - Quantum dots, wires and well-Spin and angular momentum

UNIT II QUANTUM ELECTRONICS 6


UNIT III NANO ELECTRONIC TRANSISTORS 6

Coulomb blockade - Coulomb blockade in Nano capacitors - Coulomb blockade in tunnel junctions - Single electron transistors, Semiconductor nanowire FETs and SETs, Molecular SETs and molecular electronics - Memory cell.

UNIT IV NANO ELECTRONIC TUNNELING AND SUPER CONDUCTING DEVICES 6


UNIT V NANOTUBES AND NANOSTRUCTURE DEVICES 6


PRACTICAL EXERCISES: 30 PERIODS

T-CAD/ Any other relevant software based Simulations

1. Field Effect Transistors
2. Single Electron Transistors
3. Tunneling devices

COURSE OUTCOMES:

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

CO1: Understand the basics of nano electronics including quantum wires, dots and wells

CO2: Use the mechanism behind quantum electronic devices

CO3: Analyze the key performance aspects of tunneling and superconducting nano electronic devices
CO4: Apply the knowledge in the development of nanotubes and nanostructure devices

TOTAL: 60 PERIODS

TEXTBOOKS

REFERENCES
4. Brajesh Kumar Kaushik, Nanoelectronics: Devices, Circuits and Systems, Elsevier science, 2018

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CEC347 RADAR TECHNOLOGIES L T P C
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COURSE OBJECTIVES:
The student should be made to:
- Understand the basics of Radar and Radar equation
- Understand the types of Radar
- Understand tracking Radar
- Understand the various signal processing in Radar
- Understand the Subsystems in Radar

UNIT I INTRODUCTION TO RADAR EQUATION

UNIT II CW, MTI AND PULSE DOPPLER RADAR
CW and Frequency Modulated Radar, Doppler and MTI Radar- Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target
Detector, Limitations to MTI Performance, MTI from a Moving Platform (AMIT), Pulse Doppler Radar.

UNIT III TRACKING RADAR
9 Tracking with Radar, Monopulse Tracking, Conical Scan, Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking - Comparison of Trackers, Track while Scan (TWS) Radar - Target prediction , state estimation, Measurement models, alpha – beta tracker, Kalman Filtering, Extended Kalman filtering.

UNIT IV RADAR SIGNAL PROCESSING

UNIT V RADAR TRANSMITTERS AND RECEIVERS

TOTAL:45 PERIODS

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

CO1:Identify the Radar parameters
CO2:Differentiate various radar types
CO3:Evaluate different tracking and filtering schemes
CO4:Apply signal processing in target detection
CO5:Design Radar transmitter and receiver blocks

TEXT BOOKS

REFERENCES

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COURSE OBJECTIVES:
- To impart knowledge on the needs for avionics for both Civil and military aircraft.
- To impart knowledge on avionics architecture and Avionics data bus.
- To impart knowledge understand the various cockpit displays and human interfaces.
- To impart knowledge on the concepts of flight control systems, FMS and their importance.
- To impart knowledge on different navigation aids and need for certification.

UNIT I  INTRODUCTION TO AVIONICS  9

UNIT II  DIGITAL AVIONICS BUS ARCHITECTURE  9

UNIT III  COCKPIT DISPLAYS AND MAN-MACHINE INTERACTION  9
Trends in display technology- CRT, LED, LCD, EL and plasma panel - Touch screen - Direct voice input (DVI) – Civil cockpit and military cockpit: MFD, MFK, HUD, HDD, HMD, HOTAS – Glass cockpit.

UNIT IV  FLIGHT CONTROL SYSTEMS  9

UNIT V  NAVIGATION SYSTEMS  9

COURSE OUTCOMES:  TOTAL: 45 PERIODS
Upon completion of the course, students will be able to:
CO1: Explain the different of Avionics Systems and its need for civil and military aircrafts considering the reliability and safety aspects.
CO2: Select a suitable architecture and data bus based on the requirements.
CO3: Compare the different display technologies used in cockpit.
CO4: Explain the principles of flight control systems and the importance of FMS.
CO5: Explain the communication and navigation techniques used in aircrafts.

TEXT BOOK:

REFERENCES:
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CEC346 POSITIONING AND NAVIGATION SYSTEMS  
L T P C  
3 0 0 3

COURSE OBJECTIVES
- To explain the fundamentals of navigation systems.
- To understand the inertial navigation systems.
- To acquire knowledge on radio navigation.
- To have an overview of global positioning systems.
- To learn the hybrid navigation systems.

UNIT I NAVIGATION CONCEPTS  

UNIT II INERTIAL NAVIGATION SYSTEMS  

UNIT III RADIO NAVIGATION & AIR TRAFFIC MANAGEMENT  
Different types of radio navigation- ADF, VOR, DME, TACAN, VORTAC - Doppler – HyperbolicNavigations – Air Traffic Management – RADAR Surveillance - Airborne Collision Avoidance Systems

UNIT IV GLOBAL POSITIONING SYSTEM  
Overview of GPS: Basic concept, system architecture, , GPS Signals Signal structure, anti-spoofing (AS), selective availability, GPS for position and velocity determination, GPS aided Geo-augmented navigation (GAGAN) architecture -GPS error sources-clock error, ionospheric error, tropospheric error, multipath, ionospheric error estimation using dual frequency GPS receiver
Hybrid Navigation - Introduction to Kalman filtering – Case Studies -Integration of GPS and INS using Kalman Filter - Relative Navigation – fundamentals – Equations of Relative Motion for circular orbits (Clohessy_Wiltshire Equations) - Sensors for Rendezvous Navigation - Relative positioning - Point positioning and differential positioning - Differential GPS (DGPS) and Space based Augmentation system (SBAS)- Concepts - Relative GPS - Formation Flying - Figure of Merit (FOM)

TOTAL: 45 PERIODS

COURSE OUTCOME:
Upon completion of the course, students will be able to
CO1 : Understand the advanced concepts of Positioning and Navigation systems and exposure on various Navigation systems
CO2 : Know about Gyroscopes and accelerometers and Inertial Navigation systems and its types and Mechanisation
CO3 : Explain the different Radio Navigation aids and its usage for civil and military aircrafts and satellites
CO4 : Explain the Satellite Navigation – GPS and its usage in aircraft and spacecraft applications
CO5: Deploy these skills effectively in the analysis and understanding of hybrid navigation systems and Relative navigation in a spacecraft.

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COURSE OBJECTIVES:
The student should be made to:
- Understand the basics of satellite orbits
- Understand the satellite segment and earth segment
- Understand Link Power budget calculation
- Understand the various satellite access and coding technology
- Understand the applications of satellite

UNIT I    SATELLITE ORBITS

UNIT II    SPACE SEGMENT
Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders Antenna Subsystem.

UNIT III    SATELLITE LINK DESIGN
Basic link analysis, Uplink and Downlink Design equation, Free space loss-Atmospheric effects, Ionospheric scintillation, Rain induced attenuation and interference, system noise temperature, Link Design with and without frequency reuse.

UNIT IV    SATELLITE ACCESS AND CODINGTechniques

UNIT V    SATELLITE APPLICATIONS
INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, LEO, MEO, Satellite Navigational System. GPS-Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH).

TOTAL:45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1:Identify the satellite orbits
CO2:Analyze the satellite subsystems
CO3:Evaluate the satellite link power budget
CO4:Identify access technology for satellite
CO5:Design various satellite applications

TEXT BOOKS:

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CEC348 REMOTE SENSING L T P C 3 0 0 3

UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION 9


UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL 9


UNIT III ORBITS AND PLATFORMS 9

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

UNIT IV SENSING TECHNIQUES 9

UNIT V   DATA PRODUCTS AND INTERPRETATION


TOTAL:45 PERIODS

TEXTBOOKS:

REFERENCES:

COURSE OUTCOMES
CO1: To understand the principles of electromagnetic radiation.
CO2: To learn the atmospheric radiation interactions.
CO3: To study the laws of planetary motion.
CO4: To classify the different types of resolution.
CO5: To know the concepts of digital interpretation.

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CEC351   ROCKETRY AND SPACE MECHANICS   L  T  P  C
3 0 0 3

COURSE OBJECTIVES:
- This course presents the fundamental aspects of rocket motion along with detailed estimation of rocket trajectories.
- This course also imparts knowledge on optimization of multistage rockets.
- This course provides the basics of space mechanics required for an aeronautical student.
This course helps students to provide with the basics of orbit transfer of satellites.
This course will help students to gain knowledge on various control methods of rockets.

UNIT I \hspace{1cm} ORBITAL MECHANICS \hspace{1cm} 9

UNIT II \hspace{1cm} SATELLITE DYNAMICS \hspace{1cm} 9

UNIT III \hspace{1cm} ROCKET MOTION \hspace{1cm} 9
Principle of operation of rocket motor – thrust equation – one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields – Description of vertical, inclined and gravity turn trajectories – determinations of range and altitude – simple approximations to burnout velocity.

UNIT IV \hspace{1cm} ROCKET AERODYNAMICS \hspace{1cm} 9

UNIT V \hspace{1cm} STAGING AND CONTROL OF ROCKET VEHICLES \hspace{1cm} 9
Need for multi staging of rocket vehicles – multistage vehicle optimization – stage separation dynamics and separation techniques- aerodynamic and jet control methods of rocket vehicles – SITVC.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, students will be able
CO1: To knowledge on the fundamental laws of orbital mechanics with particular emphasis on interplanetary trajectories.
CO2: To calculate orbital parameters and perform conceptual trajectory designs for geocentric or interplanetary missions.
CO3: To familiarize themselves with trajectory calculations for planar motion of rockets.
CO4: To determine forces and moments acting on airframe of a missile.
CO5: To acquire knowledge on the need for staging and stage separation dynamics of rocket vehicles.

TEXT BOOKS

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CEC345 OPTICAL COMMUNICATION & NETWORKS

COURSE OBJECTIVES:
- To Study About The Various Optical Fiber Modes, Configuration Of Optical Fibers
- To Study Transmission Characteristics Of Optical Fibers.
- To Learn About The Various Optical Sources, Detectors And Transmission Techniques.
- To Explore Various Idea About Optical Fiber Measurements And Various Coupling
- To Enrich The Knowledge About Optical Communication Systems And Networks.

UNIT-I INTRODUCTION TO OPTICAL FIBER COMMUNICATION
Introduction - The General Systems - Advantages of Optical Fiber Communication - Ray Theory

UNIT-II TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS

UNIT-III OPTICAL SOURCES AND OPTICAL DETECTORS

UNIT-IV OPTICAL FIBER MEASUREMENTS
UNIT-V  OPTICAL NETWORKS


**TOTAL: 45 PERIODS**

**COURSE OUTCOMES**

At the end of the course, the student will be able to understand the

**CO1**: Realize Basic Elements In Optical Fibers, Different Modes And Configurations.

**CO2**: Analyze The Transmission Characteristics Associated With Dispersion And Polarization Techniques.

**CO3**: Design Optical Sources And Detectors With Their Use In Optical Communication System.

**CO4**: Construct Fiber Optic Receiver Systems, Measurements And Techniques.

**CO5**: Design Optical Communication Systems And Its Networks.

**TEXT BOOKS:**


**REFERENCES:**


**CO’s-PO’s & PSO’s MAPPING**

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COURSE OBJECTIVES

- To study the various network layer and transport layer protocols for wireless networks
- To study the architecture and interference mitigation techniques in 3G standards
- To learn about 4G technologies and LTE-A in mobile cellular network.
- To learn about the layer level functionalities in interconnecting networks.
- To study the emerging techniques in 5G network.

UNIT I WIRELESS PROTOCOLS 9
Mobile network layer- Fundamentals of Mobile IP, data forwarding procedures in mobile IP, IPv4, IPv6, IP mobility management, IP addressing - DHCP, Mobile transport layer-Traditional TCP, congestion control, slow start, fast recovery/fast retransmission, classical TCP improvements-Indirect TCP, snooping TCP, Mobile TCP.

UNIT II 3G EVOLUTION 9

UNIT III 4G EVOLUTION 9
Introduction to LTE-A – Requirements and Challenges, network architectures – EPC, E- UTRAN architecture - mobility management, resource management, services, channel -logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.

UNIT IV LAYER-LEVEL FUNCTIONS 9
Characteristics of wireless channels - downlink physical layer, uplink physical layer, MAC scheme - frame structure, resource structure, mapping, synchronization, reference signals and channel estimation, SC-FDMA, interference cancellation – CoMP, Carrier aggregation, Services - multimedia broadcast/multicast, location-based services.

UNIT V 5G EVOLUTION 9

TOTAL: 45 PERIODS

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

CO1: Design and implement the various protocols in wireless networks.
CO2: Analyze the architecture of 3G network standards.
CO3: Analyze the difference of LTE-A network design from 4G standard.
CO4: Design the interconnecting network functionalities by layer level functions.
CO5: Explore the current generation (5G) network architecture.

TEXTBOOKS
REFERENCES

CO’s-PO’s & PSO’s MAPPING

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CEC331 4G / 5G COMMUNICATION NETWORKS L T P C 2 0 2 3

COURSE OBJECTIVES
● To learn the evolution of wireless networks.
● To get acquainted with the fundamentals of 5G networks.
● To study the processes associated with 5G architecture.
● To study spectrum sharing and spectrum trading.
● To learn the security features in 5G networks.

UNIT I EVOLUTION OF WIRELESS NETWORKS 6

UNIT II 5G CONCEPTS AND CHALLENGES 6
Fundamentals of 5G technologies, overview of 5G core network architecture, 5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.

UNIT III NETWORK ARCHITECTURE AND THE PROCESSES 6
5G architecture and core, network slicing, multi access edge computing (MEC) visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, and edge computing. 5G protocols: 5G NAS, NGAP, GTP-U, IPSec and GRE.

UNIT IV DYNAMIC SPECTRUM MANAGEMENT AND MM-WAVES 6
Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves.

UNIT V SECURITY IN 5G NETWORKS 6
Security features in 5G networks, network domain security, user domain security, flow based QoS framework, mitigating the threats in 5G.

30 PERIODS
PRACTICAL EXERCISES: 30 PERIODS

SIMULATION USING MATLAB

1. 5G-Compliant waveform generation and testing
2. Modeling of 5G Synchronization signal blocks and bursts
3. Channel modeling in 5G networks
4. Multiband OFDM demodulation
5. Perfect Channel estimation

COURSE OUTCOMES
CO1: To understand the evolution of wireless networks.
CO2: To learn the concepts of 5G networks.
CO3: To comprehend the 5G architecture and protocols.
CO4: To understand the dynamic spectrum management.
CO5: To learn the security aspects in 5G networks.

TOTAL 60 PERIODS

TEXT BOOKS
1. 5G Core networks: Powering Digitalization, Stephen Rommer, Academic Press, 2019

REFERENCES
1. 5G Simplified: ABCs of Advanced Mobile Communications, Jyrki. T.J.Penttinen, Copyrighted Material.

CO’s-PO’s & PSO’s MAPPING

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CEC354 SOFTWARE DEFINED NETWORKS L T P C

COURSE OBJECTIVES:

- To understand the need for SDN and its data plane operations
- To understand the functions of control plane
- To comprehend the migration of networking functions to SDN environment
- To explore various techniques of network function virtualization
- To comprehend the concepts behind network virtualization

UNIT I SDN: BACKGROUND AND DATA PLANE 6
UNIT II  
SDN Control Plane 

UNIT III  
UNIT TITLE 

UNIT IV 
NETWORK FUNCTION VIRTUALIZATION 

UNIT V 
NETWORK VIRTUALIZATION 

PRACTICAL EXERCISES: 
1. Installing Mininet simulator 
2. Creating a 1 controller, 3 node topology, POX controller 
3. Ability to view, read/write Flow table rules (for different applications - say firewall, Learning switch etc.), POX, Open vSwitch 
4. Building a SDN based application

COURSE OUTCOMES: 
After the successful completion of this course, the student will be able to 
CO1: Describe the motivation behind SDN and its data plane (K2) 
CO2: Identify the functions of control plane (K3) 
CO3: Apply SDN to networking applications (K3) 
CO4: Apply various operations of network function virtualization 
CO5: Explain various use cases of SDN

TEXT BOOKS 

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CEC371  MASSIVE MIMO NETWORKS  L T P C

2 0 2 3

COURSE OBJECTIVES:

- To gain knowledge about massive MIMO networks.
- To understand the massive MIMO propagation channels.
- To learn about channel estimation in single cell and multicell massive MIMO systems.
- To comprehend the concepts of massive MIMO deployment in the context of single cell and multicell deployment.

UNIT I  MASSIVE MIMO NETWORKS

Definition of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink, Basic Impact of Spatial Channel Correlation, Channel Hardening and Favourable Propagation, Local Scattering Spatial Correlation Model

UNIT II  THE MASSIVE MIMO PROPAGATION CHANNEL


UNIT III  SINGLE-CELL SYSTEMS


UNIT IV  MULTI-CELL SYSTEMS

Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission -Zero-Forcing - Maximum-Ratio, Discussion -Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-Synchronous Pilot Interference

UNIT V  CASE STUDIES

PRACTICAL EXERCISES:
Implementation of (Using Matlab)
1. Massive MIMO hybrid beamforming
2. Single cell massive MIMO downlink communications
3. Multicell massive MIMO downlink communications.
4. Precoding in massive MIMO single cell and multicell downlink communications
5. Channel estimation in massive MIMO system

COURSE OUTCOMES:
CO1: Understand and explain massive MIMO networks.
CO2: Analyze massive MIMO propagation channels and their capacity bounds
CO3: Examine channel estimation techniques for single cell system.
CO4: Analyze channel estimation techniques for multi cell system.
CO5: Explain the concepts underlining the deployment of single and multicell massive MIMO systems.

TEXT BOOKS

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178
• To provide understanding on protocols and networks related to green future wireless communication technologies.

UNIT I COOPERATIVE COMMUNICATIONS AND GREEN CONCEPTS 9
Network architectures and research issues in cooperative cellular wireless networks; Cooperative communications in OFDM and MIMO cellular relay networks: issues and approaches; Fundamental trade-offs on the design of green radio networks, Green modulation and coding schemes.

UNIT II COOPERATIVE TECHNIQUES 9
Cooperative techniques for energy efficiency, Cooperative base station techniques for cellular wireless networks; Turbo base stations; Antenna architectures for cooperation; Cooperative communications in 3GPP LTE-Advanced, Partial information relaying and Coordinated multi-point transmission in LTE-Advanced.

UNIT III RELAY-BASED COOPERATIVE CELLULAR NETWORKS 9
Distributed space-time block codes; Collaborative relaying in downlink cellular systems; Radio resource optimization; Adaptive resource allocation; Cross-layer scheduling design for cooperative wireless two-way relay networks; Network coding in relay-based networks.

UNIT IV GREEN RADIO NETWORKS 9

UNIT V ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS 9
Cross-layer design of adaptive packet scheduling for green radio networks; Energy-efficient relaying for cooperative cellular wireless networks; Energy performance in TDD-CDMA multihop cellular networks; Resource allocation for green communication in relay-based cellular networks; Green Radio Test-Beds and Standardization Activities.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: The student would be able to appreciate the necessity and the design aspects of cooperative communication
CO2: The student would be able to appreciate the necessity and the design aspects of green wireless communication.
CO3: The student would be able to evolve new techniques in wireless communication
CO4: The students would be able to demonstrate the feasibility of using mathematical models using simulation tools.
CO5: The student would be able to demonstrate the impact of the green engineering solutions in a global, economic, environmental and societal context.

TEXT BOOKS

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SOFT CORE – MANAGEMENT

GE3751 PRINCIPLES OF MANAGEMENT

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

UNIT II PLANNING 9

UNIT III ORGANISING 9

UNIT IV DIRECTING 9

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.
TEXT BOOKS:

REFERENCES:

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GE3752 TOTAL QUALITY MANAGEMENT L T P C 3 0 0 3

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

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

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

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.

CO’s- PO’s & PSO’s MAPPING

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

REFERENCES:
Heinemann Ltd, 2016.
2006.
GE3753  ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING  

COURSE OBJECTIVES:

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

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

UNIT II  PRODUCTION AND COST ANALYSIS  

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

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

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

COURSE OUTCOMES: Students able to

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

TEXT BOOKS:

REFERENCES:
5. Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009

CO’s-PO’s & PSO’s MAPPING

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GE3754 HUMAN RESOURCE MANAGEMENT L T P C
3 0 0 3

COURSE 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

185
COURSE OUTCOMES:
CO1: Students would have gained knowledge on the various aspects of HRM
CO2: Students will gain knowledge needed for success as a human resources professional.
CO3: Students will develop the skills needed for a successful HR manager.
CO4: Students would be prepared to implement the concepts learned in the workplace.
CO5: Students would be aware of the emerging concepts in the field of HRM

TEXT BOOKS:

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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GE3755 KNOWLEDGE MANAGEMENT L T P C 3 0 0 3

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
9
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
9
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
9
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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TEXT BOOK:

REFERENCE:
COURSE OBJECTIVES

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

UNIT – I  INTRODUCTION TO MANAGEMENT  9
Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg’s Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

UNIT – II  FUNCTIONS OF MANAGEMENT - I  9
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  9
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  9
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  9
Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course the students would be able to

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

CO2 Discuss the planning; organizing and staffing functions of management in professional organization.

CO3 Apply the leading; controlling and decision making functions of management in professional organization.

CO4 Discuss the organizational theory in professional organization.

CO5 Apply principles of productivity and modern concepts in management in professional organization.

TEXTBOOKS:

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MANDATORY COURSES I

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

COURSE OUTLINE

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

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

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

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

UNIT V  GENDER AND REPRESENTATION
Advertising and popular visual media.

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

TOTAL : 45 PERIODS

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

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

1. COURSE CONTENTS

Introduction to Elements of Literature

1. Relevance of literature

   a) Enhances Reading, thinking, discussing and writing skills.

   b) Develops finer sensibility for better human relationship.

   c) Increases understanding of the problem of humanity without bias.
d) Providing space to reconcile and get a cathartic effect.

2. Elements of fiction

   a) Fiction, fact and literary truth.

   b) Fictional modes and patterns.

   c) Plot character and perspective.

3. Elements of poetry

   a) Emotions and imaginations.

   b) Figurative language.

   c) (Simile, metaphor, conceit, symbol, pun and irony).

   d) Personification and animation.

   e) Rhetoric and trend.

4. Elements of drama

   a) Drama as representational art.

   b) Content mode and elements.

   c) Theatrical performance.

   d) Drama as narration, mediation and persuasion.

   e) Features of tragedy, comedy and satire.

3. READINGS:


3.1 Textbook:

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

4.1 *Tutorials:*

4.2 *Laboratory:*

4.3 *Project: The students will write a term paper to show their understanding of a particular piece of literature

5. **ASSESSMENT:**

5.1 HA:

5.2 Quizzes- HA:

5.3 Periodical Examination: one

5.4 Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc.

5.5 Final Exam: **TOTAL : 45 PERIODS**

**OUTCOME OF THE COURSE:**

- Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.

**MX3083**  
**FILM APPRECIATION**  
L T P C  
3 0 0 0

In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.

**Theme - A: The Component of Films**

A-1: The material and equipment  
A-2: The story, screenplay and script  
A-3: The actors, crew members, and the director

A-4: The process of film making… structure of a film

**Theme - B: Evolution of Film Language**

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

B-4: Talkies
Theme - C: Film Theories and Criticism/Appreciation

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

Theme – D: Development of Films

D-1: Representative Soviet films
D-2: Representative Japanese films
D-3: Representative Italian films
D-4: Representative Hollywood film and the studio system

Theme - E: Indian Films

E-1: The early era
E-2: The important films made by the directors
E-3: The regional films

E-4: The documentaries in India

READING:

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

MX3084 DISASTER RISK REDUCTION AND MANAGEMENT 3 0 0 0

COURSE OBJECTIVE

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

UNIT I HAZARDS, VULNERABILITY AND DISASTER RISKS 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 -

TOTAL : 45 PERIODS

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

REFERENCES

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

CO’s-PO’s & PSO’s MAPPING

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MANDATORY COURSES II

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

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

UNIT I HEALTH AND ITS IMPORTANCE

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


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

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken
Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.


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

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

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

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 4+4
AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.
Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.
Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal
Prevention of illness with our traditional system of medicine
Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

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


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

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
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
4. 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,f%20have%20time%20to%20co
ok.
5. Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html
9. BMI https://www.hsph.harvard.edu/nutritionsource/healthy-weight/
13. CAM : https://www.hindawi.com/journals/ecam/2013/376327/

COURSE OUTCOMES:
After completing the course, the students will be able to:
CO1: Learn the importance of different components of health
CO2: Gain confidence to lead a healthy life
CO3: Learn new techniques to prevent lifestyle health disorders
CO4: 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)

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

MX3088 STATE, NATION BUILDING AND POLITICS IN INDIA

COURSE OBJECTIVE:
The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.

TOPICS:
Understanding the need and role of State and politics.
Development of Nation-State, sovereignty, sovereignty in a globalized world.
Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government-unitary-federal, Presidential-Parliamentary,
The idea of India.
1857 and the national awakening.
1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India.
Goals, objective and philosophy.
Why a federal system?
National integration and nation-building.
Challenges of nation-building – State against democracy (Kothari)
New social movements.
The changing nature of Indian Political System, the future scenario.
What can we do?

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


TOTAL : 45 PERIODS

MX3089 INDUSTRIAL SAFETY L T P C 3 0 0 0

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

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

UNIT II STANDARDS AND REGULATIONS

UNIT III SAFETY ACTIVITIES

UNIT IV WORKPLACE HEALTH AND SAFETY
Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety-Toxic gas Release
UNIT V HAZARD IDENTIFICATION TECHNIQUES
Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis-Hazard and Operability-Fault Tree Analysis-Event Tree Analysis Qualitative and Quantitative Risk Assessment-Checklist Analysis-Root cause analysis-What-If Analysis- and Hazard Identification and Risk Assessment

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Course outcomes on completion of this course the student will be able:
CO1: Understand the basic concept of safety.
CO2: Obtain knowledge of Statutory Regulations and standards.
CO3: Know about the safety Activities of the Working Place.
CO4: Analyze on the impact of Occupational Exposures and their Remedies
CO5: 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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1 - low, 2 - medium, 3 - high, '-' - no correlation
COURSE OBJECTIVES:

- To outline the space environment and their effects.
- To extend the origin of universe and development.
- To classify the galaxies and their evolution.
- To interpret the variable stars in the galaxies.
- To explain theory of formation of our solar system.

UNIT I
INTRODUCTION

UNIT II
ORIGIN OF UNIVERSE
Early history of the universe – Big-Bang and Hubble expansion model of the universe – cosmic microwave background radiation – dark matter and dark energy.

UNIT III
GALAXIES
Galaxies, their evolution and origin – active galaxies and quasars – Galactic rotation – Stellar populations – galactic magnetic field and cosmic rays.

UNIT IV
STARS

UNIT V
SOLAR SYSTEM

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Obtain a broad, basic knowledge of the space sciences.
CO2: Explain the scientific concepts such as evolution by means of natural selection, age of the Earth and solar system and the Big-Bang.
CO3: Describe the main features and formation theories of the various types of observed galaxies, in particular the Milky Way.
CO4: Explain stellar evolution, including red giants, supernovas, neutron stars, pulsars, white dwarfs and black holes, using evidence and presently accepted theories;
CO5: Describe the presently accepted formation theories of the solar system based upon observational and physical constraints;
TEXT BOOKS:

REFERENCES:

OIE351 INTRODUCTION TO INDUSTRIAL ENGINEERING  L T P C
3 0 0 3

COURSE OBJECTIVES:
The objective of this course is to provide foundation in Industrial Engineering in order to enable the students to make significant contributions for improvements in diverse organizations.

- Explain the concepts productivity and productivity measurement approaches.
- Explain the basic principles in facilities planning and plant location.
- Apply work study and ergonomic principles to design workplaces for the improvement of human performance.
- Impart knowledge to design and implement Statistical Process control in any industry.
- Recognize the concept of Production and Operations Management in creating and enhancing a firm’s competitive advantages.

UNIT I INTRODUCTION
9

UNIT II PLANT LOCATION AND LAYOUT
9

UNIT III WORK SYSTEM DESIGN & ERGONOMICS
9

UNIT IV STATISTICAL QUALITY CONTROL
9

UNIT V PRODUCTION PLANNING AND CONTROL
9
COURSE OUTCOMES:
At the end of the course, Students will be able to
CO1: Ability To define the concepts of productivity and productivity measurement approaches.
CO2: Ability to evaluate appropriate location models for various facility types and design various facility layouts
CO3: Ability To conduct a method study and time study to improve the efficiency of the system.
CO4: Ability to Control the quality of processes using control charts in manufacturing/service industries.
CO5: Ability to define the Planning strategies and Material Requirement Plan.

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

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TEXT BOOK:

REFERENCES:
2. Martand Telsang,2006, Industrial Engineering and Production Management, S. Chand and Company

OBT351 FOOD, NUTRITION AND HEALTH L T P C 3 0 0 3

COURSE OBJECTIVES:
- Build knowledge and an overview on general aspects of nutrition and health.
- Distinguish the nutritive value of various food items, BMI calculation differentiating super junk, and functional foods in the market.
- To Solve the real-world problems based on nutrition and health

UNIT-I FOOD AND MICROBIOLOGY OF HEALTH: 9

UNIT-II  NUTRIENTS AND FOOD ADDITIVES:  

UNIT-III  NANO FOOD TECHNOLOGY:  
Nano materials as food components, food packaging and nano materials, policies on usage of nanomaterials in foods. Food product development: steps involved in food product development, shelf-life assessment.

UNIT-IV  FOOD RELATED NUTRITIONAL DISORDERS AND ENERGY CALCULATION:  

UNIT-V  CONSUMERS ON GM FOODS AND CONTEMPORARY ISSUES:  
Global perspective of consumers on GM foods; Major concerns of transgenic, foods GM ingredients in food products. (labeling, bioavailability, safety aspects); regulatory agencies involved in GM foods, Case studies- GM foods.

TOTAL:45 PERIODS

TEXT BOOK(S):  

REFERENCE BOOKS:  

EXPECTED COURSE OUTCOME:  
1. To be able to understand the nutritional values of the various types of foods
2. To be able to Analyze the role of food in the metabolic activity of the healthy diet
3. To be able to Infer the BMI calculation and stress related diseases.
4. To be able to Elaborate the independent decision on the choice of food to prevent life style disorders and diseases
5. To be able to Assess about the food laws governance
6. To be able to Compare junk, modified and super foods
COURSE OBJECTIVE:

- To impart the knowledge and skills to identify, assess and mitigate the environmental and social impacts of developmental projects

UNIT I  INTRODUCTION

UNIT II  ENVIRONMENTAL ASSESSMENT
Screening and Scoping in EIA – Drafting of Terms of Reference, Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna - Matrices – Networks – Checklist Methods - Mathematical models for Impact prediction – Analysis of alternatives

UNIT III  ENVIRONMENTAL MANAGEMENT PLAN

UNIT IV  SOCIO ECONOMIC ASSESSMENT
Baseline monitoring of Socio economic environment – Identification of Project Affected Personal – Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts – Cost benefit Analysis-

UNIT V  CASE STUDIES

TOTAL: 45 PERIODS

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

CO1: carry out scoping and screening of developmental projects for environmental and social assessments

CO2: explain different methodologies for environmental impact prediction and assessment

CO3: plan environmental impact assessments and environmental management plans

CO4: evaluate environmental impact assessment reports

TEXTBOOKS:

REFERENCES:

OEE351 RENEWABLE ENERGY SYSTEM L T P C 3 0 0 3

COURSE OBJECTIVES:
- To provide knowledge about various renewable energy technologies
- To enable students to understand and design a PV system.
- To provide knowledge about wind energy system.
- To provide knowledge about various possible hybrid energy systems.
- To gain knowledge about application of various renewable energy technologies.

UNIT I INTRODUCTION
Primary energy sources, renewable vs. non-renewable primary energy sources, renewable energy resources in India, Current usage of renewable energy sources in India, future potential of renewable energy in power production and development of renewable energy technologies.

UNIT II SOLAR ENERGY

UNIT III WIND ENERGY
Wind energy principles, wind site and its resource assessment, wind assessment, Factors influencing wind, wind turbine components, wind energy conversion systems (WECS), Classification of WECS devices, wind electric generating and control systems, characteristics and applications.

UNIT IV BIO-ENERGY

UNIT V OTHER TYPES OF ENERGY
Energy conversion from Hydrogen and Fuel cells, Geo thermal energy Resources, types of wells, methods of harnessing the energy, potential in India. OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants and their economics.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course students will be able to:
CO1: Attained knowledge about various renewable energy technologies
CO2: Ability to understand and design a PV system.
CO3: Understand the concept of various wind energy system.
CO4: Gained knowledge about various possible hybrid energy systems
CO5: Attained knowledge about various application of renewable energy technologies

REFERENCES
2. Tiwari and Ghosal/ Narosa, ‘Renewable energy resources’.

CO’s-PO’s & PSO’s MAPPING

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OEI351 INTRODUCTION TO INDUSTRIAL INSTRUMENTATION AND CONTROL
L T P C 3 0 0 3

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

UNIT - I COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -I 9
Unit Operation, Measurement and Control:-Transport of solid, liquid and gases - Evaporators – Crystallizers-Dryers.

UNIT - II COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -II 9
Unit Operation, Measurement and Control: - Distillation – Refrigeration processes – Chemical reactors.
UNIT - III  PROCESS MEASUREMENT AND CONTROL IN PETROCHEMICAL INDUSTRY
Process flow diagram of Petro Chemical Industry - Gas oil separation in production platform – wet gas processing – Fractionation Column – Catalytic Cracking unit – Catalytic reforming unit

UNIT - IV  PROCESS MEASUREMENT AND CONTROL IN THERMAL POWER PLANT INDUSTRY
Process flow diagram of Coal fired thermal Power Plant– Coal pulverizer - Deaerator – Boiler drum - Superheater – Turbines.

UNIT - V  PROCESS MEASUREMENT AND CONTROL IN PAPER & PULP INDUSTRY
Process flow diagram of paper and pulp industry – Batch digestor – Continuous sulphated digestor – Control problems on the paper machine.

TOTAL: 45 PERIODS

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

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

TEXT BOOKS:

REFERENCES:


List of Open Source Software/ Learning website:
5. https://www.cocosimulator.org/
6. https://dwsim.fossee.in/

CO’s-PO’s & PSO’s MAPPING

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OMA351 GRAPH THEORY

COURSE OBJECTIVES
- To understand the graph models and basic concepts of graphs.
- To study the characterization and properties of trees and graph connectivity.
- To provide an exposure to the Eulerian and Hamiltonian graphs.
- To introduce Graph colouring and explain its significance.
- To provide an understanding of Optimization Graph Algorithms.

UNIT I INTRODUCTION TO GRAPHS

UNIT II TREES AND CONNECTIVITY
Bridges – Trees – Characterization and properties of trees – Cut vertices – Connectivity.
UNIT III TRAVERSABILITY

UNIT IV PLANARITY AND COLOURING

UNIT V OPTIMIZATION GRAPH ALGORITHMS

TOTAL: 45 PERIODS

COURSE OUTCOMES
At the end of this course, the student will be able to
CO1: Apply graph models for solving real world problem.
CO2: Understand the importance the natural applications of trees and graph connectivity.
CO3: Understand the characterization study of Eulerian graphs and Hamiltonian graphs.
CO4: Apply the graph colouring concepts in partitioning problems.
CO5: Apply the standard optimization graph algorithms in solving application problems.

TEXT BOOKS

REFERENCES

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CCS355 NEURAL NETWORKS AND DEEP LEARNING L T P C
L T P C

COURSE OBJECTIVES:

- To understand the basics in deep neural networks
- To understand the basics of associative memory and unsupervised learning networks

213
- To apply CNN architectures of deep neural networks
- To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks.
- To apply autoencoders and generative models for suitable applications.

UNIT I INTRODUCTION
Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction-Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.

UNIT II ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS

UNIT III THIRD-GENERATION NEURAL NETWORKS

UNIT IV DEEP FEEDFORWARD NETWORKS

UNIT V RECURRENT NEURAL NETWORKS

LAB EXPERIMENTS:
1. Implement simple vector addition in TensorFlow.
2. Implement a regression model in Keras.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras.
6. Improve the Deep learning model by fine tuning hyper parameters.
7. Implement a Transfer Learning concept in Image Classification.
8. Using a pre trained model on Keras for Transfer Learning
9. Perform Sentiment Analysis using RNN
10. Implement an LSTM based Autoencoder in TensorFlow/Keras.
11. Image generation using GAN
Additional Experiments:
12. Train a Deep learning model to classify a given image using pre trained model
13. Recommendation system from sales data using Deep Learning
14. Implement Object Detection using CNN
15. Implement any simple Reinforcement Algorithm for an NLP problem

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1: Apply Convolution Neural Network for image processing.
CO2: Understand the basics of associative memory and unsupervised learning networks.
CO3: Apply CNN and its variants for suitable applications.
CO4: Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.
CO5: Apply autoencoders and generative models for suitable applications.

TEXT BOOKS:

REFERENCES:
4. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress, 2018

CO’s- PO’s & PSO’s MAPPING

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COURSE OBJECTIVES:
- The primary objective of this module is to examine and explore the role and importance of digital marketing in today's rapidly changing business environment.
- It also focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.

UNIT I  INTRODUCTION TO ONLINE MARKET  6
Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.

UNIT II  SEARCH ENGINE OPTIMISATION  6

UNIT III  E- MAIL MARKETING  6
E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns- Profiling and targeting

UNIT IV  SOCIAL MEDIA MARKETING  6

UNIT V  DIGITAL TRANSFORMATION  6
Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.

30 PERIODS
PRACTICAL EXERCISES: 30 PERIODS
1. Subscribe to a weekly/quarterly newsletter and analyze how its content and structure aid with the branding of the company and how it aids its potential customer segments.
2. Perform keyword search for a skincare hospital website based on search volume and competition using Google keyword planner tool.
3. Demonstrate how to use the Google WebMasters Indexing API
4. Discuss an interesting case study regarding how an insurance company manages leads.
5. Discuss negative and positive impacts and ethical implications of using social media for political advertising.
6. Discuss how Predictive analytics is impacting marketing automation

COURSE OUTCOMES:
CO1: To examine and explore the role and importance of digital marketing in today’s rapidly changing business environment.
CO2: To focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.
CO3: To know the key elements of a digital marketing strategy.
CO4: To study how the effectiveness of a digital marketing campaign can be measured
CO5: To demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.

TOTAL:60 PERIODS

TEXT BOOKS
2. Digital Marketing by Vandana Ahuja; Publisher: Oxford University Press (April 2015); ISBN-10: 0199455449.

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OPEN ELECTIVE II

OIE352 RESOURCE MANAGEMENT TECHNIQUES L T P C

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COURSE OBJECTIVES:
- Learn to formulate linear programming problems and solve LPP using simple algorithm
- Learn to solve networking problems
- Learn to formulate and solve integer programming problems
- Learn to solve Non Linear programming problems
- Learn to understand and solve project management problems

UNIT I LINEAR PROGRAMMING

UNIT II DUALITY AND NETWORKS
UNIT III  INTEGER PROGRAMMING
Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming.

UNIT IV  CLASSICAL OPTIMISATION THEORY:

UNIT V  OBJECT SCHEDULING:
Network diagram representation – Critical path method – Time charts and resource leveling – PERT.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon Completion of the course, the students should be able to:
CO1 : Understand to formulate linear programming problems and solve LPP using simple algorithm
CO2 : Understand to solve networking problems
CO3 : Understand to formulate and solve integer programming problems
CO4 : Understand to solve Non Linear programming problems
CO5 : Understand to understand and solve project management problems

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OMG351 FINTECH REGULATION

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COURSE OBJECTIVES:
1. To learn about Laws and Regulation
2. To acquire the knowledge of Regulations of Fintech firm and their role in Market
UNIT I  INTRODUCTION 9
The Role of the Regulators, Equal Treatment and Competition, Need for a regulatory assessment of Fintech, India Regulations, The Risks to Consider, Regtech and SupTech, The rise of TechFins, Regulatory sandboxes, compliance and whistleblowing.

UNIT II  INNOVATION AND REGULATION 9

UNIT II  CROWDFUNDING AND DIGITAL ASSETS 9

UNIT IV  MARKETPLACE LENDING AND MOBILE PAYMENTS 9

UNIT V  ANTI-MONEY LAUNDERING AND CYBERSECURITY 9
Reporting requirements under the Bank Secrecy Act, Patriot Act, Penalties for violating the BSA, Virtual currencies and the Bank Secrecy Act, Cybersecurity Frameworks, Cybersecurity Act of 2015, Contractual and Self Regulatory obligations.

TOTAL:45 PERIODS

REFERENCES
6. Lee Reiners, FinTech Law and Policy, 2018

OFD351  HOLISTIC NUTRITION  L T P C
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UNIT I  NUTRITION AND HEALTH 9
Introduction to the principles of nutrition; Basics of nutrition including: micronutrients (vitamins and minerals), the energy-yielding nutrients (Carbohydrates, Lipids and Proteins), metabolism, digestion, absorption and energy balance. Lipids: their functions, classification, dietary requirements, digestion & absorption, metabolism and links to the major fatal diseases, heart disease and cancer.
UNIT II  AYURVEDA – MIND/BODY HEALING  9
Philosophy of Holistic Nutrition with spiritual and psychological approaches towards attaining optimal health; Principles and practical applications of Ayurveda, the oldest healing system in the world. Three forces – Vata, Pitta and Kapha, that combine in each being into a distinct constitution. Practical dietary and lifestyle recommendations for different constitutions will also be explored in real case studies.

UNIT III  NUTRITION AND ENVIRONMENT  9
Based on an underlying philosophy that environments maintain and promote health and that individuals have a right to self-determination and self-knowledge, Nutrition principles which promote health and prevent disease. Safety of our food supply, naturally occurring and environmental toxins in foods, microbes and food poisoning.

UNIT IV  COMPARATIVE DIETS  9
Evaluating principles of food dynamics, nutrient proportions, holistic individuality, the law of opposites, food combining, and more. Therapeutic benefits and limitations of several alternative diet approaches, including: modern diets (intermittent fasting, macrobiotics), food combining (colour-therapy/rainbow diet), high protein diets (Ketogenic, Paleo), Vegetarian approaches (plant-based/vegetarian/vegan variations, fruitarian, raw food), as well as cleansing and detoxification diets (caffeine, alcohol, and nicotine detoxes, juice fasts).

UNIT V  PREVENTIVE HEALTH CARE  9
Proper nutrition protection against, reverse and/or retard many ailments including: osteoporosis, diabetes, atherosclerosis and high blood pressure, arthritis, cancer, anemia, kidney disease and colon cancer. Current research developments on phytochemicals, antioxidants and nutraceuticals will be explored.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1 Discuss the role of essential nutrients in physical, mental and emotional wellness
CO2 Discuss the role of deficiencies in essential nutrients in the disease process
CO3 Explain how the standard American diet relates to the disease process
CO4 Identify five contemporary eating “styles” and lists the pros and cons of each
CO5 Discuss the concept of whole foods nutrition and its relationship to wellness

TEXTBOOKS

REFERENCES
1. Modern Nutrition in Health & Disease by Young & Shils.
COURSE OBJECTIVES:

- To introduce the students to areas of agricultural systems in which IT and computers play a major role.
- To also expose the students to IT applications in precision farming, environmental control systems, agricultural systems management and weather prediction models.

UNIT I PRECISION FARMING

Precision agriculture and agricultural management – Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling.

UNIT II ENVIRONMENT CONTROL SYSTEMS

Artificial light systems, management of crop growth in greenhouses, simulation of CO$_2$ consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture.

UNIT III AGRICULTURAL SYSTEMS MANAGEMENT

Agricultural systems - managerial overview, Reliability of agricultural systems, Simulation of crop growth and field operations, Optimizing the use of resources, Linear programming, Project scheduling, Artificial intelligence and decision support systems.

UNIT IV WEATHER PREDICTION MODELS

Importance of climate variability and seasonal forecasting, Understanding and predicting world’s climate system, Global climatic models and their potential for seasonal climate forecasting, General systems approach to applying seasonal climate forecasts.

UNIT V E-GOVERNANCE IN AGRICULTURAL SYSTEMS

Expert systems, decision support systems, Agricultural and biological databases, e-commerce, e-business systems & applications, Technology enhanced learning systems and solutions, e-learning, Rural development and information society.

TOTAL: 45 PERIODS

TEXTBOOKS:

REFERENCES:

COURSE OUTCOME:

CO1: The students shall be able to understand the applications of IT in remote sensing applications such as Drones etc.

CO2: The students will be able to get a clear understanding of how a greenhouse can be automated and its advantages.
**CO3:** The students will be able to apply IT principles and concepts for management of field operations.

**CO4:** The students will get an understanding about weather models, their inputs and applications.

**CO5:** The students will get an understanding of how IT can be used for e-governance in agriculture.

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

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<th>Course Outcome</th>
<th>CO1</th>
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<td>Individual and Team work</td>
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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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1 - low, 2 - medium, 3 - high, ‘-’ - no correlation
COURSE OBJECTIVES:

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

UNIT – I MATHEMATICAL MODELLING
Introduction – transfer function – simple electrical, mechanical, pneumatic, hydraulic and thermal systems—analogies

UNIT -II FEEDBACK CONTROL SYSTEMS
Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios

UNIT - III TIME DOMAIN ANALYSIS
Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.

UNIT - IV STABILITY ANALYSIS
Necessary and sufficient conditions, Routh-Hurwitz criteria of stability, Root locus and Bodet techniques, Concept and construction, frequency response.

UNIT - V STATE SPACE TECHNIQUE
State vectors—state space models—Digital Controllers—design aspects.

TOTAL: 45 PERIODS

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

1. Explore various controllers presently used in industries.
2. Develop control structures for industrial processes.
3. Implement the controllers for various transfer functions of industrial systems.
4. Using software tools for practical exposures to the controllers used in industries by undergoing training.
5. Realisation of various stability criterion techniques for economical operation of process.

COURSE OUTCOMES:

CO1 To represent and develop systems in different forms using the knowledge gained (L5).
CO2 To analyses the system in time and frequency domain (L4).
CO3 Ability to Derive Transfer function Model of Electrical and Mechanical Systems. (L2)
CO4 Ability to Obtain the transfer Function by the Reduction of Block diagram & Signal flow graph (L3)
CO5 To analyses the stability of physical systems(L4).
CO6 To acquire and analyse knowledge in State variable model for MIMO systems(L1)
TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1. https://nptel.ac.in/courses/112107240
2. https://onlinecourses.nptel.ac.in/noc20_me25/preview
3. https://onlinecourses.nptel.ac.in/noc20_ee90/preview

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

OPY351 PHARMACEUTICAL NANOTECHNOLOGY L T P C 3 0 0 3

COURSE OBJECTIVES:
- The goal of this course is to provide an insight into the fundamentals of nanotechnology in biomedical and Pharmaceutical research. It will also guide the students to understand how nanomaterials can be used for a diversity of analytical and medicinal rationales.

UNIT I NANOSTRUCTURES
Preparation, properties and characterization - Self-assembling nanostructure - vesicular and micellar polymerization-nanofilms - Metal Nanoparticles- lipid nanoparticles- nanoemulsion - Molecular nanomaterials: dendrimers, etc.,
UNIT II   NANOTECHNOLOGY IN BIOMEDICAL INDUSTRY  

UNIT III   NANOTECHNOLOGY IN CANCER THERAPY  

UNIT IV   NANOTECHNOLOGY IN COSMETICS  

UNIT V   NANOTOXICITY  
NanoToxicology- introduction, dose relationship- Hazard Classification-Risk assessment and management - factors affecting nano toxicity- Dermal Effects of Nanomaterials, Pulmonary, Neuro and Cardiovascular effects of Nanoparticles - Gene–Cellular and molecular Interactions of Nanomaterials.

TOTAL:45 PERIODS

COURSE OUTCOMES:
The student will be able to

CO1:Identify the process for the preparation and characterization of the different nanostructured materials.

CO2:Apply the nanotechnology in biomedical discipline with related to drug delivery and disease diagnosis

CO3:Develop the process, experiments and apply in identifying in a societal and global context.

CO4:Design and develop the process with suitable equipment for the preparation of nanomaterials in developing cosmetic products.

CO5:Understand the ethical principles to confirm the safety of the nano products with respect to risk assessment and its management.

CO6:Have the knowledge about nanotechnology products and its different applications in a societal and global context.

TEXT BOOKS:

REFERENCES:
CO’s-PO’s & PSO’s MAPPING

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1 - low, 2 - medium, 3 - high, '-' - no correlation
(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.)

OAE351 AVIATION MANAGEMENT L T P C 3 0 0 3

COURSE OBJECTIVES:
- To acquire solid background of managerial skills in aviation management
- To develop personality to face business difficulties.
- To control multicultural conditions.
- To identify the relevant analytical and logical skills to deal with problems in the airline industry.
- To learn the concepts of performing well in teams, professionalism, and the knowledge acquired in the field of airport planning, airport security, passengers forecasting, aerodromes work etc

UNIT I INTRODUCTION
History of aviation – organisation, global, social & ethical environment – history of Aviation in India – major players in the airline industry - swot analysis of the different Airline companies in India – market potential of airline industry in India – new airport Development plans – current challenges in the airline industry - competition in the Airline industry – domestic and international from an Indian perspective

UNIT II AIRPORT INFRASTRUCTURE AND MANAGEMENT
Airport planning – terminal planning design and operation – airport operations – Airport functions – organisation structure in an airline - airport authority of India - Comparison of global and Indian airport management – role of AAI -airline privatisation - full Privatisation - gradual privatisation – partial privatization

UNIT III AIR TRANSPORT SERVICES
Various airport services - international air transport services – Indian scenario – an Overview of airports in Delhi, Mumbai, Hyderabad and Bangalore – the role of private Operators – airport development fees, rates, tariffs
UNIT IV INSTITUTIONAL FRAMEWORK
Role of DGCA - slot allocation – methodology followed by AFC and DGCA -management of Bilaterals – economic regulations

UNIT V CONTROLLING
Role of air traffic control - airspace and navigational aids – control process – case Studies in airline industry – Mumbai Delhi airport privatisation – Navi Mumbai airport Tendering process – 6 cases in the airline industry

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES

COURSE OUTCOMES:
CO1: To interpret business difficulties.
CO2: To Dissect multicultural conditions.
CO3: To identify and apply the relevant analytical and logical skills to deal with problems in the airline industry.
CO4: To Develop well in teams, professionalism etc.
CO5: To apply the knowledge acquired in the field of airport planning, airport security, passengers forecasting, aerodromes work etc.

CCS342 DEVOPS L T P C
2 0 2 3

COURSE OBJECTIVES:
• To introduce DevOps terminology, definition & concepts
• To understand the different Version control tools like Git, Mercurial
• To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
• To understand Configuration management using Ansible
• Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

UNIT I INTRODUCTION TO DEVOPS
Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.
UNIT II  COMPILe AND BUILD USING MAVEN & GRADLE  6  
Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases (compile build, test, package) Maven Profiles, Maven repositories (local, central, global), Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle

UNIT III  CONTINUOUS INTEGRATION USING JENKINS  6  
Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

UNIT IV  CONFIGURATION MANAGEMENT USING ANSIBLE  6  
Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible

UNIT V  BUILDING DEVOPS PIPELINES USING AZURE  6  
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file

COURSE OUTCOMES:
CO1: Understand different actions performed through Version control tools like Git.
CO2: Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
CO3: Ability to Perform Automated Continuous Deployment
CO4: Ability to do configuration management using Ansible
CO5: Understand to leverage Cloud-based DevOps tools using Azure DevOps

PRACTICAL EXERCISES:
1. Create Maven Build pipeline in Azure
2. Run regression tests using Maven Build pipeline in Azure
3. Install Jenkins in Cloud
4. Create CI pipeline using Jenkins
5. Create a CD pipeline in Jenkins and deploy in Cloud
6. Create an Ansible playbook for a simple web application infrastructure
7. Build a simple application using Gradle
8. Install Ansible and configure ansible roles and to write playbooks

TEXT BOOKS

REFERENCES
2. by Mitesh Soni

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

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

CCS361 ROBOTIC PROCESS AUTOMATION L T P C
2 0 2 3

COURSE OBJECTIVES:
- To understand the basic concepts of Robotic Process Automation.
- To expose to the key RPA design and development strategies and methodologies.
- To learn the fundamental RPA logic and structure.
- To explore the Exception Handling, Debugging and Logging operations in RPA.
- To learn to deploy and Maintain the software bot.

UNIT I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 6

UNIT II AUTOMATION PROCESS ACTIVITIES 6
Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events

UNIT III APP INTEGRATION, RECORDING AND SCRAPING 6
App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, Scraping data from website and writing to CSV. Process Mining.
UNIT IV   EXCEPTION HANDLING AND CODE MANAGEMENT

UNIT V   DEPLOYMENT AND MAINTENANCE
Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA

PRACTICAL EXERCISES:
Setup and Configure a RPA tool and understand the user interface of the tool:
1. Create a Sequence to obtain user inputs display them using a message box;
2. Create a Flowchart to navigate to a desired page based on a condition;
3. Create a State Machine workflow to compare user input with a random number.
4. Build a process in the RPA platform using UI Automation Activities.
5. Create an automation process using key System Activities, Variables and Arguments
6. Also implement Automation using System Trigger
7. Automate login to (web)Email account
8. Recording mouse and keyboard actions.
9. Scraping data from website and writing to CSV
10. Implement Error Handling in RPA platform
11. Web Scraping
12. Email Query Processing

TOTAL:60 PERIODS

TEXT BOOKS:

REFERENCES:
1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018

CO’s- PO’s & PSO’s MAPPING

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1 - low, 2 - medium, 3 - high, '-' - no correlation
OPEN ELECTIVE III

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

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

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

UNIT I 9

UNIT II 9

UNIT III 9

UNIT IV 9

UNIT V 9
Listening and Speaking – Contextual listening – Listening to instructions – Listening for specific information – Identifying detail, main ideas – Following signpost words – Stress, rhythm and intonation - Speaking to respond and elicit ideas – Guided speaking – Opening phrases – Interactive communication – Dysfluency -Sentence stress – Speaking on a topic – Giving opinions

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

**CO’s-PO’s & PSO’s MAPPING**

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

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

**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/
OMG352          NGOS AND SUSTAINABLE DEVELOPMENT          L T P C
                          3 0 0 3

COURSE OBJECTIVES

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

Unit I   ENVIRONMENTAL CONCERNS    9
Introduction to sustainable development goals, Global responsibility of environmental concern, Importance of environmental preservation, Environmental threats, Pollution and its types, Effects of Pollution, Pollution control, Treatment of wastes

UNIT II   ROLE OF NGOS    9
Role of NGO’s in national development, NGO’s and participatory management, Challenges and limitations of NGO’s, Community Development programmes, Role of NGO’s in Community Development programmes, Participation of NGO’s in environment management, Corporate Social responsibility, NGO’s and corporate social responsibility

UNIT III   SUSTAINABLE DEVELOPMENT    9
Issues and Challenges of Sustainable Development, Bioenergy, Sustainable Livelihoods and Rural Poor in Sustainable Development, Protecting ecosystem services for sustainable development, Non-renewable sources of energy and its effect, Renewable sources of energy for sustainability, Nuclear resources and Legal Regulation of Hazardous Substances, Sustainable Development: Programme and Policies, Sustainability assessment and Indicators

UNIT IV   NGO’S FOR SUSTAINABILITY    9
Civil Society Initiatives in Environment Management, Civil Society Initiatives for Sustainable Development, Global Initiatives in Protecting Global Environment, World Summit on Sustainable Development (Johannesburg Summit 2002), Ecological economics, Environmental sustainability, Social inclusion, Health for all, education for all, Food security and Water security, NGOs and Sustainable Development strategies

UNIT V   LEGAL FRAMEWORKS    9
Need for a Legal framework and its enforcement, Legal measures to control pollution, Environmental Legislations in India, Mechanism to implement Environmental Laws in India, Legal Protection of Forests Act 1927, Legal Protection of Wild Life, Role of NGO’s in implementing environmental laws, Challenges in the implementation of environmental legislation

TOTAL 45 : PERIODS

COURSE OUTCOMES

Upon completion of this course, the student will:

CO1 Have a thorough grounding on the issues and challenges being faced in attaining sustainable development
CO2 have a knowledge on the role of NGOs towards sustainable development
CO3 present strategies for NGOs in attaining sustainable development
CO4 recognize the importance of providing energy, food security and health equity to all members of the society without damaging the environment
CO5 understand the environmental legislations
REFERENCE BOOKS

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

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

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

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

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

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

TOTAL 45 : PERIODS

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

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

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

UNIT – II SOLAR ENERGY

UNIT – III WIND ENERGY

UNIT – IV BIO-ENERGY

UNIT – V OCEAN AND GEOTHERMAL ENERGY

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

CO’S-PO’S & PSO’S MAPPING

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

OME354

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

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

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

UNIT III
APPLIED DESIGN THINKING TOOLS
Concept of Minimum Usable Prototype [MUP] - MUP challenge brief - Designing & Crafting the value proposition - Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design
UNIT IV  CONCEPT GENERATION
Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts

UNIT V  SYSTEM THINKING
System Thinking, Understanding Systems, Examples and Understandings, Complex Systems
TOTAL: 45 PERIODS

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

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

REFERENCES
1. https://www.ideou.com/pages/design-thinking#process
4. https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e
6. https://blog.forgeforward.in/star-tup-failure-is-like-true-lie-7812cdfe9b85

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

UNIT II  MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION  9 Hours

UNIT III  DATA PROCESSING  9 Hours

UNIT IV  3D SCANNING AND MODELLING  9 Hours

UNIT V  INDUSTRIAL APPLICATIONS  9 Hours

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Apply the fundamental concepts and principles of reverse engineering in product design and development.
CO2: Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
CO3: Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.
CO4: Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
CO5: Analyze the various legal aspect
CO6: Applications of reverse engineering in product design and development.

TEXT BOOKS:

REFERENCES:

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OPR351 SUSTAINABLE MANUFACTURING  L T P C  3 0 0 3

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

UNIT – I ECONOMIC SUSTAINABILITY  9

UNIT – II SOCIAL AND ENVIRONMENTAL SUSTAINABILITY  9
Social sustainability – Introduction-Work management -Human rights - Societal commitment - Customers -Business practices -Modelling and assessing social sustainability. Environmental issues pertaining to the manufacturing sector: Pollution - Use of resources -Pressure to reduce costs - Environmental management: Processes that minimize negative environmental impacts - environmental legislation and energy costs - need to reduce the carbon footprint of manufacturing Operations-Modelling and assessing environmental sustainability

UNIT – III SUSTAINABILITY PRACTICES  9
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  9
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  9

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:

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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  9

UNIT III  MOTORS AND DRIVES  9
Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT IV  POWER CONVERTERS AND CONTROLLERS  9
Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes

UNIT V  HYBRID AND ELECTRIC VEHICLES  9
Main components and working principles of a hybrid and electric vehicles. Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

TOTAL: 45 PERIODS

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

TEXT BOOKS:

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

CO’s-PO’s & PSO’s MAPPING

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

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

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

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

UNIT IV  AIRCRAFT STABILITY AND STRUCTURAL THEORY  10

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

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

UNIT I  INTRODUCTION

UNIT II  FUNCTIONS OF MANAGEMENT

UNIT III  ORGANIZATIONAL BEHAVIOUR

UNIT IV  GROUPDYNAMICS

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

TOTAL: 45 PERIODS
COURSE OUTCOMES:
CO1: Understand the basic concepts of industrial management
CO2: Identify the group conflicts and its causes.
CO3: Perform swot analysis
CO4: Analyze the learning curves
CO5: Understand the placement and performance appraisal

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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OIE354 QUALITY ENGINEERING

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

UNIT I INTRODUCTION

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

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

UNIT IV STATISTICAL PROCESS CONTROL
Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.
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  L T P C
3 0 0 3

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

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

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

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

UNIT IV  FIRE SEVERITY AND REPAIR TECHNIQUES

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

UNIT V  WORKING AT HEIGHTS


TOTAL : 45 PERIODS

COURSE OUTCOMES

On completion of the course the student will be able to

CO1: Understand the effect of fire on materials used for construction

CO2: Understand the method of test for non-combustibility and fire resistance; and will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.

CO3: To understand the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.

CO4: To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.

CO5: Describe the safety techniques and improve the analytical and intelligence to take the right decision at right time.

TEXT BOOKS


REFERENCES:


### CO’s- PO’s & PSO’s MAPPING

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<th>CO’s</th>
<th>PO’s</th>
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1 - low, 2 - medium, 3 - high, '-' - no correlation

### OML351 INTRODUCTION TO NON-DESTRUCTIVE TESTING

**L T P C**

3 0 0 3

### COURSE OBJECTIVES:

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

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

### UNIT I INTRODUCTION TO NDT & VISUAL TESTING

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

### UNIT II LIQUID PENETRANT & MAGNETIC PARTICLE TESTING

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

### UNIT III EDDY CURRENT TESTING & THERMOGRAPHY


### UNIT IV ULTRASONIC TESTING & AET

Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of

UNIT V RADIOPHGRAPHY 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.

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

TEXT BOOKS:

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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1 - low, 2 - medium, 3 - high, '-' - no correlation
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.
CO4: Apply PLC as a controller in mechatronics system.
CO5: Design and develop the apt mechatronics system for an application.

TOTAL: 45 PERIODS
CO’s-PO’s & PSO’s MAPPING

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<th>COs/POs &amp; PSOs</th>
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TEXT BOOKS

REFERENCES

ORA351 FOUNDATION OF ROBOTICS

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

UNIT – I FUNDAMENTALS OF ROBOT

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

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

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

TOTAL : 45 PERIODS

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

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<th>CO’s-PO’s &amp; PSO’s MAPPING</th>
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TEXT BOOKS:

REFERENCES:

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

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

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

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

UNIT III BASICS OF AERODYNAMICS 9

UNIT IV BASICS OF AIRCRAFT STRUCTURES 9

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

TOTAL : 45 PERIODS
COURSE OUTCOMES:
CO1: Illustrate the history of aircraft & developments over the years
CO2: Ability to identify the types & classifications of components and control systems
CO3: Explain the basic concepts of flight & Physical properties of Atmosphere
CO4: Identify the types of fuselage and constructions.
CO5: Distinguish the types of Engines and explain the principles of Rocket

TEXT BOOKS

REFERENCE

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

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

UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION 9

UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL 9

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

UNIT IV SENSING TECHNIQUES 9
Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal
sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV – Orbital and sensor characteristics of live Indian earth observation satellites

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

TOTAL:45 PERIODS

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

TEXTBOOKS:

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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<td>Conduct Investigations of Complex Problems</td>
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<td>Project Management and Finance</td>
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OA351 URBAN AGRICULTURE

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

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

UNIT II VERTICAL FARMING

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

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Demonstrate the principles behind crop production and various parameters that influences the crop growth on roof tops
CO2: Explain different methods of crop production on roof tops
CO3: Explain nutrient and pest management for crop production on roof tops
CO4: Illustrate crop water requirement and irrigation water management on roof tops
CO5: Explain the concept of waste management on roof tops

TEXT BOOKS:
REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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| PSO1 To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill | 1   | 2   | 1   | 1   | 2   | 1                                 |
| PSO2 To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies. | 2   | 1   | 2   | 1   | 1   | 1                                 |
| PSO3 To inculcate entrepreneurial skills through strong Industry-Institution linkage. | 1   | 2   | 1   | 2   | 1   | 2                                 |

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

OEN351 DRINKING WATER SUPPLY AND TREATMENT L T P C

COURSE OBJECTIVE:
- To equip the students with the principles and design of water treatment units and distribution system.
UNIT I SOURCES OF WATER


UNIT II CONVEYANCE FROM THE SOURCE


UNIT III WATER TREATMENT

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

UNIT IV ADVANCED WATER TREATMENT


UNIT V WATER DISTRIBUTION AND SUPPLY


TOTAL: 45 PERIODS

COURSE OUTCOMES

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

TEXTBOOKS:

REFERENCES:
CO’s- PO’s & PSO’s MAPPING

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

OEE352 ELECTRIC VEHICLE TECHNOLOGY L T P C
3 0 0 3

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

UNIT I ROTATING POWER CONVERTERS

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

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

UNIT IV HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS
UNIT V MECHANICS OF HYBRID ELECTRIC VEHICLES AND CONTROL OF VEHICLES

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

COURSE OUTCOMES:

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

CO’s-PO’s & PSO’s MAPPING

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

REFERENCES:


OEI353 INTRODUCTION TO PLC PROGRAMMING

COURSE OBJECTIVES:

- Understand basic PLC terminologies digital principles, PLC architecture and operation.
- Familiarize different programming language of PLC.
- Develop PLC logic for simple applications using ladder logic.
- Understand the hardware and software behind PLC and SCADA.
- Exposures about communication architecture of PLC/SCADA.
UNIT I  INTRODUCTION TO PLC  9
Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers/DSP, PLC/DDC- PLC Construction: What is a PLC, PLC Memories, PLC I/O, , PLC Special I/O, PLC Types.

UNIT II  PLC INSTRUCTIONS  9
PLC Basic Instructions: PLC Ladder Language- Function block Programming- Ladder/Function Block functions- PLC Basic Instructions, Basic Examples (Start Stop Rung, Entry/Reset Rung)- Configuration of Sensors, Switches, Solid State Relays- Interlock examples- Timers, Counters, Examples.

UNIT III  PLC PROGRAMMING  9
Different types of PLC program, Basic Ladder logic, logic functions, PLC module addressing, registers basics, basic relay instructions, Latching Relays, arithmetic functions, comparison functions, data handling, data move functions, timer-counter instructions, input-output instructions, sequencer instructions

UNIT IV  COMMUNICATION OF PLC AND SCADA  9
Communication Protocol – Modbus, HART, Profibus- Communication facilities SCADA: - Hardware and software, Remote terminal units, Master Station and Communication architectures

UNIT V  CASE STUDIES  9
Stepper Motor Control- Elevator Control-CNC Machine Control- conveyor control-Interlocking Problems

TOTAL:45 PERIODS

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

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

TEXT BOOKS:
1. Frank 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

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

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

OCH351 NANO TECHNOLOGY

UNIT I INTRODUCTION 8
General definition and size effects–important nano structured materials and nano particles- importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials – Ionic properties of nanomaterials- Nano catalysis.

UNIT II SYNTHESIS OF NANOMATERIALS 8
Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.

UNIT III NANO COMPOSITES 10
Definition- importance of nanocomposites- nano composite materials-classification of composites- metal/metal oxides, metal-polymer- thermoplastic based, thermostet based and elastomer based- influence of size, shape and role of interface in composites applications.

UNIT IV NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES 10
Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice-clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.
UNIT V APPLICATIONS OF NANO MATERIALS

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

TOTAL : 45 PERIODS

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

TEXT BOOKS

REFERENCES

CO’s-PO’s & PSO’s MAPPING

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interference the different characterization techniques for nanomaterials

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

OCH352 FUNCTIONAL MATERIALS L T P C 3 0 0 3

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

UNIT I INTRODUCTION 9

UNIT II MOLECULAR SELF ASSEMBLY 9

UNIT III BIO-INSPIRED MATERIALS 9

UNIT IV SMART OR INTELLIGENT MATERIALS 9
Criteria for Smartness, Significance of Smart Materials, Representative Examples like Smart Gels and Polymers, Electro/Magneto Rheological Fluids, Smart Electroceramics, Technical Limitations and Challenges, Functional Nanocomposites, Polymer-carbon nanotube composites.

UNIT V MATERIALS FOR POLYMER ELECTRONICS 9
Polymers for Electronics, Organic Light Emitting Diodes, Working Principle of OLEDs, Illustrated Examples, Organic Field-Effect Transistors Operating Principle, Design Considerations, Polymer FETs vs Inorganic FETs, Liquid Crystal Displays, Engineering Aspects of Flat Panel Displays, Intelligent Polymers for Data Storage, Polymer-based Data Storage-Principle, Magnetic Vs. Polymer-based Data Storage.

TOTAL: 45 PERIODS
COURSE OUTCOME:
- Students will be able to differentiate among various functional properties and select appropriate material for certain functional applications, analyze the nature and potential of functional material.

TEXT BOOK:

REFERENCE:

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

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

UNIT II TRADITIONAL METHODS OF FOOD PROCESSING

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

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

OFD353 INTRODUCTION TO FOOD PROCESSING L T P C 3 0 0 3

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

UNIT I PROCESSING OF FOOD AND ITS IMPORTANCE 9
Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.

UNIT II METHODS OF FOOD HANDLING AND STORAGE 9
Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.

UNIT III LARGE-SCALE FOOD PROCESSING 12
Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods.

UNIT IV FOOD WASTES IN VARIOUS PROCESSES 6
Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment.
UNIT V FOOD HYGIENE

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course the students are expected to
CO1 Be aware of the different methods applied to processing foods.
CO2 Be able to understand the significance of food processing and the role of food and beverage industries in the supply of foods.

TEXT BOOKS/REFERENCES:

OPY352 IPR FOR PHARMA INDUSTRY L T P C 3 0 0 3

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

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

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

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


UNIT V INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY


TOTAL:45 PERIODS

TEXT BOOKS:

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

COURSE OUTCOME
The student will be able to

CO1 Understand and differentiate the categories of intellectual property rights.
CO2 Describe about patents and procedure for obtaining patents.
CO3 Distinguish plant variety, traditional knowledge and geographical indications under IPR.
CO4 Provide the information about the different enforcements and practical aspects involved in protection of IPR.
CO5 Provide different organizations role and responsibilities in the protection of IPR in the international level.
CO6 Understand the interrelationships between different Intellectual Property Rights on International Society

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1 - low, 2 - medium, 3 - high, '-' - no correlation
COURSE OBJECTIVE:
- To enable the students to understand the basics and different types of finishes required for textile materials and machines used for finishing.

UNIT I RESIN FINISHING

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

UNIT III SOIL RELEASE AND ANTISTATIC FINISHES

UNIT IV MECHANICAL FINISHES

UNIT V STIFFENING AND SOFTENING
Concept of stiffening and softening of textile materials. Mechanism in the weight reduction of PET. Concept of Micro encapsulation techniques in finishing process, Nano finish, Plasma Treatment and Bio finishing.

COURSE OUTCOMES:
Upon completion of the course, the students will be able to Understand the
- CO: 2 Concept of Flame proof & flame retardancy, waterproof and water repellent, Antimicrobial finishes.
- CO: 3 Concept of Soil Release, Anti Pilling, UV Protection and Antistatic finishes.
- CO: 4 Concept of Mechanical finishing.
- CO: 5 Basics of Micro encapsulation techniques, Nano finish, Plasma Treatment.

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
1. Microencapsulation in finishing, Review of progress of Colouration, SDC, 2001 62
OTT352 INDUSTRIAL ENGINEERING FOR GARMENT INDUSTRY

COURSE OBJECTIVES:
- To enable the students to learn about basics of industrial engineering and different tools of industrial engineering and its application in apparel industry

UNIT I INTRODUCTION 9
Scope of industrial engineering in apparel industry, role of industrial engineers.
Productivity: Definition - Productivity, Productivity measures. Reduction of work content due to the product and process, Reduction of ineffective time due to the management, due to the worker. Causes for low productivity in apparel industry and measures for improvement.

UNIT II WORK STUDY 9
Definition, Purpose, Basic procedure and techniques of work-study.
Work environment – Lighting, Ventilation, Climatic condition on productivity.
Temperature control, humidity control, noise control measures. Safety and ergonomics on work station and work environment.
Material Handling – Objectives, Classification and characteristics of material handling equipments, Specialized material handling equipments.

UNIT III METHOD STUDY 9
Definition, Objectives, Procedure, Process charts and symbols. Various charts – Charts indicating process sequence: Outline process chart, flow process chart (man type, material type and equipment type); Charts using time scale – multiple activity chart. Diagrams indicating movement – flow diagram, string diagram, cycle graph, chrono cycle graph, travel chart.
MOTION STUDY: Principle of motion economy, Two handed process chart, micro motion analysis – therbligs, SIMO chart.

UNIT IV WORK MEASUREMENT 9
Definition, purpose, procedure, equipments, techniques. Time study - Definition, basics of time study- equipments. Time study forms, Stop watch procedure. Predetermined motion time standards (PMTS). Time Study rating, calculation of standard time, Performance rating – relaxation and other allowances. Calculation of SAM for different garments, GSD.

UNIT V WORK STUDY APPLICATION 9
Application of work study techniques in cutting, stitching and packing in garment industry. Workaids in sewing, Pitch diagram, Line balancing, Capacity planning, scientific method of training.

TOTAL: 45 PERIODS

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

TEXTBOOKS:

REFERENCES

CO’s-PO’s & PSO’s MAPPING

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

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

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

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

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

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

UNIT V  BASICS OF KNITTING AND NONWOVEN

TOTAL : 45 PERIODS

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

TEXTBOOKS

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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OPE351 INTRODUCTION TO PETROLEUM REFINING AND PETROCHEMICALS

COURSE OBJECTIVE:
The course is aimed to
Gain knowledge about petroleum refining process and production of petrochemical products.

UNIT I ORIGIN, FORMATION AND REFINING OF CRUDE OIL
UNIT II  CRACKING  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.

COURSE OUTCOMES:
On the completion of the course students are expected to
CO1: Understand the classification, composition and testing methods of crude petroleum and its products. Learn the mechanism of refining process.
CO2: Understand the insights of primary treatment processes to produce the precursors.
CO3: Study the secondary treatment processes cracking, vis-breaking and coking to produce more petroleum products.
CO4: Appreciate the need of treatment techniques for the removal of sulphur and other impurities from petroleum products.
CO5: Understand the societal impact of petrochemicals and learn their manufacturing processes.
CO6: Learn the importance of optimization of process parameters for the high yield of petroleum products.

TEXT BOOKS

REFERENCES

CPE334  ENERGY CONSERVATION AND MANAGEMENT  L T P C  3 0 0 3

COURSE OBJECTIVES:
At the end of the course, the student is expected to
- understand and analyse the energy data of industries
- carryout energy accounting and balancing
• conduct energy audit and suggest methodologies for energy savings and
• utilise the available resources in optimal ways

UNIT I INTRODUCTION
9

UNIT II ELECTRICAL SYSTEMS
9

UNIT III THERMAL SYSTEMS
9

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students can able to analyze the energy data of industries.
CO1: Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.
CO2: Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.
CO3: Skills on combustion thermodynamics and kinetics.
CO4: Apply calculation and design tube still heaters.
CO5: Studied different heat treatment furnace.
CO6: Practical and theoretical knowledge burner design.

TEXT BOOKS:

REFERENCES:
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

Injection molding – Principles and processing outline, machinery, accessories and functions, specifications, process variables, mould cycle. Types of clamping: hydraulic and toggle mechanisms. Start-up and shut down procedures-Cylinder nozzles- Press capacity projected area-Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables. Basic mould types. Reciprocating vs. plunger type injection moulding. Thermoplastic vs. thermosetting injection moulding. Injection moulding vs. other plastic processing techniques. State-of-the art injection moulding techniques - Introduction to trouble shooting

UNIT IV COMPRESSION AND TRANSFER MOLDING

Compression moulding – Basic principles of compression and transfer moulding-Meaning of terms- Bulk factor and flow properties, moulding materials, process variables and process cycle, Inter relation between flow properties-Curing time-Mould temperature and Pressure requirements. Preforms and preheating- Techniques of preheating. Machines used-Types of compression mould-positive, semi-positive and flash. Common moulding faults and their correction- Finishing of mouldings. Transfer moulding: working principle, equipment, Press capacity-Integral moulds and auxiliary ram moulds, moulding cycle, moulding tolerances, pot transfer, plunger transfer and screw transfer moulding techniques, advantages over compression moulding
UNIT V BLOW MOLDING, THERMOFORMING AND CASTING


TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Ability to find out the correlation between various processing techniques with product properties.

CO2: Understand the major plastics processing techniques used in moulding (injection, blow, compression, and transfer), extrusion, thermoforming, and casting.

CO3: Acquire knowledge on additives for plastic compounding and methods employed for the same

CO4: Familiarize with the machinery and ancillary equipment associated with various plastic processing techniques.

CO5: Select an appropriate processing technique for the production of a plastic product

REFERENCES


CBM348 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT

COURSE OBJECTIVES:

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

276
UNIT I  BASICS OF PRODUCT DEVELOPMENT  

UNIT II  REQUIREMENTS AND SYSTEM DESIGN  

UNIT III  DESIGN AND TESTING  

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

UNIT V  BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY  

TOTAL: 45 PERIODS

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

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

CO’s-PO’s & PSO’s MAPPING

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

CBM333  ASSISTIVE TECHNOLOGY  L T P C
3 0 0 3

COURSE OBJECTIVES:
The student should be made to:
- To know the hardware requirement various assistive devices
- To understand the prosthetic and orthotic devices
- To know the developments in assistive technology

UNIT I  CARDIAC ASSIST DEVICES  9
Cardiac functions and parameters, principle of External counter pulsation techniques, intra aortic balloon pump, Auxiliary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, cardiac pacemaker.

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

UNIT III  HEARING AIDS  9
Anatomy of ear, Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT IV  PROSTHETIC AND ORTHODIC DEVICES  9
Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices.

UNIT V  RECENT TRENDS  9
Transcutaneous electrical nerve stimulator, bio-feedback, assistive devices in drug delivery
COURSE OUTCOMES:
On successful completion of this course, the student will be able to

CO1: Interpret the various mechanical techniques that will help in assisting the heart functions.

CO2: Describe the underlying principles of hemodialyzer machine.

CO3: Indicate the methodologies to assess the hearing loss.

CO4: Evaluate the types of assistive devices for mobilization.

CO5: Explain about TENS and biofeedback system.

TEXT BOOKS

REFERENCES
4. Cardiac Assist Devices, Daniel Goldstein (Editor), Mehmet Oz (Editor), Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1

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

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OMA352 OPERATIONS RESEARCH

COURSE OBJECTIVES:
This course will help the students to

- determine the optimum solution for Linear programming problems.
- study the Transportation and assignment models and various techniques to solve them.
- acquire the knowledge of optimality, formulation and computation of integer programming problems.
- acquire the knowledge of optimality, formulation and computation of dynamic programming problems.
- determine the optimum solution for non-linear programming problems.
UNIT I  LINEAR PROGRAMMING

UNIT II  TRANSPORTATION AND ASSIGNMENT PROBLEMS

UNIT III  INTEGER PROGRAMMING

UNIT IV  DYNAMIC PROGRAMMING PROBLEMS

UNIT V  NON - LINEAR PROGRAMMING PROBLEMS

TOTAL:45 PERIODS

COURSE OUTCOMES :
At the end of the course, students will be able to
CO1: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.
CO2:analyze the concept of developing, formulating, modeling and solving transportation and assignment problems.
CO3:solve the integer programming problems using various methods.
CO4:conceptualize the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming.
CO5:determine the optimum solution for non linear programming problems.

TEXT BOOKS:

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OMA353 ALGEBRA AND NUMBER THEORY  L T P C

3 0 0 3

COURSE OBJECTIVES:
- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To examine the key questions in the Theory of Numbers.
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

UNIT I GROUPS AND RINGS
Groups: Definition - Properties - Homomorphism - Isomorphism - Cyclic groups - Cosets - Lagrange's theorem.
Rings: Definition - Sub rings - Integral domain - Field - Integer modulo n - Ring homomorphism.

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

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

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
CO2: Demonstrate accurate and efficient use of advanced algebraic techniques.
CO3: The students should be able to demonstrate their mastery by solving non-trivial problems related to the concepts, and by proving simple theorems about the, statements proven by the text
TEXT BOOKS:

REFERENCES:

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OMA354 LINEAR ALGEBRA

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

UNIT I MATRICES AND SYSTEM OF LINEAR EQUATIONS

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

UNIT III LINEAR TRANSFORMATION
Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem– Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation – Diagonalization.
UNIT IV INNER PRODUCT SPACES
Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation.

UNIT V EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION

TOTAL: 45 PERIODS

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

TEXT BOOKS

REFERENCES

CO’s-PO’s & PSO’s MAPPING

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1 - low, 2 - medium, 3 - high, '-' - no correlation
COURSE OBJECTIVE:
• To impart knowledge about the basics of lean principles, tools and techniques, and implementation in the construction industry.

UNIT I INTRODUCTION 9
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 9
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 9
Concepts in lean thinking - Principles of lean construction - Variability and its impact - Traditional construction and lean construction - Traditional project delivery - Lean construction and workflow reliability - Work structuring - Production control.

UNIT IV LEAN TOOLS AND TECHNIQUES 9

UNIT V LEAN IMPLEMENTATION IN CONSTRUCTION INDUSTRY 9
Lean construction implementation - Enabling lean through information technology - Lean in design - Design Structure - BIM (Building Information Modelling) - IPD (Integrated Project Delivery) - Sustainability through lean construction approach.

TOTAL : 45 PERIODS

COURSE 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:

OBT352 BASICS OF MICROBIAL TECHNOLOGY

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

UNIT I  BASICS OF MICROBES AND ITS TYPES
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
CO1: Microbes and their types
CO2: Cultivation of microbes
CO3: Pathogens and control measures for safety
CO4: Microbes in different industry for economy.

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

UNIT I CARBOHYDRATES
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

COURSE OUTCOMES:
CO1: Students will learn about various kinds of biomolecules and their physiological role.
CO2: Students will gain knowledge about various metabolic disorders and will help them to know the importance of various biomolecules in terms of disease correlation.

TOTAL: 45 PERIODS

TEXT BOOKS

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

COURSE OBJECTIVES:

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

UNIT I   INTRODUCTION TO CELL

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 reticulum, 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 meosis, Comparison 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

COURSE OUTCOMES:

CO1: Understanding of cell at structural and functional level.

CO2: Understand the central dogma of life and its significance.

CO3: Comprehend the basic mechanisms of cell division.

TEXTBOOKS:

REFERENCES:

OPEN ELECTIVE IV

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

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

UNIT I

UNIT II

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

UNIT IV

UNIT V

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

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

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

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

**REFERENCES**


**OMA355 ADVANCED NUMERICAL METHODS**

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**COURSE 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


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

TEXT BOOKS:

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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COURSE OBJECTIVES:
- To introduce the basic concepts of probability, one and two dimensional random variables with applications to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in communication networks.
- To acquaint with specialized random processes which are apt for modelling the real time scenario.
- To understand the concept of correlation and spectral densities.
- To understand the significance of linear systems with random inputs.

UNIT I RANDOM VARIABLES

UNIT II RANDOM PROCESSES

UNIT III SPECIAL RANDOM PROCESSES

UNIT IV CORRELATION AND SPECTRAL DENSITIES

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

TOTAL: 45 PERIODS

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

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

TEXT BOOKS
REFERENCES

COURSE OBJECTIVES:

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the concept of queueing models and apply in engineering.
- To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.
- To study the system reliability and hazard function for series and parallel systems.
- To implement Markovian Techniques for availability and maintainability which opens up new avenues for research.

UNIT I RANDOM PROCESSES

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

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

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

TOTAL: 45 PERIODS

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

CO1: Enable the students to apply the concept of random processes in engineering disciplines.

CO2: Students acquire skills in analyzing various queueing models.

CO3: Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.

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

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

TEXT BOOKS


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OMG354 PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS

COURSE OBJECTIVES:

- To know the basic concept and function of Production and Operation Management for entrepreneurship.
- To understand the Production process and planning.
- To understand the Production and Operations Management Control for business owners.

UNIT I INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT 9
Functions of Production Management - Relationship between production and other functions – Production management and operations management, Characteristics of modern production and operation management, organisation of production function, recent trends in production/operations management - production as an organisational function, decision making in production Operations research

UNIT II PRODUCTION & OPERATION SYSTEMS 9
Production Systems- principles - Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning- Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry

UNIT III PRODUCTION & OPERATIONS PLANNING 9
Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of production process systems – Steps for production process- Production Planning Control Functions – Planning phase- Action phase- Control phase - Aggregate production planning

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS 9

UNIT V CONTROLLING PRODUCTION & OPERATIONS MANAGEMENT 9

COURSE OUTCOMES:
Upon completion of this course the learners will be able:

CO 1 To understand the basics and functions of Production and Operation Management for business owners.
CO 2 To learn about the Production & Operation Systems.
CO 3 To acquaint on the Production & Operations Planning Techniques followed by entrepreneurs in Industries.

TOTAL 45 : PERIODS
CO 4 To known about the Production & Operations Management Processes in organisations.
CO 5 To comprehend the techniques of controlling , Production and Operations in industries.

REFERENCES

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

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

UNIT I INTRODUCTION 9
Uni-variate, Bi-variate and Multi-variate techniques – Classification of multivariate techniques –
Guidelines for multivariate analysis and interpretation.

UNIT II PREPARING FOR MULTIVARIATE ANALYSIS 9
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 9
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 9
Confirmatory Factor Analysis, Structural equation modelling, Mediation models, Moderation
models, Longitudinal studies.

UNIT V ADVANCED MULTIVARIATE TECHNIQUES 9
Multiple Discriminant Analysis, Logistic Regression, Cluster Analysis, Conjoint Analysis,
multidimensional scaling.

TOTAL: 45 PERIODS

COURSE OUTCOMES :
CO1: Demonstrate a sophisticated understanding of the concepts and methods; know the exact
scopes and possible limitations of each method; and show capability of using multivariate
techniques to provide constructive guidance in decision making.
CO2: Use advanced techniques to conduct thorough and insightful analysis, and interpret the
results correctly with detailed and useful information.
CO3: Show substantial understanding of the real problems; conduct deep analysis using correct
methods; and draw reasonable conclusions with sufficient explanation and elaboration.
CO4: Write an insightful and well-organized report for a real-world case study, including thoughtful
and convincing details.
CO5: Make better business decisions by using advanced techniques in data analytics.

REFERENCES:

OME352 ADDITIVE MANUFACTURING  L(838,520),(862,532)(864,520),(889,532)(900,520),(932,532)(934,520),(958,532) T  P  C
3 0 0 3

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

UNIT I INTRODUCTION

UNIT II VAT POLYMERIZATION AND MATERIAL EXTRUSION

UNIT III POWDER BED FUSION AND BINDER JETTING

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:

COURSE OBJECTIVES
- To introduce the fundamental concepts of the new product development
- To develop material specifications, analysis and process.
- To Learn the Feasibility Studies & reporting of new product development.
- To study the New product qualification and Market Survey on similar products of new product development
- To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model
UNIT I  FUNDAMENTALS OF NPD


UNIT II  MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS

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

UNIT III  ESSENTIALS OF NPD


UNIT IV  CRITERIONS OF NPD

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

UNIT V  REPORTING & FORWARD-THINKING OF NPD

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

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Discuss fundamental concepts and customer specific requirements of the New Product development
CO2: Discuss the Material specification standards, analysis and fabrication, manufacturing process.
CO3: Develop Feasibility Studies & reporting of New Product development
CO4: Analyzing the New product qualification and Market Survey on similar products of new product development
CO5: 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

CO’s-PO’s & PSO’s MAPPING

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

COURSE OBJECTIVES:
The course aims to
- Outline Fundamental concepts in UI & UX
- Introduce the principles of Design and Building an mobile app
- Illustrate the use of CAD in product design
- Outline the choice and use of prototyping tools
- Understanding design of electronic circuits and fabrication of electronic devices

UNIT I UI/UX 9

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

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

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:

CO1: Create quick UI/UX prototypes for customer needs

CO2: Develop web application to test product traction / product feature

CO3: Develop 3D models for prototyping various product ideas

CO4: Built prototypes using Tools and Techniques in a quick iterative methodology

TEXT BOOKS

REFERENCES

MF3010  MICRO AND PRECISION ENGINEERING

COURSE OBJECTIVES:
At the end of this course the student should be able to
- Learn about the precision machine tools
- Learn about the macro and micro components.
- Understand handling and operating of the precision machine tools.
- Learn to work with miniature models of existing machine tools/robots and other instruments.
- Learn metrology for micro system

UNIT I  INTRODUCTION TO MICROSYSTEMS

Design, and material selection, micro-actuators: hydraulic, pneumatic, electrostatic/ magnetic etc. for medical to general purpose applications. Micro-sensors based on Thermal, mechanical, electrical properties; micro-sensors for measurement of pressure, flow, temperature, inertia, force, acceleration, torque, vibration, and monitoring of manufacturing systems.

UNIT II  FABRICATION PROCESSES FOR MICRO-SYSTEMS:
Additive, subtractive, forming process, microsystems-Micro-pumps, micro-turbines, micro engines, micro-robot, and miniature biomedical devices
UNIT III  INTRODUCTION TO PRECISION ENGINEERING  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.

COURSE OUTCOMES:
Upon the completion of this course the students will be able to
CO1: Select suitable precision machine tools and operate
CO2: Apply the macro and micro components for fabrication of micro systems.
CO3: Apply suitable machining process
CO4: Able to work with miniature models of existing machine tools/robots and other instruments.
CO5: Apply metrology for micro system

TEXT BOOKS:

REFERENCES:

OMF354  COST MANAGEMENT OF ENGINEERING PROJECTS  LT P C
3 0 0 3

COURSE OBJECTIVES:
• Summarize the costing concepts and their role in decision making
• Infer the project management concepts and their various aspects in selection
• Interpret costing concepts with project execution
• Develop knowledge of costing techniques in service sector and various budgetary control techniques
• Illustrate with quantitative techniques in cost management

UNIT I  INTRODUCTION TO COSTING CONCEPTS  9
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.
UNIT II  INTRODUCTION TO PROJECT MANAGEMENT  9
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomerate of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts

UNIT III  PROJECT EXECUTION AND COSTING CONCEPTS  9
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing

UNIT IV  COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL  9

UNIT V  QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT  9
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand the costing concepts and their role in decision making.
CO2: Understand the project management concepts and their various aspects in selection.
CO3: Interpret costing concepts with project execution.
CO4: Gain knowledge of costing techniques in service sector and various budgetary control techniques.
CO5: Become familiar with quantitative techniques in cost management.

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:
- The objective of this course is to make the students 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- NiMh 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  9
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  9

UNIT V  BMS ARCHITECTURE AND REAL TIME COMPONENTS  9
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. ARBIRN Battery Tester. BMS Development with Modeling software and Model-Based Design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, students will be able to
CO1: Acquire knowledge of different Li-ion Batteries performance.
CO2: Design a Battery Pack and make related calculations.
CO3: Demonstrate a Battery Model or Simulation.
CO5: Approach different BMS architectures during real world usage.

TEXT BOOKS

REFERENCE BOOKS
1. Developing Battery Management Systems with Simulink and Model-Based Design-whitepaper
2. Panasonic NCR18650B- DataSheet
3. bq76PL536A-Q1- IC DataSheet
4. CC2662R-Q1- IC DataSheet
COURSE OBJECTIVES:

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

UNIT I  INTRODUCTION TO MEASUREMENTS AND SENSORS  9

UNIT II  VARIABLE RESISTANCE AND INDUCTANCE SENSORS  9
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT

UNIT III  VARIABLE AND OTHER SPECIAL SENSORS  9
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.

UNIT IV  AUTOMOTIVE ACTUATORS  9

UNIT V  AUTOMATIC TEMPERATURE CONTROL ACTUATORS  9
Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: List common types of sensor and actuators used in vehicles.

CO2: Design measuring equipment’s for the measurement of pressure force, temperature and flow.

CO3: Generate new ideas in designing the sensors and actuators for automotive application

CO4: Understand the operation of these sensors, actuators and electronic control.

CO5: Design temperature control actuators for vehicles.

TEXT BOOKS:


REFERENCES:

OAS353 SPACE VEHICLES

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

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

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

UNIT III ENGINE SYSTEMS, CONTROLS, AND INTEGRATION

UNIT IV THRUST VECTOR CONTROL
TVC Mechanisms with a Single Nozzle – TVC with Multiple Thrust Chambers or Nozzles – Testing – Integration with Vehicle – SITVC method – other jet control methods - exhaust plume problems in space environment

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

TOTAL: 45 PERIODS

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

OIM352 MANAGEMENT SCIENCE

COURSE OBJECTIVES:

Of this course are

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

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANISATION


UNIT II OPERATIONS AND MARKETING MANAGEMENT


UNIT III HUMAN RESOURCES MANAGEMENT

Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Wage and Salary Administration, Promotion, Transfer, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating - Capability Maturity Model (CMM) Levels.

UNIT IV PROJECT MANAGEMENT

Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

UNIT V STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES


TOTAL: 45 PERIODS
OURSEOUTCOMES:
Upon completion of the course, Students will be able to
CO1: Plan an organizational structure for a given context in the organization to carry out production operations through Work-study.
CO2: Survey the markets, customers and competition better and price the given products appropriately.
CO3: Ensure quality for a given product or service.
CO4: Plan, schedule and control projects through PERT and CPM.
CO5: Evaluate strategy for a business or service organization.

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

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TEXTBOOKS:

REFERENCES:

OIM353 PRODUCTION PLANNING AND CONTROL

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

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

UNITII  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.

UNITIII  PRODUCT PLANNING AND PROCESS PLANNING
Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

UNITIV  PRODUCTION SCHEDULING

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

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

TEXT BOOKS:

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

UNIT II FORECASTING, CAPACITY AND FACILITY DESIGN

UNIT III DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS
UNIT IV  MATERIALS MANAGEMENT  
Materials Management – COURSE OBJECTIVES, Planning, Budgeting and Control.  
Purchasing – COURSE OBJECTIVES, Functions, Policies, Vendor rating and Value Analysis. 

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: The students will appreciate the role of Production and Operations management in enabling and enhancing a firm’s competitive advantages in the dynamic business environment.
CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.
CO3: The students will be able to formulate and Assess Aggregate Planning strategies and Material Requirement Plan.
CO4: The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.
CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance.

CO’s- PO’s & PSO’s MAPPING

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TEXT BOOKS

REFERENCES

310
OSF352 INDUSTRIAL HYGIENE

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COURSE OBJECTIVES:

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

UNIT I INTRODUCTION AND SCOPE


UNIT II MONITORING FOR SAFETY, HEALTH & ENVIRONMENT


UNIT III OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION


UNIT IV OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT


UNIT-V INDUSTRIAL HAZARDS


TOTAL 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:
1. R. K. Jain and Sunil S. Rao, Industrial Safety, Health and Environment Management Systems,
   Khanna publishers, New Delhi (2006)

REFERENCES:
   Jourdan publication
2. Frank P Lees - Loss of prevention in Process Industries, Vol. 1 and 2,
   India
   Ltd., London
5. R. K. Jain and Sunil S. Rao, Industrial Safety, Health and Environment Management Systems,

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OSF353 CHEMICAL PROCESS SAFETY L T P C
3 0 0 3

COURSE OBJECTIVES
- Teach the principles of safety applicable to the design, and operation of chemical process
  plants.
- Ensure that potential hazards are identified and mitigation measures are in place to prevent
  unwanted release of energy.
- Learn about the hazardous chemicals into locations that could expose employees and others
to serious harm.
• Focuses on preventing incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals.
• Ensure that the general design of the plant is capable of complying with the dose limits in force and with the radioactive releases.

UNIT I SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES 9
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 9
Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self - heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening,

UNIT III SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS 9
Design principles -Process design development -types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares- new concepts in safety design and operation- Pressure vessel testing standards- Inspection techniques for boilers and reaction vessels.

UNIT IV SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS 9
Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards -standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures- condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

UNIT V SAFETY AND ANALYSIS 9
Safety vs reliability- quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students able to
CO1 Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.
CO2 Develop thorough knowledge about safety in the operation of chemical plants.
CO3 Apply the principles of safety in the storage and handling of gases.
CO4 Identify the conditions that lead to reaction hazards and adopt measures to prevent them.
CO5 Develop thorough knowledge about
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OML352 ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS L T P C 3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
- Understanding the importance of various materials used in electrical, electronics and magnetic applications
- Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
- Gaining knowledge on the selection of suitable materials for the given application
- Knowing the fundamental concepts in Semiconducting materials
- Getting equipped with the materials used in optical and optoelectronic applications.

UNIT I DIELECTRIC MATERIALS
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

UNIT II MAGNETIC MATERIALS
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis.
UNIT III  SEMICONDUCTOR MATERIALS  9
Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale
Integration techniques. Concept of superconductivity; theories and examples for high temperature
superconductivity; discussion on specific superconducting materials; comments on fabrication and
engineering applications.

UNIT IV  MATERIALS FOR ELECTRICAL APPLICATIONS  9
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors,
bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials,
thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on
insulation.

UNIT V  OPTICAL AND OPTOELECTRONIC MATERIALS  9
Principles of photoconductivity - effect of impurities - principles of luminescence-laser principles -
He-Ne, injection lasers, LED materials - binary, ternary photoelectronic materials - LCD materials -
photo detectors - applications of optoelectronic materials - optical fibres and materials - electro
optic modulators - Kerr effect - Pockels effect.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
CO1:Understand various types of dielectric materials, their properties in various conditions.
CO2:Evaluate magnetic materials and their behavior.
CO3:Evaluate semiconductor materials and technologies.
CO4:Select suitable materials for electrical engineering applications.
CO5:Identify right material for optical and optoelectronic applications

TEXT BOOKS:
1. Pradeep Fulay, “Electronic, Magnetic and Optical materials”, CRC Press, taylor and Francis, 2

REFERENCE BOOKS:
   Sons, 2011.

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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
- Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications
- Gaining knowledge on dimensionality effects on different properties of nanomaterials
- Getting acquainted with the different processing techniques employed for fabricating nanomaterials
- Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
- Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

UNIT I  NANOMATERIALS
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
CO1: Evaluate nanomaterials and understand the different types of nanomaterials
CO2: Recognise the effects of dimensionality of materials on the properties
CO3: Process different nanomaterials and use them in engineering applications
CO4: Use appropriate techniques for characterising nanomaterials
CO5: Identify and use different nanomaterials for applications in different engineering fields.
TEXT BOOKS:

REFERENCES:

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OMR352 HYDRAULICS AND PNEUMATICS

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COURSE OBJECTIVES:
- To knowledge on fluid power principles and working of hydraulic pumps
- To obtain the knowledge in hydraulic actuators and control components
- To understand the basics in hydraulic circuits and systems
- To obtain the knowledge in pneumatic and electro pneumatic systems
- To apply the concepts to solve the trouble shooting

UNIT I FLUID POWER PRINCIPILES AND HYDRAULIC PUMPS

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS
UNIT III HYDRAULIC CIRCUITS AND SYSTEMS  
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS  

UNIT V TROUBLE SHOOTING AND APPLICATIONS  

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

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TEXT BOOKS

REFERENCES
OMR353 SENSORS

COURSE OBJECTIVES:
- To learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics.
- To understand basic working principle, construction, Application and characteristics of displacement, speed and ranging sensors.
- To understand and analyze the working principle, construction, application and characteristics of force, magnetic and heading sensors.
- To learn and analyze the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors.
- To familiarize students with different signal conditioning circuits design and data acquisition system.

UNIT I SENSOR CLASSIFICATION, CHARACTERISTICS AND SIGNAL TYPES


UNIT II DISPLACEMENT, PROXIMITY AND RANGING SENSORS


UNIT III FORCE, MAGNETIC AND HEADING SENSORS


UNIT IV OPTICAL, PRESSURE, TEMPERATURE AND OTHER SENSORS

Photo Conductive Cell, Photo Voltaic, Photo Resistive, LDR – Fiber Optic Sensors – Pressure – Diaphragm – Bellows - Piezoelectric - Piezo-resistant - Acoustic, Temperature – IC, Thermistor, RTD, Thermocouple – Non Contact Sensor - Chemical Sensors - MEMS Sensors - Smart Sensors.

UNIT V SIGNAL CONDITIONING


TOTAL: 45 PERIODS
COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors. They can also analyze the sensor response.
CO2: Analyze and select suitable sensor for displacement, proximity and range measurement.
CO3: Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.
CO4: Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.
CO5: Select and design suitable signal conditioning circuit with proper compensation and linearizing element based on sensor output signal.

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TEXT BOOKS

REFERENCES

ORA352 CONCEPTS IN MOBILE ROBOTS L T P C
3 0 0 3

COURSE OBJECTIVES
- To introduce mobile robotic technology and its types in detail.
- To learn the kinematics of wheeled and legged robot.
- To familiarize the intelligence into the mobile robots using various sensors.
- To acquaint the localization strategies and mapping technique for mobile robot.
- To aware the collaborative mobile robotics in task planning, navigation and intelligence.
UNIT I  INTRODUCTION TO MOBILE ROBOTICS

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:
COORUSE OBJECTIVES:

- To impart knowledge on basics of propulsion system and ship dynamic movements
- To educate them on basic layout and propulsion equipment’s
- To impart basic knowledge on performance of the ship
- To impart basic knowledge on Ship propeller and its types
- To impart knowledge on ship rudder and its types

UNIT I  BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS  9
law of floatation - Basics principle of propulsion- Earlier methods of propulsion- ship propulsion machinery- boiler, Marine steam engine, diesel engine, ship power transmission system, ship dynamic structure, Marine propulsion equipment - shaft tunnel, Intermediate shaft and bearing, stern tube, stern tube sealing etc. degree of freedom, Modern propelling methods- water jet propulsion , screw propulsion.

UNIT II  SHIPS MOVEMENTS AND SHIP STABILIZATION  9
Thrust augmented devices, Ship hull, modern ship propulsion design, bow thruster – Advantages, various methods to stabilize the ship- passive and active stabilizer, fin stabilizer, bilge keel - stabilizing and securing ship in port- effect of tides on ship – effect of river water and sea water sailing vessel, Load line and load line of marking- draught markings.

UNIT III  SHIPS SPEED AND ITS PERFORMANCE  9
Ship propulsion factors, factors affecting ships speed, various velocities of ship, hull drag, effects of fouling on ships hull, ship wake, relation between powers, Fuel consumption of ship, cavitations - effects of cavitation’s, ship turning radius.

UNIT IV  BASICS OF PROPELLER  9

UNIT V  BASICS OF RUDDER  9
Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings- Rudder pintle - Rudder types- Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits of various types of rudders, Propeller and rudder interaction, Rudder stopper, movement of rudders, Basic construction of Rudder

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:

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

OMV351 MARINE MERCHANT VESSELS LT P C 3 0 0 3

COURSE OBJECTIVES:
At the end of the course, students are expected to acquire
- Knowledge on basics of Hydrostatics
- Familiarization on types of merchant ships
- Knowledge on Shipbuilding Materials
- Knowledge on marine propeller and rudder
- Awareness on governing bodies in shipping industry

UNIT I INTRODUCTION TO HYDROSTATICS 9
Archimedes Principle- Laws of floatation – Meta centre – stability of floating and submerged bodies-
Density, relative density - Displacement –Pressure –centre of pressure.

UNIT II TYPES OF SHIP 10
General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil
tankers- Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gas carriers - Chemical
tankers - Passenger ships

UNIT III SHIPBUILDING MATERIALS 9
Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel
sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys,
Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced
Composites

UNIT IV MARINE PROPELLER AND RUDDER 8
Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its
effects on propeller
UNIT V  GOVERNING BODIES FOR SHIPPING INDUSTRY

Role of IMO (International Maritime Organization), SOLAS (International Convention for the Safety of Life at Sea), MARPOL (International Convention for the Prevention of Pollution from Ships), MLC (Maritime Labour Convention), STCW 2010 (International Convention on Standards of Training, Certification and Watch keeping for Seafarers), Classification societies Administration authorities

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, students would

CO1: Acquire Knowledge on floatation of ships
CO2: Acquire Knowledge on features of various ships
CO3: Acquire Knowledge of Shipbuilding Materials
CO4: Acquire Knowledge to identify the different types of marine propeller and rudder
CO5: Understand the Roles and responsibilities of governing bodies

TEXT BOOKS:

2. Dr.DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006

REFERENCES:

2. MARPOL Consolidated Edition, Bhandakar Publications, 2018

OMV352  ELEMENTS OF MARINE ENGINEERING  L T P C  3 0 0 3

COURSE OBJECTIVES:

At the end of the course, students are expected to

- Understand the role of Marine machinery systems
- Be familiar with Marine propulsion machinery system
- Acquaint with Marine Auxiliary machinery system
- Have acquired basics of Marine Auxiliary boiler system
- Be aware of ship propellers and steering system

UNIT I  ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS  9

Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems

UNIT II  MARINE PROPULSION MACHINERY SYSTEM  9

Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system
UNIT III    MARINE AUXILIARY MACHINERY SYSTEM  
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of 
engine, Difference between slow speed and medium speed engines – advantages, limitations and 
applications

UNIT IV    MARINE BOILER SYSTEM  
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on 
board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and 
accessories – importance of mountings, need for accessories

UNIT V    SHIP PROPELLERS AND STEERING MECHANISM  
Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, 
Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram 
steering gear, Electric steering gear

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, students should able to,
CO1:Distinguish the role of various marine machinery systems 
CO2:Relate the components of marine propulsion machinery system 
CO3:Explain the importance of marine auxiliary machinery system 
CO4:Acquire knowledge of marine boiler system 
CO5:Understand the importance of ship propellors and steering system

TEXT BOOKS:
   Heinemann, London, 2011

REFERENCES:
1. Alan L.Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of 
   Marine Engineers (India), Mumbai, 2006
   Engineers (India), Mumbai, 2015

COURSE OBJECTIVES:
• To understand the basics of drone concepts
• To learn and understand the fundamentals of design, fabrication and programming of 
   drone
• To impart the knowledge of an flying and operation of drone
• To know about the various applications of drone
• To understand the safety risks and guidelines of fly safely

UNIT I    INTRODUCTION TO DRONE TECHNOLOGY  
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of 
drones based on their method of propulsion- Drone technology impact on the businesses- 
Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and
UNIT II  DRONE DESIGN, FABRICATION AND PROGRAMMING 9
Classifications of the UAV - Overview of the main drone parts - Technical characteristics of the parts - Function of the component parts - Assembling a drone - The energy sources - Level of autonomy - Drones configurations - The methods of programming drone - Download program - Install program on computer - Running Programs - Multi rotor stabilization - Flight modes - Wi-Fi connection.

UNIT III  DRONE FLYING AND OPERATION 9
Concept of operation for drone - Flight modes - Operate a small drone in a controlled environment - Drone controls Flight operations - management tool - Sensors - Onboard storage capacity - Removable storage devices - Linked mobile devices and applications

UNIT IV  DRONE COMMERCIAL APPLICATIONS 9
Choosing a drone based on the application - Drones in the insurance sector - Drones in delivering mail, parcels and other cargo - Drones in agriculture - Drones in inspection of transmission lines and power distribution - Drones in filming and panoramic picturing

UNIT V  FUTURE DRONES AND SAFETY 9
The safety risks - Guidelines to fly safely - Specific aviation regulation and standardization - Drone license - Miniaturization of drones - Increasing autonomy of drones - The use of drones in swarms

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Know about various types of drone technology, drone fabrication, and programming.
CO2: Execute suitable operating procedures for functioning a drone
CO3: Select appropriate sensors and actuators for drones
CO4: Develop a drone mechanism for specific applications
CO5: Create the programs for various drones

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<tr>
<th>CO's-PO's &amp; PSO's MAPPING</th>
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<td>CO/PO &amp; PSO</td>
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<td>Average</td>
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TEXT BOOKS
REFERENCES

OGI352 GEOGRAPHICAL INFORMATION SYSTEM L T P C 3 0 0 3

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

UNIT I FUNDAMENTALS OF GIS 9

UNIT II SPATIAL DATA MODELS 9

UNIT III DATA INPUT AND TOPOLOGY 9

UNIT IV DATA QUALITY AND STANDARDS 9
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure

UNIT V DATA MANAGEMENT AND OUTPUT 9
Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS- distributed GIS.

TOTAL:45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to
CO1 Have basic idea about the fundamentals of GIS.
CO2 Understand the types of data models.
CO3 Get knowledge about data input and topology
CO4 Gain knowledge on data quality and standards
CO5 Understand data management functions and data output

TEXTBOOKS:

REFERENCES:

CO’s-PO’s & PSO’s MAPPING: GEOGRAPHICAL INFORMATION SYSTEM

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<th>Course Outcome</th>
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<td>PO3</td>
<td>Design/Development of Solutions</td>
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<td>Conduct Investigations of Complex Problems</td>
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<td>The Engineer and Society</td>
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<td>Communication</td>
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<td>Project Management and Finance</td>
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<td>Life-long Learning</td>
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<td>Knowledge of Geoinformatics discipline</td>
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<td>PSO2</td>
<td>Critical analysis of Geoinformatics</td>
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<td>Engineering problems and innovations</td>
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<td>PSO3</td>
<td>Conceptualization and evaluation of Design solutions</td>
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1 - low, 2 - medium, 3 - high, ‘-' - no correlation

OAI352 AGRICULTURE ENTREPRENEURSHIP DEVELOPMENT  L  T  P  C  3  0  0  3

COURSE OBJECTIVES
- To introduce the importance of Agri-business management, its characteristics and principles
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.

UNIT I ENTREPRENEURIAL ENVIRONMENT IN INDIAN CONTEXT  9
Entrepreneur Development(ED): Concept of entrepreneur and entrepreneurship assessing overall business environment in Indian economy- Entrepreneurial and managerial characteristics-
Entrepreneurship development programmers (EDP)-Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment.

UNIT II AGRIPRNEURSHIP IN GLOBAL ARENA: LEGAL PERSPECTIVE 9
Importance of agribusiness in Indian economy - International trade-WTO agreements- Provisions related to agreements in agricultural and food commodities - Agreements on Agriculture (AOA)- Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS).

UNIT III ENTREPRENEURSHIP MANAGEMENT: FINANCIAL PERSPECTIVE 9

UNIT IV ENTREPRENEURIAL OPPORTUNITIES: ECONOMIC GROWTH PERSPECTIVE 9
Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country. Overview of Indian social, political system and their implications for decision making by individual entrepreneurs- Economic system and its implication for decision making by individual entrepreneurs.

UNITV ENTREPRENEURIAL PROMOTION MEASURES AND GOVERNMENT SUPPORT 9
Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis- Government schemes and incentives for promotions of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract framing (CF) and Joint Venture (JV), public-private partnerships (PPP) - overview of agricultural engineering industry, characteristics of Indian farm machinery industry.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Judge about agricultural finance, banking and cooperation
CO2: Evaluate basic concepts, principles and functions of financial management
CO3: Improve the skills on basic banking and insurance schemes available to customers
CO4: Analyze various financial data for efficient farm management
CO5: Identify the financial institutions

TEXT BOOKS
REFERENCES

CO’s-PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>PO/PSO</th>
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<td>PO7 Environment and sustainability</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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<td>PSO3 To inculcate entrepreneurial skills through strong Industry-Institution linkage.</td>
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OEN352 BIODIVERSITY CONSERVATION L T P C
3 0 0 3

COURSE OBJECTIVE:
- The identification of different aspects of biological diversity and conservation techniques.
UNIT I  INTRODUCTION  9
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  9
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  9
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  9
Biodiversity Hot-spots, Floristic and Faunal Regions in India and World; IUCN Red List; Factors affecting Diversity, Impact of Exotic Species and Human Disturbance on Diversity, Dispersal, Diversity-Stability Relationship; Socio-economic Issues of Biodiversity; Sustainable Utilization of Bioresources; National Movements and International Convention/Treaties on Biodiversity.

UNIT V  CONSERVATIONS OF BIODIVERSITY  9
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:

COURSE 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.
OEE353  INTRODUCTION TO CONTROL SYSTEMS  

COURSE OBJECTIVES

- To impart knowledge on various representations of systems.
- To familiarize time response analysis of LTI systems and steady state error.
- To analyze the frequency responses and stability of the systems.
- To analyze the stability of linear systems in frequency domain and time domain.
- To develop linear models mainly state variable model and transfer function model.

UNIT I  MATHEMATICAL MODELS OF PHYSICAL SYSTEMS  9

Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction–Signal flow graphs.

UNIT II  TIME RESPONSE ANALYSIS & ROOTLOCUSTECHNIQUE  9


UNIT III  FREQUENCY RESPONSE ANALYSIS  9

Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV  STABILITY CONCEPTS & ANALYSIS  9


UNIT V  STATE VARIABLE ANALYSIS  9

Concept of state – State Variable & State Model – State models for linear & continuous time systems–Solution of state & output equation–controllability & observability.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Ability to

- **CO1:** Design the basic mathematical model of physical System.
- **CO2:** Analyze the time response analysis and techniques.
- **CO3:** Analyze the transfer function from different plots.
CO4: Apply the stability concept in various criterion.
CO5: Assess the state models for linear and continuous Systems.

TEXTBOOKS

REFERENCES
2. Control System Dynamics" by Robert Clark, Cambridge University Press, 1996 USA.

CO’s-PO’s & PSO’s MAPPING

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OEI354 INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS LT P C 3 0 03

COURSE OBJECTIVES:
- To educate on design of signal conditioning circuits for various applications.
- To Introduce signal transmission techniques and their design.
- Study of components used in data acquisition systems interface techniques
- To educate on the components used in distributed control systems
- To introduce the communication buses used in automation industries.

UNIT I INTRODUCTION 9

UNIT II AUTOMATION COMPONENTS 9
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  9
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  9
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  9
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer
Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL:45 PERIODS

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

COURSE OUTCOMES:
Students able to
CO1  Design a signal conditioning circuits for various application (L3).
CO2  Acquire a detail knowledge on data acquisition system interface and DCS system (L2).
CO3  Understand the basics and Importance of communication buses in applied automation
    Engineering (L2).
CO4  Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic
    Instructions Studied for Ladder Logic and Function BIock.(L3)
CO5  Able to develop a PLC logic for a specific application on real world problem. (L5)

TEXT BOOKS:
    2006.

REFERENCES:
1.  John W. Webb and Ronald A. Reis, “Programmable Logic Controllers: Principles and
    2016.
    2011.

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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<th>CO’s</th>
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1 - low, 2 - medium, 3 - high, -1 - no correlation

OCH353 ENERGY TECHNOLOGY

UNIT I INTRODUCTION
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources

UNIT II CONVENTIONAL ENERGY
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III NON-CONVENTIONAL ENERGY
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV BIOMASS ENERGY
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte
fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT V  ENERGY CONSERVATION

Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.

CO2: Students will excel as professionals in the various fields of energy engineering

CO3: Compare different renewable energy technologies and choose the most appropriate based on local conditions.

CO4: Explain the technological basis for harnessing renewable energy sources.

CO5: Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.

TEXT BOOKS


REFERENCES


CO’s-PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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<td>Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.</td>
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| Students will excel as professionals in the
various fields of energy engineering

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<td>Explain the technological basis for harnessing renewable energy sources.</td>
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<td>Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.</td>
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OVERALL CO 2 2 1 3 3 2 2 1 1 1 3 2 1 3

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

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

OCH354 SURFACE SCIENCE L T P C 3 0 0 3

COURSE OBJECTIVE:
- To enable the students to analyze properties of a surfaces and correlate them to structure, chemistry, and physics and surface modification technique.

UNIT I SURFACE STRUCTURE AND EXPERIMENTAL PROBES 9
Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, absorbate structure, Band and Vibrational structure, Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy

UNIT II ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT SURFACES 9
Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods
UNIT III LIQUID INTERFACES
Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells

UNIT IV HETEROGENEOUS CATALYSIS
Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, Fischer-Tropsch and Automotive catalysis, Role of promoters and poisons, Bimetallic surfaces, surface functionalization and clusters in catalysis, Role of Sabatier principle in catalyst design, Rate oscillations and spatiotemporal pattern formation

UNIT V EPITAXIAL GROWTH AND NANO SURFACE-STRUCTURES

TOTAL: 45 PERIODS

COURSE OUTCOME:
- Upon completion of this course, the students can understand, predict and design surface properties based on surface structure. Students would understand the physics and chemistry behind surface phenomena

TEXT BOOK:

REFERENCE:

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

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

UNIT I
Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.

UNIT II
Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum,
osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foam mat 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 electrolysis, 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:
COURSE OBJECTIVES:
• To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
• To help become skilled in systems for food safety surveillance
• To be aware of the regulatory and statutory bodies in India and the world
• To ensure processed food meets global standards

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

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

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

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

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

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

REFERENCES:
1. Handbook of food toxicology by S. S. Deshpande, 2002
2. The food safety information handbook by Cynthia A. Robert, 2009
4. Microbiological safety of Food by Hobbs BC, 1973
COURSE OBJECTIVES:

- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease.

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

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

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

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

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

TOTAL: 45 PERIODS

TEXT BOOKS:
3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006
REFERENCES:
1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007

COURSE OUTCOME - NUTRACEUTICALS

| CO 1 | acquire knowledge about the Nutraceuticals and functional foods, their classification and benefits. |
| CO 2 | acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes. |
| CO 3 | attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods. |
| CO 4 | distinguish the various \textit{In vitro} and \textit{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. |

CO’s-PO’s & PSO’s MAPPING

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<thead>
<tr>
<th>NUTRACEUTICALS</th>
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1 - low, 2 - medium, 3 - high, '-' - no correlation

OTT354 BASICS OF DYEING AND PRINTING L T P C 3 0 0 3

COURSE OBJECTIVE:
- To enable the students to learn about the basics of Pretreatment, dyeing, printing and machinery in textile processing.

UNIT I INTRODUCTION
Impurities present in different fibres, Inspection of grey goods and lot preparation. Shearing,
UNIT II  
PRE TREATMENT  

UNIT III  
DYEING  

UNIT IV  
PRINTING  
Definition of printing – Difference between printing and dyeing- Classification thickeners – Requirements to be good thickener, printing paste Preparation - different styles of printing.

UNIT V  
MACHINERIES  

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to Understand the
CO1: Basics of grey fabric 
CO2: Basics of pre treatment
CO3: Concept of Dyeing
CO4: Concept of Printing
CO5: Machinery in processing industry

TEXT BOOKS:

REFERENCES:
2. Dr. N N Mahapatra., “Textile dyeing”, Wood head publishing India, 2018
4. Bleaching & Mercerizing – BTRA Silver Jubilee Monograph series

CO’s-PO’s & PSO’s MAPPING
1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
COURSE OBJECTIVES

- To enable the students to learn about the types of fibre and its properties

UNIT I  INTRODUCTION TO TEXTILE FIBRES  9
Definition of various forms of textile fibres - staple fibre, filament, bicomponent fibres. Classification of Natural and Man-made fibres, essential and desirable properties of Fibres. Production and cultivation of Natural Fibers: Cotton, Silk, Wool - Physical and chemical structure of the above fibres.

UNIT II  REGENERATED FIBRES  9
Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel, Tencel

UNIT III  SYNTHETIC FIBRES  9
Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass, carbon. Introduction to spin finishes and texturization

UNIT IV  SPECIALITY FIBRES  9
Properties and end uses of high tenacity and high modulus fibres, high temperature and flame retardant fibres, Chemical resistant fibres
UNIT V  FUNCTIONAL SPECIALITY FIBRES

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

TOTAL: 45 PERIODS

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

CO1: Understand the process sequence of various fibres
CO2: Understand the properties of various fibres

TEXT BOOKS:


REFERENCES:


OTT355  GARMENT MANUFACTURING TECHNOLOGY

L T P C
3 0 0 3

COURSE OBJECTIVE:

• To enable the students to understand the basics of pattern making, cutting and sewing.
• To expose the students to various problems & remedies during garment manufacturing

UNIT I  PATTERN MAKING, MARKER PLANNING, CUTTING

Anthropometry, specification sheet, pattern making – principles, basic pattern set drafting, grading, marker planning, spreading & cutting

UNIT II  TYPES OF SEAMS, STITCHES AND FUNCTIONS OF NEEDLES

Different types of seams and stitches; single needle lock stitch machine – mechanism and accessories; needle – functions, special needles, needlepoint

UNIT III  COMPONENTS AND TRIMS USED IN GARMENT

Sewing thread-construction, material, thread size, packages, accessories – labels, linings, interlinings, wadding, lace, braid, elastic, hook and loop fastening, shoulder pads, eyelets and laces, zip fasteners, buttons
UNIT IV  GARMEN T INSPECTION AND DIMENSIONAL CHANGES
Raw material, in process and final inspection; needle cutting; sewability of fabrics; strength
properties of apparel; dimensional changes in apparel due to laundering, dry-cleaning, steaming
and pressing.

UNIT V GARMEN T PRESSING, PACKING AND CARE LABELING
Garment pressing – categories and equipment, packing; care 346abelling of apparels

TOTAL: 45 PERIODS

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

CO1: Pattern making, marker planning, cutting
CO2: Types of seams, stitches and functions of needles
CO3: Components and trims used in garment
CO4: Garment inspection and dimensional changes
CO5: Garment pressing, packing and care labelling

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

REFERENCES:
5. Pradip V.Mehta, “An Introduction to Quality Control for the Apparel Industry”, J.S.N.

CO’s-PO’s & PSO’s MAPPING

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<thead>
<tr>
<th>CO’s</th>
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| Avg  | 1.6 | 1.2 | 1   | 0.8 | 1.4 | 0.8 | 1.4 | 1   | 0.2 | 1.8 | 2.4 | 1   | 1.8 | 2.6 | 1   | 2.6 |

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

- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen’s Compensation and other laws) enacted for the protection of employees health at work settings
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I INTRODUCTION
Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.

UNIT II OCCUPATIONAL HEALTH AND HYGIENE

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS

UNIT IV HAZARDS AND RISK MANAGEMENT

UNIT V ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT

TOTAL: 45 PERIODS

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

CO1: Describe, with example, the common work-related diseases and accidents in occupational setting
CO2: Name essential members of the Occupational Health team
CO3: What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee
COURSE OBJECTIVES:
- To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.

UNIT I \textbf{FLUID MECHANICS CONCEPTS} 9
Fluid definition and classification of fluids, types of fluids, Rheological behaviour of fluids & Newton's Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems),Basic equations of fluid flow - Continuity equation, Euler's equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits - Hagen Poiseuille equation (no derivation). Flow through stagnant fluids – theory of Settling and Sedimentation – Equipment (cyclones, thickeners) Conceptual numericals.

UNIT II \textbf{FLOW MEASUREMENTS & MECHANICAL OPERATIONS} 9

UNIT III \textbf{CONDUCTIVE & CONVECTIVE HEAT TRANSFER} 9
Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).

UNIT IV \textbf{BASICS OF MASS TRANSFER} 9

UNIT V \textbf{MASS TRANSFER OPERATIONS} 9
Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction).Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method.Drying- drying operations, batch and continuous drying. Conceptual numerical.

COURSE OUTCOMES:
At the end of the course the student will be able to:
CO1:State and describe the nature and properties of the fluids.
CO2:Study the different flow measuring instruments, the principles of various size reductions, conveying equipment’s, sedimentation and mixing tanks.
CO3:Comprehend the laws governing the heat and mass transfer operations to solve the problems.
CO4:Design the heat transfer equipment suitable for specific requirement.
TEXTBOOK(S)
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008

REFERENCE BOOKS
2. Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996

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

COURSE OBJECTIVES
• Understand the advantages, disadvantages and general classification of plastic materials
• To know the manufacturing, sources, and applications of engineering thermoplastics
• Understand the basics as well as the advanced applications of various plastic materials in the industry
• To understand the preparation methods of thermosetting materials
• Select suitable specialty plastics for different end applications

UNIT I INTRODUCTION TO PLASTIC MATERIALS
Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermostetting 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
CO1: To study the importance, advantages and classification of plastic materials
CO2: Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics
CO3: To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins
CO4: Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU
CO5: To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

REFERENCES

OPT353  PROPERTIES AND TESTING OF PLASTICS  
COURSE OBJECTIVES
- To understand the relevance of standards and specifications as well as the specimen preparation for polymer testing.
- To study the mechanical properties and testing of polymer materials and their structural property relationships.
- To understand the thermal properties of polymers and their testing methods.
- To gain knowledge on the electrical and optical properties of polymers and their testing methods.
- To study about the environmental effects and prevent polymer degradation.

UNIT I  INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS  
UNIT II MECHANICAL PROPERTIES
9
Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact
strength, resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic
fatigue, ageing properties, Basic concepts of stress and strain, short term tests: Viscoelastic
behavior (simple models: Kelvin model for creep and stress relaxation, Maxwell-Voigt model,
strain recovery and dynamic response), Effect of structure and composition on mechanical
properties, Behavior of reinforced polymers

UNIT III THERMAL RHEOLOGICAL PROPERTIES
9
Thermal properties: Transition temperatures, specific heat, thermal conductivity, co-efficient of
thermal expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness
temperature, thermal stability and flammability. Product testing: Plastic films, sheeting, pipes,
laminates, foams, containers, cables and tubes.

UNIT IV ELECTRICAL AND OPTICAL PROPERTIES
9
Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and
power factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric co-
efficient, dielectric polarization), dissipation factor and its importance. Optical properties:
transparency, refractive index, haze, gloss, clarity, birefringence.

UNIT V ENVIRONMENTAL AND CHEMICAL RESISTANCE
9
Environmental stress crack resistance (ESCR), water absorption, weathering, aging, ozone
resistance, permeability and adhesion. Tests for chemical resistance. Acids, alkalies, Flammability
tests- oxygen index test.

COURSE OUTCOMES
CO1: Understand the relevance of standards and specifications.
CO2: Summarize the various test methods for evaluating the mechanical properties of the
polymers.
CO3: To know the thermal, electrical & optical properties of polymers.
CO4: Identify various techniques used for characterizing polymers.
CO5: Distinguish the processability tests used for thermoplastics, thermosets and
elastomers.

REFERENCES
1. F. Majewska, H. Zowall, Handbook of analysis of synthetic polymers and plastics, Ellis
Horwood Limited Publisher 1977.
COURSE OBJECTIVES:
The student should be made to:
- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS

UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES
Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS

UNIT IV SMART TEXTILE

UNIT V APPLICATIONS OF WEARABLE SYSTEMS
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

COURSE 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
Preamble:
1. To study the applications of information technology in health care management.
2. This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

UNIT I INTRODUCTION TO MEDICAL INFORMATICS
Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues , Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics

UNIT II COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING
Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III COMPUTERISED PATIENT RECORD
Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT IV COMPUTER ASSISTED MEDICAL DECISION-MAKING
Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer–assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis inclinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.
UNIT V  RECENT TRENDS IN MEDICAL INFORMATICS
Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
CO1: Explain the structure and functional capabilities of Hospital Information System.
CO2: Describe the need of computers in medical imaging and automated clinical laboratory.
CO3: Articulate the functioning of information storage and retrieval in computerized patient record system.
CO4: Apply the suitable decision support system for automated clinical diagnosis.
CO5: Discuss the application of virtual reality and telehealth technology in medical industry.

TEXT BOOKS:

REFERENCES:

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OCE354 BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT

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COURSE 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

COURSE OUTCOMES

On completion of the course, the student will be able to apply appropriate management techniques towards managing the water resources.

CO1 Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.

CO2 Discuss on the different water uses; how it is impacted and ways to tackle these impacts.

CO3 Explain the economic aspects of water and choose the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.

CO4 Illustrate the recent trends in water management.

CO5 Understand the implementation hitches and the institutional frameworks.

TEXT BOOKS


REFERENCES


2. IWRM Guidelines at River Basin Level (UNESCO, 2008).


UNIT I BIOLOGICAL TREATMENT PROCESS 9

UNIT II WASTE BIOMASS AND ITS VALUE ADDITION 9
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 9
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 9
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 9
Overview of composting process - Benefits of composting, Role of microorganisms in composting - Factors affecting the composting process - Waste Materials for Composting, Fundamentals of composting process - Composting technologies, Composting systems – Nonreactor Composting, Reactor composting - Compost Quality

TOTAL: 45 PERIODS

COURSE OUTCOMES
After completion of this course, the students should be able

CO1: To learn the various methods biological treatment
CO2: To know the details of waste biomass and its value addition
CO3: To develop the bioconversion processes to convert wastes to energy
CO4: To synthesize the chemicals and enzyme from wastes
CO5: To produce the biocompost from wastes
CO6: To apply the theoretical knowledge for the development of value added products

TEXT BOOKS

REFERENCE BOOKS

OBT356 LIFESTYLE DISEASES L T P C 3 0 0 3

UNIT I INTRODUCTION 9
Lifestyle diseases – Definition ; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use ; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise.

UNIT II CANCER 9
Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment

UNIT III CARDIOVASCULAR DISEASES 9
Coronary atherosclerosis – Coronary artery disease; Causes - Fat and lipids, Alcohol abuse; Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation

UNIT IV DIABETES AND OBESITY 9
Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI

UNIT V RESPIRATORY DISEASES 9
Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking - Diagnosis - Pulmonary function testing

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

OBT357 BIOTECHNOLOGY IN HEALTH CARE L T P C 3 0 0 3

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

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

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

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

UNIT V  BASICS OF IMAGING MODALITIES

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE BOOKS
LEARNING OBJECTIVES

- To acquire the knowledge of the decision areas in finance.
- To learn the various sources of Finance.
- To describe about capital budgeting and cost of capital.
- To discuss on how to construct a robust capital structure and dividend policy.
- To develop an understanding of tools on Working Capital Management.

UNIT I  INTRODUCTION TO FINANCIAL MANAGEMENT
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:
Investment Decisions: capital budgeting - Need and Importance - Techniques of Capital Budgeting - Payback - ARR - NPV - IRR - Profitability Index. Cost of Capital - Cost of Specific Sources of Capital - Equity - Preferred Stock - Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV  FINANCING AND DIVIDEND DECISION

UNIT V  WORKING CAPITAL DECISION

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
2. Prasanna Chandra, Financial Management,
COURSE OBJECTIVES:
- Describe the investment environment in which investment decisions are taken.
- Explain how to Value bonds and equities
- Explain the various approaches to value securities
- Describe how to create efficient portfolios through diversification
- Discuss the mechanism of investor protection in India.

UNIT I  THE INVESTMENT ENVIRONMENT  9
The investment decision process, Types of Investments – Commodities, Real Estate and FinancialAssets, the Indian securities market, the market participants and trading of securities, securitymarket indices, sources of financial information, Concept of return and risk, Impact of Taxes andInflationonreturn.

UNIT II  FIXED INCOME SECURITIES  9
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, defaultrisk andcreditrating.

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
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:

CMG334 INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS LT P C
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


TOTAL: 45 PERIODS

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

CMG335  FINTECH PERSONAL FINANCE AND PAYMENTS  LT P C 3 0 0 3

UNIT I  CURRENCY EXCHANGE AND PAYMENT

Understand the concept of Crypto currency- Bitcoin and Applications -Cryptocurrencies and Digital Crypto 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

TOTAL : 45 PERIODS

REFERENCE
5. IIBF, Digital Banking, Taxmann Publication, 2016

CMG336 INTRODUCTION TO FINTECH 3 0 0 3

COURSE OBJECTIVES:
- To learn about history, importance and evolution of Fintech
- To acquire the knowledge of Fintech in payment industry
- To acquire the knowledge of Fintech in insurance industry
- To learn the Fintech developments around the world
- To know about the future of Fintech

UNIT I INTRODUCTION
Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY
FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.
UNIT III INSURANCE INDUSTRY

UNIT IV FINTECH AROUND THE GLOBE

UNIT V FUTURE OF FINTECH
How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

TOTAL : 45 PERIODS

REFERENCES
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
6. Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018

VERTICAL 2: ENTREPRENEURSHIP
CMG337 FOUNDATIONS OF ENTREPRENEURSHIP

COURSE OBJECTIVES
- To develop and strengthen the entrepreneurial quality and motivation of learners.
- To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of entrepreneurship and management in Technology oriented businessess.
- To empower the learners to run a Technology driven business efficiently and effectively
UNIT I  INTRODUCTION TO ENTREPRENEURSHIP  9
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  9

UNIT III  FUNDAMENTALS OF TECHNOPRENEURSHIP  9
Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characteristicics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends

UNIT IV  APPLICATIONS OF TECHNOPRENEURSHIP  9
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  9

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of Entrepreneurship
CO 2 Understand the business ownership patterns and environment
CO 3 Understand the Job opportunities in Industries relating to Technopreneurship
CO 4 Learn about applications of technopreneurship and successful technopreneurs
CO 5 Acquaint with the recent and emerging trends in entrepreneurship

TOTAL 45 : PERIODS

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 businessess.
- To empower the learners to build robust teams for running and leading a business efficiently and effectively

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

UNIT II MANAGING AND DEVELOPING EFFECTIVE TEAMS
Team-based Organisations- Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.

UNIT III INTRODUCTION TO LEADERSHIP
Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership - Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment.

UNIT IV LEADERSHIP IN ORGANISATIONS

UNIT V LEADERSHIP EFFECTIVENESS

TOTAL 45 : PERIODS

COURSE OUTCOMES
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of managing teams for business.
CO 2 Understand developing effective teams for business management.
CO 3 Understand the fundamentals of leadership for running a business.
CO 4 Learn about the importance of leadership for business development.
CO 5 Acquaint with emerging trends in leadership effectiveness for entrepreneurs.

REFERENCES:

CMG339 CREATIVITY & INNOVATION IN ENTREPRENEURSHIP L T P C
3 0 0 3

COURSE OBJECTIVES
- To develop the creativity skills among the learners
- To impart the knowledge of creative intelligence essential for entrepreneurs
- To know the applications of innovation in entrepreneurship.
- To develop innovative business models for business.

UNIT I CREATIVITY
Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity- Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- Creative Personality and Motivation.

UNIT II CREATIVE INTELLIGENCE
Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training--Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III INNOVATION

UNIT IV INNOVATION AND ENTREPRENEURSHIP
Unit V INNOVATIVE BUSINESS MODELS

COURSE OUTCOMES
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of creativity for developing Entrepreneurship
CO 2 Understand the importance of creative intelligence for business growth
CO 3 Understand the advances through Innovation in Industries
CO 4 Learn about applications of innovation in building successful ventures
CO 5 Acquaint with developing innovative business models to run the business efficiently and effectively

Suggested Readings:
Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand
Strategic Innovation: Building and Sustaining Innovative Organizations- Course Era, Raj Echambadi.

CMG340 PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS

COURSE OBJECTIVES:
• To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
• To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
• To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.

UNIT I INTRODUCTION TO MARKETING MANAGEMENT

UNIT II MARKETING ENVIRONMENT
UNIT III  PRODUCT AND PRICING MANAGEMENT  9

UNIT IV  PROMOTION AND DISTRIBUTION MANAGEMENT  9

UNIT V  CONTEMPORARY ISSUES IN MARKETING MANAGEMENT  9

COURSE OUTCOMES:  
After completion of this course, the students will be able to :  
CO1 Have the awareness of marketing management process  
CO 2 Understand the marketing environment  
CO 3 Acquaint about product and pricing strategies  
CO 4 Knowledge of promotion and distribution in marketing management.  
CO 5 Comprehend the contemporary marketing scenairos and offer solutions to marketing issues.

REFERENCES:  
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

COURSE OUTCOMES:
Upon completion of this course the learners will be able:
CO 1 To understand the Evolution of HRM and Challenges faced by HR Managers
CO 2 To learn about the HR Planning Methods and practices.
CO 3 To acquaint about the Recruitment and Selection Techniques followed in Industries.
CO 4 To known about the methods of Training and Employee Development.
CO 5 To comprehend the techniques of controlling human resources in organisations.

REFERENCES
COURSE OBJECTIVES

- To develop the basics of business venture financing.
- To impart the knowledge essential for entrepreneurs for financing new ventures.
- To acquaint the learners with the sources of debt and equity financing.
- To empower the learners towards fund raising for new ventures effectively.

UNIT I ESSENTIALS OF NEW BUSINESS VENTURE 9

UNIT II INTRODUCTION TO VENTURE FINANCING 9

UNIT III SOURCES OF DEBT FINANCING 9

UNIT IV SOURCES OF EQUITY FINANCING 9
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 9

COURSE 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

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:
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:
3. Johari J.C.: Indian Politics, Vishal Publications Ltd, New Delhi
4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi
UNIT-I
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

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

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

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

UNIT-V
1. Employer Employee Relations
2. Wage and Salary Administration
3. Allowances and Benefits

REFERENCES:
1. Stahl Glean O: Public Personnel Administration
4. Dwivedi O.P and Jain R.B: India’s Administrative state.
7. Davar R.S. Personnel Management & Industrial Relations

TOTAL: 45 PERIODS
UNIT I (9)
Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration

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

UNIT III (9)
Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design.

UNIT IV (9)
Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making

UNIT V (9)
Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard, Peter Drucker

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

TOTAL: 45 PERIODS
UNIT 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
Meaning and Definition of Public Policy - Nature, Scope and Importance of public policy – Public
policy relationship with social sciences especially with political science and Public Administration.

UNIT-II
Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System’s
Approach – Dror’s Optimal Model

UNIT-III
Major stages involved in Policy making Process – Policy Formulation – Policy Implementation –
Policy Evaluation.

UNIT-IV
Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role
of Political Parties.

UNIT-V
Introduction to the following Public Policies – New Economic Policy – Population Policy –
Agriculture policy - Information Technology Policy.

TOTAL: 45 PERIODS

REFERENCES:
4. Pradeep Saxena : Public Policy Administration and Development
2016.
COURSE OBJECTIVE:
- To learn the applications of statistics in business decision making.

UNIT I INTRODUCTION
Basic definitions and rules for probability, Baye's theorem and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT II SAMPLING DISTRIBUTION AND ESTIMATION
Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters.

UNIT III TESTING OF HYPOTHESIS - PARAMETRIC TESTS
Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.

UNIT IV NON-PARAMETRIC TESTS

UNIT V CORRELATION AND REGRESSION

TOTAL:45 PERIODS

COURSE OUTCOMES:
- To facilitate objective solutions in business decision making.
- To understand and solve business problems
- To apply statistical techniques to data sets, and correctly interpret the results.
- To develop skill-set that is in demand in both the research and business environments
- To enable the students to apply the statistical techniques in a work setting.

REFERENCES:
COURSE OBJECTIVES:

- To know how to derive meaning from huge volume of data and information.
- To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION
Data mining, Text mining, Web mining, Data warehouse.

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

COURSE OUTCOMES:

CO1: Learn to apply various data mining techniques into various areas of different domains.
CO2: Be able to interact competently on the topic of data mining for business intelligence.
CO3: Apply various prediction techniques.
CO4: Learn about supervised and unsupervised learning technique.
CO5: Develop and implement machine learning algorithms

REFERENCES:

1. Jiawei Han and Micheline Kamber, Data Mining concepts and techniques, Kaufmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
7. G. K. Gupta, Introduction to Data mining with Case Studies, Prentice hall of India, 2011
9. Elizabeth Vitt, Michael Luckevich Stacia Misner, Business Intelligence, Microsoft, 2011
COURSE OBJECTIVE:

- To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
- To know the different types of HR metrics and understand their respective impact and application.
- To understand the impact and use of HR metrics and their connection with HR analytics.
- To understand common workforce issues and resolving them using people analytics.

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

UNIT II - HR ANALYTICS I: RECRUITMENT
Recruitment Metrics: Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio - Quality of hire.

UNIT III - HR ANALYTICS - TRAINING AND DEVELOPMENT
Training & Development Metrics: Percentage of employees trained - Internally and externally trained - Training hours and cost per employee - ROI.

UNIT IV - HR ANALYTICS EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION
Employee Engagement Metrics: Talent Retention index - Voluntary and involuntary turnover - grades, performance, and service tenure - Internal hired index Career Progression Metrics: Promotion index - Rotation index - Career path index.

UNIT V - HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT
Workforce Diversity and Development Metrics: Employees per manager – Workforce age profiling - Workforce service profiling - Churnover index - Workforce diversity index - Gender mix

COURSE 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

COURSE OBJECTIVE:
- To showcase the opportunities that exist today to leverage the power of the web and social media

UNIT I - MARKETING ANALYTICS
Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT II - COMMUNITY BUILDING AND MANAGEMENT
History and Evolution of Social Media-Understanding Science of Social Media –Goals for using Social Media- Social Media Audience and Influencers - Digital PR- Promoting Social Media Pages-Linking Social Media Accounts-The Viral Impact of Social Media.

UNIT III - SOCIAL MEDIA POLICIES AND MEASUREMENTS
Social Media Policies-Etiquette, Privacy- ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV - WEB ANALYTICS
Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT V - SEARCH ANALYTICS
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

TOTAL: 45 PERIODS

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

REFERENCES:
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004
COURSE OBJECTIVE:

- To treat the subject in depth by emphasizing on the advanced quantitative models and methods in operations and supply chain management and its practical aspects and the latest developments in the field.

UNIT I - INTRODUCTION
Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains.

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

UNIT III - INVENTORY MANAGEMENT
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV - TRANSPORTATION NETWORK MODELS

UNIT V - MCDM MODELS
Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the analytical network process (ANP), TOPSIS.

TOTAL: 45 PERIODS

COURSE OUTCOME:

- To enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.

REFERENCES:
COURSE OBJECTIVE:

- This course introduces a core set of modern analytical tools that specifically target finance applications.

UNIT I - CORPORATE FINANCE ANALYSIS  
Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.

UNIT II - FINANCIAL MARKET ANALYSIS  
Estimation and prediction of risk and return (bond investment and stock investment) –Time series-examining nature of data, Value at risk, ARMA, ARCH and GARCH.

UNIT III - PORTFOLIO ANALYSIS  
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.

UNIT IV - TECHNICAL ANALYSIS  

UNIT V - CREDIT RISK ANALYSIS  
Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.

COURSE OUTCOME

- The learners should be able to perform financial analysis for decision making using excel, Python and R.

REFERENCES:
COURSE OBJECTIVE:

- To impart knowledge about sustainable Infrastructure development goals, practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.

UNIT I SUSTAINABLE DEVELOPMENT GOALS

UNIT II SUSTAINABLE INFRASTRUCTURE PLANNING

UNIT III SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES

UNIT IV SUSTAINABLE CONSTRUCTION MATERIALS
UNIT V SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS


TOTAL: 45 PERIODS

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

CO1 Understand the environment sustainability goals at global and Indian scenario.

CO2 Understand risks in development of projects and suggest mitigation measures.

CO3 Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.

CO4 Explain Life Cycle Analysis and life cycle cost of construction materials.

CO5 Explain the new technologies for maintenance of infrastructure projects.

REFERENCES:
5. New Building Materials and Construction World magazine
7. Munier N, "Introduction to Sustainability", Springer2005
COURSE OBJECTIVES:
- To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.

UNIT I AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS  
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

COURSE OUTCOME

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

CO1 Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture

CO2 Discuss the sustainable ways in managing soil health, nutrients, pests and diseases

CO3 Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources

CO4 Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas

CO5 Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

REFERENCES:

1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020


CO’s-PO’s & PSO’s MAPPING - SUSTAINABLE AGRICULTURE PRACTICES

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CES333    SUSTAINABLE BIOMATERIALS

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COURSE OBJECTIVES

- To impart knowledge of biomaterials and their properties
- To learn about Fundamentals aspects of Biopolymers and their applications
- To learn about bioceramics and biopolymers
- To introduce the students about metals as biomaterials and their usage as implants
- To make the students understand the significance of bionanomaterials and its applications.
UNIT-I INTRODUCTION TO BIOMATERIALS

UNIT-II BIO POLYMERS
Molecular structure of polymers -Molecular weight - Types of polymerization techniques—Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials - Polyethylene -Polymethylmethacrylate (PMMA)-Polyactic acid (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethane reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT-III BIO CERAMICS AND BIOCOMPOSITES
General properties- Bio ceramics -Silicate glass - Alumina (Al2O3) -Zirconia (ZrO2)-Carbon-Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites-Polymer Matrix Composite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)—glass ceramics - Orthopedic implants-Tissue engineering scaffolds

UNIT-IV METALS AS BIOMATERIALS
Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys-Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals

UNIT-V NANOBIO MATERIALS

COURSE OUTCOMES
CO1:Students will gain familiarity with Biomaterials and they will understand their importance.
CO2:Students will get an overview of different biopolymers and their properties
CO3:Students gain knowledge on some of the important Bioceramics and Biocomposite materials
CO4:Students gain knowledge on metals as biomaterials
CO5:Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

REFERENCES
6. Vasif Hasirci, Nesrin Hasirci “Fundamentals of Biomaterials” Springer, 2018

CES334                         MATERIALS FOR ENERGY SUSTAINABILITY                         L T P C
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COURSE OBJECTIVES
• To familiarize the students about the challenges and demands of energy sustainability
• To provide fundamental knowledge about electrochemical devices and the materials used.
• To introduce the students to various types of fuel cell
• To enable students to appreciate novel materials and their usage in photovoltaic application
• To introduce students to the basic principles of various types Supercapacitors and the materials used.

UNIT-I SUSTAINABLE ENERGY SOURCES
Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy

UNIT-II ELECTROCHEMICAL DEVICES
Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O2 battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO2, LiFePO4, LiMn2O4) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)

UNIT-III FUEL CELLS

UNIT-IV PHOTOVOLTAICS

UNIT-V SUPERCAPACITORS
Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP). Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

COURSE OUTCOMES
CO1: Students will acquire knowledge about energy sustainability.
CO2: Students understand the principles of different electrochemical devices.
CO3: Students learn about the working of fuel cells and their application.
CO4: Students will learn about various Photovoltaic applications and the materials used.
CO5: The students gain knowledge on different types of supercapacitors and the performance of various materials

REFERENCES
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh
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
COURSE OBJECTIVES:
- to understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.

UNIT I: ENVIRONMENTAL MONITORING AND STANDARDS

UNIT II: MONITORING OF ENVIRONMENTAL PARAMETERS

UNIT III: ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING
Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods - Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT IV : ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISK ASSESSMENT

UNIT V: AUTOMATED DATA ACQUISITION AND PROCESSING
Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks - Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

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 soild 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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CES337 INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT

COURSE OBJECTIVES:
- To create awareness on the energy scenario of India with respect to world
- To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation
- Familiarisation on the concept of sustainable development and its benefits
- Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development
- Acquainting with energy policies and energy planning for sustainable development

UNIT I ENERGY SCENARIO
Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security
UNIT II ENERGY AND ENVIRONMENT
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

UNIT III SUSTAINABLE DEVELOPMENT

UNIT IV RENEWABLE ENERGY TECHNOLOGY

UNIT V ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
CO1: Understand the world and Indian energy scenario
CO2: Analyse energy projects, its impact on environment and suggest control strategies
CO3: Recognise the need of Sustainable development and its impact on human resource development
CO4: Apply renewable energy technologies for sustainable development
CO5: Fathom Energy policies and planning for sustainable development.

REFERENCES:
7. https://www.niti.gov.in/verticals/energy

CES338 ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT

COURSE OBJECTIVES:
• To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
• To create awareness on energy audit and its impacts
• To acquaint the techniques adopted for performance evaluation of thermal utilities
• To familiarise on the procedures adopted for performance evaluation of electrical utilities
• To learn the concept of sustainable development and the implication of energy usage

UNIT I ENERGY AND ENVIRONMENT
Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT II ENERGY AUDITING
Need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES
Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression

UNIT IV ENERGY CONSERVATION IN ELECTRICAL UTILITIES
Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

UNIT V SUSTAINABLE DEVELOPMENT

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
CO1:Understand the prevailing energy scenario
CO2:Familiarise on energy audits and its relevance
CO3:Apply the concept of energy audit on thermal utilities
CO4:Employ relevant techniques for energy improvement in electrical utilities
CO5:Understand Sustainable development and its impact on human resource development

REFERENCES: