I. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To enable the graduates to demonstrate their skills in design and develop medical devices for health care system through the core foundation and knowledge acquired in engineering and biology.

2. To enable the graduates to exhibit leadership in health care team to solve health care problems and make decisions with societal and ethical responsibilities.

3. To Carryout multidisciplinary research, addressing human healthcare problems and sustain technical competence with ethics, safety and standards.

4. To ensure that graduates will recognize the need for sustaining and expanding their technical competence and engage in learning opportunities throughout their careers.

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)**

1. To design and develop diagnostic and therapeutic devices that reduces physician burnout and enhance the quality of life for the end user by applying fundamentals of Biomedical Engineering.

2. To apply software skills in developing algorithms for solving healthcare related problems in various fields of Medical sector.

3. To adapt to emerging information and communication technologies (ICT) to innovate ideas and solutions for current societal and scientific issues thereby developing indigenous medical instruments that are on par with the existing technology.
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1 - low, 2 - medium, 3 - high, ‘-’ - no correlation
## B. E. BIOMEDICAL ENGINEERING

### CHOICE BASED CREDIT SYSTEM

### CURRICULUM AND SYLLABI FOR SEMESTERS I TO VIII

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8. GE3171 Problem Solving and Python Programming Laboratory | ESC | 0 | 0 | 4 | 4 | 2

9. BS3171 Physics and Chemistry Laboratory | BSC | 0 | 0 | 4 | 4 | 2

10. GE3172 English Laboratory | EEC | 0 | 0 | 2 | 2 | 1

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10. BM3271 Biosciences Laboratory | PCC | 0 | 0 | 4 | 4 | 2

11. GE3272 Communication Laboratory / Foreign Language | EEC | 0 | 0 | 4 | 4 | 2

**TOTAL**

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

- **Skill Based Course**

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ANNA UNIVERSITY, CHENNAI 600 025
NON-AUTONOMOUS AFFILIATED COLLEGES
REGULATIONS 2021

SEMESTER II
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* Skill Based Course

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

## SEMESTER VI

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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 should 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
**SEMESTER VII / VIII**

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**PRACTICALS**

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**TOTAL** 14 0 0 14 16

*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).

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

**SEMESTER VIII / VII**

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**TOTAL** 0 0 20 20 10

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

**TOTAL CREDITS : 163**

**ELECTIVE – MANAGEMENT COURSES**

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### MANDATORY COURSES I’

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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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<tr>
<td>Artificial Organs and Implants</td>
<td>Medical Device Design</td>
<td>Hospital Planning and Management</td>
<td>Rehabilitation Engineering</td>
<td>Computer Vision</td>
<td>Wearable Devices</td>
<td>Critical Care Equipment</td>
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<tr>
<td>Biomedical Optics and Photonics</td>
<td>Patient safety, Standards and Ethics</td>
<td>Medical Waste Management</td>
<td>Physiological Modelling</td>
<td>Speech and Audio Signal Processing</td>
<td>Body Area Networks</td>
<td>Human Assist Devices</td>
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<tr>
<td>Principles of Tissue Engineering</td>
<td>Medical Innovation and Entrepreneurship</td>
<td>Biostatistics</td>
<td>Ergonomics</td>
<td>Brain Computer Interface and Applications</td>
<td>Telehealth Technology</td>
<td>Robotics in Medicine</td>
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<tr>
<td>Genetic Engineering</td>
<td>Rapid Prototyping</td>
<td>Forensic Science in Healthcare</td>
<td>Haptics</td>
<td>Biometrics</td>
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**Registration of Professional Elective Courses from Verticals:**

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

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### OPEN ELECTIVES

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

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## SUMMARY

Name of the Programme: B.E. Biomedical Engineering

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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.
### VERTICALS FOR MINOR DEGREE
*(In addition to all the verticals of other programmes)*

*(choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)*

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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 a 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, make decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.
(iv) Literary Activity

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

(v) Proficiency Modules

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

(vi) Lectures by Eminent People

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

(vii) Visits to Local Area

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

(viii) Familiarization to Dept./Branch & Innovations

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

(ix) Department Specific Activities

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

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

References:
Guide to Induction program from AICTE
COURSE OBJECTIVES:

- To improve the communicative competence of learners.
- To learn to use basic grammatic structures in suitable contexts.
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text.
- To help learners use language effectively in professional contexts.
- To develop learners’ ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

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

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

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

**TOTAL : 45 PERIODS**

**COURSE 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 :**
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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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

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

REFERENCES:

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

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PH3151 ENGINEERING PHYSICS

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
momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum – double pendulum – Introduction to nonlinear oscillations.

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

UNIT III OSCILLATIONS, OPTICS AND LASERS 9

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

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

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

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

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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CY3151  ENGINEERING CHEMISTRY  L T P C
3 0 0 3

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

UNIT I  WATER AND ITS TREATMENT

UNIT II  NANOCHEMISTRY
Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.
UNIT III PHASE RULE AND COMPOSITES
Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.
Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

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

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

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GE3151 PROBLEM SOLVING AND PYTHON PROGRAMMING

L T P C
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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
9

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS
9
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
9
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.
UNIT IV LISTS, TUPLES, DICTIONARIES 9
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES 9
Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, students will be able to
C01: Develop algorithmic solutions to simple computational problems.
C02: Develop and execute simple Python programs.
C03: Write simple Python programs using conditionals and loops for solving problems.
C04: Decompose a Python program into functions.
C05: Represent compound data using Python lists, tuples, dictionaries etc.
C06: 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

UNIT III FOLK AND MARTIAL ARTS
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, 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 பண பொடும் – கக. கக. பிளளள (தவளியீடு: தமிழ்நொடு பொடநூலியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முளனவர் இல.சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – அமர் ததொல்லியல் பணிகள் கழகம் (தவளியீடு).
4. தபொருளந – ஆற்றங்கள் கழகம். (தவளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL – Reference Book.)

GE3152

தமிழர் மரபு L T P C 1 0 0 1

அங்க I பொருள் மரபு தொகுப்பு:

8. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL – Reference Book.)
TEXT-CUM-REFERENCE BOOKS

1. Tamil History - Politics - Society - Culture: (Tamil Nadu Government) (Published by: Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

2. Social Life of Tamils - The Classical Period (Dr. K.K. Pillay) (Published by: International Institute of Tamil Studies).

3. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies).

4. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

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GE3171 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C

0 0 4 2

COURSE OBJECTIVES:

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

EXPERIMENTS:
Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.
1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)

2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).

3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)

4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)

5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)

6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)

7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)


9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)

10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter’s age validity, student mark range validation)


12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

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

CO1: Develop algorithmic solutions to simple computational problems.

CO2: Develop and execute simple Python programs.

CO3: Implement programs in Python using conditionals and loops for solving problems.

CO4: Deploy functions to decompose a Python program.

CO5: Process compound data using Python data structures.

CO6: Utilize Python packages in developing software applications.

TEXT BOOKS:

REFERENCES:
CO’s-PO’s & PSO’s MAPPING

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BS3171 PHYSICS AND CHEMISTRY LABORATORY

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.
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.

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

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

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.
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:

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

COURSE 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

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.

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.

HS3252 PROFESSIONAL ENGLISH - II

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

UNIT I  MAKING COMPARISONS  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
Reading –Newspaper articles; Writing – Recommendations, Transcoding, Accident Report, Survey
Report Grammar – Reported Speech, Modals Vocabulary – Conjunctions- use of prepositions

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

REFERENCES:
   press. New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001,
   NewDelhi.

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

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

Lagrange’s and Newton’s divided difference interpolations – Newton’s forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson’s 1/3 rules.

UNIT V   NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS


TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

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

TEXT BOOKS:


REFERENCES:


CO’s- PO’s & PSO’s MAPPING

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TOTAL: 60 PERIODS
COURSE OBJECTIVES:
The student should be:
- To study structural and functional properties of carbohydrates, proteins, lipids and amino acids
- To emphasize the role of these biomolecules by providing basic information on specific metabolic diseases and disorders of these biomolecules
- Gain knowledge on the structural and functional aspects of living organisms.
- Know the etiology and remedy in treating the pathological diseases.

UNIT I   FUNDAMENTALS TO BIOCHEMISTRY
Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, 
Handerson - Hasselbalch equation, physiological buffers in living systems, Energy in living organism. Properties of water and their applications in biological systems. Introduction to Biomolecules, Biological membrane, Clinical application of Electrolytes and radioisotopes.

UNIT II   CARBOHYDRATES, LIPIDS, PROTEIN
Classification of carbohydrates - mono, di, oligo and polysaccharides. Structure, physical and 
chemical properties of carbohydrates - Classification of lipids- simple, compound, and derived 
lipids. Nomenclature of fatty acid - Structure and properties of proteins, structural organization of 
proteins, classification and properties of amino acids. Nucleic acid: Structural aspects – Components of DNA and RNA, Nucleosides & Nucleotides (introduction, structure & bonding), Double helical structure of DNA (Watson-Crick model), various forms of DNA.

UNIT III   CELL DEGENERATION, REPAIR AND NEOPLASIA
Cell injury - Reversible cell injury and Irreversible cell injury and Necrosis, Apoptosis, Intracellular 
accumulations, Pathological calcification- Dystrophic and Metastatic. cellular adaptations of growth and 
differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, 
Benign and Malignant tumours, carcinogenesis, spread of tumours Autopsy and biopsy.

UNIT IV   FLUID AND HEMODYNAMIC DERANGEMENTS
Edema, Hyperemia/Ischemia, normal hemostasis, thrombosis, disseminated intravascular 
coaulation, embolism, infarction, shock, Chronic venous congestion. Hematological disorders-
Bleeding disorders, Leukaemias, Lymphomas Haemorrhage.

UNIT V   FUNDAMENTALS OF MICROBIOLOGY AND IMMUNOPATHOLOGY
Structure of Bacteria and Virus - Morphological features and structural organization of bacteria and 

TOTAL : 45 PERIODS
COURSE OUTCOMES:
At the end of the course, the student should be able to:
CO1: Explain the fundamentals of biochemistry
CO2: Analyze structural and functional aspects of living organisms.
CO3: Explain the function of microscope
CO4: Describe methods involved in treating the pathological diseases.

TEXT BOOKS:

REFERENCES:

BE3251  BASIC ELECTRICAL AND ELECTRONICS ENGINEERING  L  T  P  C  3  0  0  3

COURSE OBJECTIVES:
- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics
- To introduce the functional elements and working of measuring instruments

UNIT I  ELECTRICAL CIRCUITS  9
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm’s Law - Kirchhoff’s Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)
Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

UNIT II  ELECTRICAL MACHINES  9
UNIT III ANALOG ELECTRONICS

UNIT IV DIGITAL ELECTRONICS
Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only).

UNIT V MEASUREMENTS AND INSTRUMENTATION

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completing this course, the students will be able to
CO1: Compute the electric circuit parameters for simple problems
CO2: Explain the working principle and applications of electrical machines
CO3: Analyze the characteristics of analog electronic devices
CO4: Explain the basic concepts of digital electronics
CO5: Explain the operating principles of measuring instruments

TEXT BOOKS:

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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COURSE OBJECTIVE:
- To provide understanding of the application of the radiation concepts and methods of Physics in Medical science
- To accentuate the principle, effects and clinical applications of ionizing, non-ionizing and electromagnetic radiation.
- To enunciate the fundamentals of acoustic waves and their interaction with human tissues.
- To explore the effects of radiation in matter and how isotopes are produced.
- To study effects of sound and light in human body.

UNIT I  LOW ENERGY ELECTROMAGNETIC SPECTRUM AND ITS MEDICAL APPLICATION

Physics of light, Intensity of light, limits of vision and color vision an overview, Non-ionizing Electromagnetic Radiation: Overview of non-ionizing radiation effects-Tissue as a leaky dielectric-Low Frequency Effects- Higher frequency effects., Thermography– Application

UNIT II  PRINCIPLES OF RADIOACTIVE NUCLIDES

Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity, Radionuclide used in Medicine and Technology, Decay series, Production of radionuclides – Cyclotron produced Radionuclide- Reactor produced Radionuclide-fission and neutron capture reaction, radionuclide Generator-Technetium generator

UNIT III  INTERACTION OF RADIATION WITH MATTER LIPIDS

Interaction of charged particles with matter –Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter- Photoelectric effect, Compton Scattering , Pair production, Attenuation of Gamma Radiation, Interaction of neutron with matter and their clinical significance

UNIT IV  RADIATION DOSE AND ITS EFFECTS

Dose and Exposure measurements – Units (SI), Inverse square law, Maximum permissible exposure, relationship between the dosimetric quantities, Radiation biology – effects of radiation, concept of LD 50, Stochastic and Non-stochastic effects, Radiation Syndrome.

UNIT V  PRINCIPLES AND APPLICATIONS OF SOUND IN MEDICINE

Physics of sound, Normal sound levels, ultrasound fundamentals, Generation of ultrasound (Ultrasound Transducer), Interaction of Ultrasound with matter- Cavitations, Reflection, Transmission, Scanning methods, Artifacts, Ultrasound- Doppler effect, Clinical Applications

TOTAL : 45 PERIODS
COURSE OUTCOMES:
Upon completion of the course, students will be able to:
CO1: Interpret the properties of electromagnetic radiations and its effect on human.
CO2: Apply the principles and understand the production of radioactive nuclides.
CO3: Explain the interaction of radiation with matter.
CO4: Identify and Analyse the radiation quantities and its effects.
CO5: Demonstrate the knowledge on the properties of sound and its application in medicine.

TEXT BOOKS:

REFERENCES:

E-RESOURCES:
1. http://www.nptel.ac.in/courses/115102017/ , “Nuclear science and Engineering”, Dr. Santanu Gosh, Department of Physics, IIT, Delhi.

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

GE3252 TAMILS AND TECHNOLOGY L T P C 1 0 0 1

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
TEXT-CUM-REFERENCE BOOKS

1. தமிழ் வரலை - மக்களும் பண பொடும் - ககககககத்தில் (தவளியீடு: தேவதீன் பாதனான மரம் கல்லுறுப்பின் பரிமாற்றங்கள்).

2. தமிழின் தமிழ் - செம்மையும் குழு (துரோஸ் பிரசுரம்).

3. தொன்னு - காலத்தில் நிறைவு காட்டகத்தில் கருப்பு சிவப்பு பொண்டங்களும் - பொண்டங்களில் கீறல் குறியீடுகளும்.

4. புகழ்கோள் - புரோஷுப் ராஜகோணம் (தேவதீன் கடது வீரப்பித்து).

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

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

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

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

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

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

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL – Reference Book.)

TOTAL: 15 PERIODS
காரணிகள் குழுப்பு கலவை.

அலகு III காரணிகள் குழுப்பு:

அலகு IV வாசிக்கலவை மொனாவை நிற்பொருக்கும் காரணிகள் குழுப்பு:

அலகு V அறிவியல் குழுப்பு காரணிகள்:

TEXT-CUM-REFERENCE BOOKS
1. தமிழக வரலொறு – முன்னெடுத்து வரலொறு – தமிழக தமிழ் முற்றுகள் (தமிழில்: தமிழ்நொடு பொடி புத்தகம், கொள்ளியையூர் பசுகால் குழும).
2. தமிழ்நொடு பொடி – முன்னெடுத்து வரலொறு (தமிழில்: பிளக்).
3. சுந்தராச் கல்வியியல் பள்ளிகள் – முன்னெடுத்து வரலொறுச் சொன்றுகள் (தமிழில்: கொள்ளியையூர் பசுகால் குழும).
4. பொிக்குளவத் திட்டம் – முன்னெடுத்து வரலொறு (தமிழில்: கொள்ளியையூர் பசுகால் குழும).
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TOTAL: 15 PERIODS
### NCC Credit Course Level 1*

**(ARMY WING)**

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#### NCC GENERAL

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<td>NCC 2</td>
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##### NATIONAL INTEGRATION AND AWARENESS

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#### PERSONALITY DEVELOPMENT

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#### LEADERSHIP

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#### SOCIAL SERVICE AND COMMUNITY DEVELOPMENT

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**TOTAL: 30 PERIODS**
NX3252  NCC Credit Course Level 1*  
(NAVAL WING)  

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### SOCIAL SERVICE AND COMMUNITY DEVELOPMENT  

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**TOTAL : 30 PERIODS**
NCC Credit Course Level 1*
(AIR FORCE WING)

NCC Credit Course Level - I

NCC GENERAL

NCC 1 Aims, Objectives & Organization of NCC 1
NCC 2 Incentives 2
NCC 3 Duties of NCC Cadet 1
NCC 4 NCC Camps: Types & Conduct 2

NATIONAL INTEGRATION AND AWARENESS

NI 1 National Integration: Importance & Necessity 1
NI 2 Factors Affecting National Integration 1
NI 3 Unity in Diversity & Role of NCC in Nation Building 1
NI 4 Threats to National Security 1

PERSONALITY DEVELOPMENT

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

LEADERSHIP

L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code 3
L 2 Case Studies: Shivaji, Jhasi Ki Rani 2

SOCIAL SERVICE AND COMMUNITY DEVELOPMENT

SS 1 Basics, Rural Development Programmes, NGOs, Contribution of Youth 3
SS 4 Protection of Children and Women Safety 1
SS 5 Road / Rail Travel Safety 1
SS 6 New Initiatives 2
SS 7 Cyber and Mobile Security Awareness 1

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

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

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES

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

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

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

PART II ELECTRICAL ENGINEERING PRACTICES

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
g) Study of emergency lamp wiring/Water heater
PART III  MECHANICAL ENGINEERING PRACTICES  15

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

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

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

SHEET METAL WORK:
   a) Making a square tray.

FOUNDRY WORK:
   a) Demonstrating basic foundry operations.

PART IV  ELECTRONIC ENGINEERING PRACTICES  15

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

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

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

TOTAL : 60 PERIODS

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

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

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

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

CO4: Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.
BM3271  BIOSCIENCES LABORATORY

COURSE OBJECTIVES:
To provide practice on:
- Estimation and quantification of biomolecules.
- Separation of macromolecules.
- Use Compound microscope
- Practice on chemical examinations, Histopathological examinations etc

LIST OF EXPERIMENTS:
1. Preparation of solutions: 1) percentage solutions, 2) molar solutions, 3) normal solutions
2. Standardization of pH meter, preparation of buffers, emulsions.
3. Spectroscopy: Determination of absorption maxima (λmax) of a given solution
4. General tests for carbohydrates, proteins and lipids.
5. Identification of Blood Collection Tubes and Phlebotomy equipment
6. Preparation of serum and plasma from blood
7. Estimation of Haemoglobin and blood glucose
8. Estimation of creatinine, urea and Uric acid
9. Separation of proteins by SDS electrophoresis (Demo) and amino acids by thin layer chromatography (Demo).
10. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)
11. Basic staining – Hematoxylin and eosin staining.
12. Special stains – cresyl fast Blue (CFV)- Trichrome – oil red O – PAS
13. Types of Staining : Simple stain, Gram stain
14. Study of parts of compound microscope
15. Study of Histopathological slides of benign and malignant tumours.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
CO1: Understand the Biochemistry laboratory functional components
CO2: Have a sound knowledge of qualitative test of different biomolecules.
CO3: Understand the basics knowledge of Biochemical parameter and their interpretation in Blood sample.
CO4: Have a sound knowledge of separation technology of proteins and amino acids.
CO5: Student can perform practical experiments on staining Processes.
TEXTBOOK:

GE3272  COMMUNICATION LABORATORY  L T P C
0 0 4 2

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

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

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

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

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

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

TOTAL: 60 PERIODS

COURSE 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.

CO’s-PO’s & PSO’s MAPPING

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

MA3351 TRANSCFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

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COURSE OBJECTIVES
- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

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

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

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS
Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Cartesian coordinates only).

UNIT IV FOURIER TRANSFORMS
UNIT V  Z-TRANSFORMS AND DIFFERENCE EQUATIONS


TOTAL: 60 PERIODS

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

CO1: Understand how to solve the given standard partial differential equations.

CO2: Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.

CO3: Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.

CO4: Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

CO5: Use the effective mathematical tools for the solutions of partial differential equations by using Z-transform techniques for discrete time systems.

TEXT BOOKS:

REFERENCES:

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

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COURSE OBJECTIVES:
The objective of this unit is to make the student learn and understand
- Introduce the concept of diodes, Bipolar Junction Transistors and FET.
- Study the various model parameters of Transistors
- Learn the concept of special semiconductor devices, Power & Display devices
- Impart the knowledge of various configurations, characteristics, applications.
- To have knowledge of display and power devices.

UNIT I SEMICONDUCTOR DIODE
PN junction diode, Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown in PN Junction Diodes.

UNIT II BIPOLAR JUNCTION TRANSISTORS

UNIT III FIELD EFFECT TRANSISTORS
MOSFETs – Drain and Transfer characteristics,-Current equations-Pinch off voltage and its significance- Threshold voltage -Channel length modulation, small signal Characteristics, D-MOSFET, E-MOSFET- Characteristics – Comparison of MOSFET with BJT.

UNIT IV SPECIAL SEMICONDUCTOR DEVICES
Metal-Semiconductor Junction - MESFET, FINFET, PINFET, CNTFET, DUAL GATE MOSFET, Point Contact Diode, p-i-n Diode, Avalanche Photodiode, Schottky barrier diode- Zener diode- Varactor diode –Tunnel diode- Gallium Arsenide device, LASER diode, LDR.

UNIT V POWER DEVICES AND DISPLAY DEVICES
UJT, Thyristor - SCR, Diac, Triac, Power BJT- Power MOSFET- DMOS-VMOS. LED, LCD, Opto Coupler, Solar cell, CCD.

COURSE OUTCOMES:
At the end of the course, the student should be able to:
- CO1: Analyze the characteristics of semiconductor diodes.
- CO2: Analyze and solve problems of Transistor circuits using model parameters.
- CO3: Identify and characterize diodes and various types of transistors.
- CO4: Analyze the characteristics of special semiconductor devices.
- CO5: Analyze the characteristics of Power and Display devices.

TOTAL:45 PERIODS

TEXT BOOK

REFERENCES

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BM3301 SENSORS AND MEASUREMENTS

COURSE OBJECTIVES:
- To understand the purpose of measurement, the methods of measurements, errors associated with measurements.
- To know the principle of transduction, classifications and the characteristics of different transducers.
- To learn the different bridges for measurement.
- To know the different display and recording devices.
- To understand various type of biosensors.

UNIT I FUNDAMENTALS OF MEASUREMENTS

UNIT II DISPLACEMENT, PRESSURE, TEMPERATURE SENSORS
Strain Gauge: Gauge factor, sensing elements, configuration, and unbounded strain gage. Capacitive transducer - various arrangements, Inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics, Active type: Thermocouple - characteristics.

UNIT III PHOTOELECTRIC AND PIEZOELECTRIC SENSORS
Phototube, scintillation counter, photo multiplier tube (PMT), photovoltaic, photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers. Optical displacement sensors and optical encoders. Piezoelectric active transducer- Equivalent circuit and its characteristics.
UNIT IV  SIGNAL CONDITIONING CIRCUITS AND METERS

Functions of signal conditioning circuits, Preamplifiers, Concepts of passive filters, Impedance matching circuits, AC and DC Bridges - wheat stone bridge, Kelvin, Maxwell, Hay, Schering, Q-meter, PMMC, MI and dynamometer type instruments - DC potentiometer- Digital voltmeter – Multi meter.

UNIT V  RECORDING DEVICES AND ADVANCED SENSORS


COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Measure various electrical parameters with accuracy, precision, resolution.
CO2: Select appropriate passive or active transducers for measurement of physical phenomenon.
CO3: Select appropriate light sensors for measurement of physical phenomenon
CO4: Use AC and DC bridges for relevant parameter measurement.
CO5: Employ multimeter, CRO and different types of recorders for appropriate measurement.

TOTAL:45 PERIODS

TEXT BOOKS

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COURSE OBJECTIVES:
- To introduce the basic concepts of DC and AC circuits behavior
- To study the transient and steady state response of the circuits subjected to step and sinusoidal excitations.
- To introduce different methods of circuit analysis using Network theorems, duality and topology

UNIT I BASIC CIRCUITS ANALYSIS

UNIT II NETWORK THEOREM AND DUALITY

UNIT III SINUSOIDAL STEADY STATE ANALYSIS

UNIT IV TRANSIENTS AND RESONANCE IN RLC CIRCUITS

UNIT V COUPLED CIRCUITS AND TOPOLOGY
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.

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
 CO1: Comprehend and design ac/dc circuits.
 CO2: Apply circuit theorems in real time.
 CO3: Evaluate ac/dc circuits.
 CO4: Analyse the electrical circuits
 CO5: Develop and understand ac/dc circuits.

TOTAL:45 PERIODS

TEXT BOOKS
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BM3351 ANATOMY AND HUMAN PHYSIOLOGY

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<td>To integrate the individual functional units of all the cells and tissues and organs into functional whole, the human body.</td>
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<td>Function is dependent on a structure, the curriculum lays stress on functional anatomy of the organs.</td>
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<td>Emphasizes on the cardiovascular, respiratory, urinary and nervous system and their interrelatedness.</td>
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<td>Stimulate the students to understand the basic functioning of every system and the resultant unified organization.</td>
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UNIT I BASIC ELEMENTS OF HUMAN BODY

UNIT II SKELETAL AND MUSCULAR SYSTEM

UNIT III CARDIOVASCULAR AND RESPIRATORY SYSTEM
UNIT IV DIGESTIVE AND EXCRETORY SYSTEMS

Structure and functions of gastrointestinal system - secretory functions of the alimentary tract - digestion and absorption in the gastrointestinal tract - structure of nephron - mechanism of urine formation - skin and sweat gland - temperature regulation.

UNIT V NERVOUS AND SENSORY SYSTEM


45 PERIODS

LIST OF EXPERIMENTS

1. Collection of Blood Samples
2. Identification of Blood groups (Forward and Reverse)
3. Bleeding and Clotting time
4. Estimation of Hemoglobin
5. Total RBC and WBC Count
6. Differential count of Blood cells
7. Estimation of ESR, PCV, MCH, MCV, MCHC
8. Hearing test – Tuning fork
9. Visual Activity – Snellen’s Chart and Jaeger’s Chart

30 PERIODS
TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1 Identify and explain basic elements of human body
CO2 Explain the functions of skeletal and muscular system
CO3 Describe the structure, function of cardiovascular system and respiratory system
CO4 Discuss the structure of digestive and excretory system.
CO5 Describe the physiological process of Nervous and sensory system

TEXT BOOKS:


REFERENCES:


CO’s- PO's & PSO’s MAPPING

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COURSE OBJECTIVES:

- To understand Object Oriented Programming concepts and basics of Java programming language
- To know the principles of packages, inheritance and interfaces
- To develop a java application with threads and generics classes
- To define exceptions and use I/O streams
- To design and build Graphical User Interface Application using JAVAFX

UNIT I  INTRODUCTION TO OOP AND JAVA

UNIT II  INHERITANCE, PACKAGES AND INTERFACES

UNIT III  EXCEPTION HANDLING AND MULTITHREADING

UNIT IV  I/O, GENERICS, STRING HANDLING

UNIT V  JAVAFX EVENT HANDLING, CONTROLS AND COMPONENTS

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

- CO1: Apply the concepts of classes and objects to solve simple problems
- CO2: Develop programs using inheritance, packages and interfaces
- CO3: Make use of exception handling mechanisms and multithreaded model to solve real world problems
- CO4: Build Java applications with I/O packages, string classes, Collections and generics concepts
- CO5: Integrate the concepts of event handling and JavaFX components and controls for developing GUI based applications

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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BM3361 FUNDAMENTALS OF ELECTRONIC DEVICES AND CIRCUITS LABORATORY

L T P C
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COURSE OBJECTIVE:

- To supplement the theory courses Semiconductor Devices and Basic Electrical Engineering.
- To assist the students in obtaining a better understanding of the operation of electronic circuits and devices.
- To provide experience in analyzing network theorems.

LIST OF EXPERIMENTS

1. Characteristics of PN and zener diode.
2. Characteristics of CE, CB configurations.
3. Half wave and Full wave rectifier with capacitor filter.
5. Study of characteristics of photo diodes.
6. Study of characteristics of SCR.
7. Verification of KVL and KCL.
8. Verification of Thevenin’s and Norton’s Theorems.
9. Verification of superposition Theorem.
10. Verification of Maximum power transfer and reciprocity theorems.

COURSE OUTCOMES:

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

CO1: Experiment and determine the VI characteristics of given PN junction diode, Zener diode, Photo diode and Silicon Controlled Rectifier.

CO2: Experiment and determine the Input & output characteristics of BJT.

CO3: Experiment and test half wave and full wave rectifier circuit using PN Junction diode and
obtain the ripple factor, rectifier efficiency and experiment and test voltage regulation characteristics using Zener diode voltage regulator circuit.

**CO4:** Experiment and test the given electric circuit using Kirchhoff’s laws and obtain the mesh current & node voltage and obtain the load current for the given circuit using Superposition, Thevenin’s, and Norton’s and Reciprocity theorems.

**CO5:** Construct and test RLC series and parallel circuits to compute the resonant frequency and bandwidth by plotting the frequency response.

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

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### BM3311

**SENSORS AND MEASUREMENTS LABORATORY**

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**COURSE OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, simulations with a futuristic vision along with socio-economic impact and issues.
- To study the characteristics of sensors, signal conditioning circuits and display devices.

**LIST OF EXPERIMENTS:**

1. Calibration of voltmeter and ammeter using shunt type Potentiometer
2. Characteristics of thermistor
3. Characteristics of thermocouple
4. Characteristics of LDR
5. Characteristics of Photo Diode
6. Characteristics of Photo transistor
7. Characteristics of RTD
8. Characteristics of LVDT
9. Measurement of unknown Resistance using Kelvin Double Bridge and Wheatstone bridge
10. Measurement of unknown Capacitance using Schering Bridge
11. Measurement of unknown Inductance using Maxwell’s & Hay’s Bridge
12. Characteristics of Hall effect transducer
13. Characteristics of strain gauge
14. Study of Electronic nose
15. Demonstration of CRO & DSO
16. Characteristics of Piezoelectric Transducer

**TOTAL:** 45 PERIODS
COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: design and understand characteristics and calibration of various transducers.
CO2: design and develop bridge circuits to find unknown variables.
CO3: select proper transducer for various applications.
CO4: understand various read out and display devices.
CO5: design a measurement system for various applications.

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

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CS3381 OBJECT ORIENTED PROGRAMMING LABORATORY L T P C
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COURSE OBJECTIVES
- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, inheritance, exception handling and file processing.
- To develop applications using generic programming and event handling

LIST OF EXPERIMENTS
1. Solve problems by using sequential search, binary search, and quadratic sorting algorithms (selection, insertion)
2. Develop stack and queue data structures using classes and objects.
3. Develop a java application with an Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club funds. Generate pay slips for the employees with their gross and net salary.
4. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method printArea( ) that prints the area of the given shape.
5. Solve the above problem using an interface.
6. Implement exception handling and creation of user defined exceptions.
7. Write a java program that implements a multi-threaded application that has three threads.
   First thread generates a random integer every 1 second and if the value is even, the second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of the cube of the number.
8. Write a program to perform file operations.
9. Develop applications to demonstrate the features of generics classes.
10. Develop applications using JavaFX controls, layouts and menus.
11. Develop a mini project for any application using Java concepts.

Lab Requirements: for a batch of 30 students
Operating Systems: Linux / Windows
Front End Tools: Eclipse IDE / Netbeans IDE

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of this course, the students will be able to
CO1 : Design and develop java programs using object oriented programming concepts
CO2 : Develop simple applications using package, exceptions, multithreading, and generics concepts
CO3 : Create GUIs and event driven programming applications for real world problems

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:**

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

**MS EXCEL:**

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

**MS POWERPOINT:**

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

TOTAL: 30 PERIODS

COURSE OUTCOMES:

On successful completion the students will be able to

CO1: Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
CO2: Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
CO3: Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

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
Axions 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
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

TOTAL : 60 PERIODS

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.

TEXT BOOKS:

REFERENCE BOOKS:

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COURSE OBJECTIVES:

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

UNIT I  ELEcTRODE CONFIGURATIONS


UNIT II  BIoSIGNAL CHARACTERISTICS

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

UNIT III  BIOAMPLIFIERS


UNIT IV  MEASUREMENT OF BIO SIGNALS


UNIT V  BIOCHEMICAL MEASUREMENTS


COURSE OUTCOMES:

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

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCE BOOKS

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BM3402 ANALOG AND DIGITAL INTEGRATED CIRCUITS

COURSE OBJECTIVES:
- To study the circuit configuration and introduce practical applications of linear integrated circuits.
- To introduce the concept of application of ADC and DAC in real time systems and Phase Locked Loop with applications.
- To introduce the design of various combinational digital circuits using logic gates
- To bring out the analysis and design procedures for synchronous and asynchronous sequential circuits

UNIT I INTRODUCTION TO OPERATIONAL AMPLIFIER AND ITS APPLICATIONS

Operational amplifier –ideal characteristics, Performance Parameters, Linear and Nonlinear Circuits and their analysis- voltage follower, Inverting amplifier, Non-inverting Amplifiers, Differentiator, Integrator, Voltage to Current converter, Instrumentation amplifier, Low pass, High pass filter and band pass filters, Comparator, Multivibrator and Schmitt trigger, Triangular wave generator.
UNIT II  DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS AND PLL  9
Analog switches, High speed sample and hold circuit and IC's, Types of D/A converter -Weighted resistor, R-2R ladder DAC, D/A Accuracy and Resolution. A/D converter - Flash, Dual slope, Successive approximation, A/D Accuracy and Resolution. Voltage controlled oscillator, Voltage to Frequency converters. PLL-Closed loop analysis of PLL, Frequency multiplication/ division, FSK demodulator.

UNIT III  THE BASIC GATES AND COMBINATIONAL LOGIC CIRCUITS  9
Number Systems – Decimal, Binary, Octal, Hexadecimal, 1’s and 2’s complements, Codes – Binary, BCD, 84-2-1, 2421, Excess 3, Biquinary, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map and Tabulation methods. Logic families- TTL, MOS, CMOS, BiCMOS - Comparison of Logic families.

UNIT IV  COMBINATIONAL LOGIC CIRCUITS  9

UNIT V  SEQUENTIAL LOGIC CIRCUITS  9
Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – state minimization, state assignment, circuit implementation. Counters, Ripple Counters, Ring Counters. Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In -Serial Out, Parallel In - Parallel Out, Universal Shift Register.

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: design new analog linear circuits and develop linear IC based Systems.
CO2: Apply the concept of ADC and DAC in real time systems and Phase Locked Loop with applications.
CO3: Use Boolean algebra and apply it to digital systems.
CO4: Design various combinational digital circuits using logic gates.
CO5: Bring out the analysis and design procedures for synchronous and asynchronous sequential circuits.

TOTAL:45 PERIODS

TEXT BOOKS

REFERENCES

CO’s- PO’s & PSO’s MAPPING

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77
BM3451  BIO CONTROL SYSTEMS  L T P C  3 0 0 3  

COURSE OBJECTIVES  
The objective of this course is to enable the student to  
- Understand the concept behind feedback and continuum in various systems and subsystems and the need for mathematical modeling of various systems.  
- Analyze the systems in time and frequency domains  
- Understand the concept of stability of various systems.  
- Apply mathematical modeling principles in understanding the various fundamental biological systems.  

UNIT I  INTRODUCTION  
Open and Closed loop Systems, Mathematical Modeling of systems, Block diagram and signal flow graph representation of systems - reduction of block diagram and signal flow graph, Introduction to Physiological control systems- Illustration, Linear models of physiological systems, Difference between engineering and physiological control systems.  

UNIT II  TIME RESPONSE ANALYSIS  
Step and impulse responses of first order and second order systems - time domain specifications of first and second order systems - steady state error constants.  

UNIT III  STABILITY ANALYSIS  

UNIT IV  FREQUENCY RESPONSE ANALYSIS  

UNIT V  BIOLOGICAL CONTROL SYSTEM ANALYSIS  

TOTAL : 45 PERIODS  

COURSE OUTCOMES  
Upon successful completion of the course, students will be able to  
CO1: Interpret the need for mathematical modeling of various systems, representation of systems in block diagrams and signal flow graphs and are introduced to biological control systems  
CO2: Determine the time response of various systems  
CO3: discuss the concept of system stability  
CO4: Examine the frequency response characteristics of various systems using different charts
CO5: Appraise the concept of modeling basic physiological systems

TEXT BOOKS

REFERENCES:

ONLINE RESOURCES
1. https://nptel.ac.in/courses/108/101/108101037/
2. https://nptel.ac.in/content/storage2/courses/112104158/lecture14.pdf
3. https://nptel.ac.in/content/storage2/courses/112104158/lecture16.pdf
4. https://nptel.ac.in/content/storage2/courses/112104158/lecture17.pdf

CO’s- PO’s & PSO’s MAPPING

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BM3401 SIGNAL PROCESSING

COURSE OBJECTIVES:
- To understand about the continuous time and discrete time signals and systems.
- To learn the analysis of LTI systems using Laplace and Z transform.
- To represent the signal in frequency domain using FFT.
- To gain knowledge about the design of IIR and FIR filters.

UNIT I FUNDAMENTALS OF SIGNALS AND SYSTEMS
Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT II ANALYSIS OF LTI SYSTEMS
UNIT III DISCRETE FOURIER TRANSFORM
DFT and its properties, magnitude and phase representation-Linear Convolution- Correlation-Circular Convolution, Overlay-add and overlap-save methods. FFT - Decimation in Time Algorithm, Decimation in Frequency Algorithm. Use of FFT in Linear Filtering.

UNIT IV INFINITE IMPULSE RESPONSE FILTERS
Analog filters – Butterworth filters, Chebyshev Type I filters (upto 3rd order), Analog Transformation of prototype LPF to BPF /BSF/ HPF. Transformation of analog filters into equivalent digital filters using Impulse invariant method and Bilinear Z transform method - Realization structures for IIR filters – direct, cascade and parallel forms.

UNIT V FINITE IMPULSE RESPONSE FILTERS AND MULTIRATE SIGNAL PROCESSING

COURSE OUTCOMES:
CO1: To classify the continuous time and discrete time signals and systems.
CO2: To analyze the signals in both continuous time and discrete time.
CO3: To apply DFT for the analysis of digital signals & systems.
CO4: To design IIR filter to process real world signals.
CO5: To design FIR filter to process real world signals.

PRACTICALS:
1. Construction of signals with different Frequencies.
2. Analyse the stability of a CT System with various inputs.
3. Analyse the stability of a DT System with various inputs.
4. Reconstruct a signal from samples and study the effect of Aliasing.
5. Spectrum Analysis using FFT
7. Finite word length effect.
9. DSP Processor Implementation. (Linear and Convolution, FFT implementation, IIR and FIR filters implementation)

Equipment required for 30 students
1. Computers with MATLAB / Equivalent software- 15 Numbers
2. TMS320C5416 Processors – 5 Numbers

TEXT BOOKS
REFERENCES

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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


TOTAL: 30 PERIODS

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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NCC Credit Course Level 2*
NX3451 (ARMY WING) NCC Credit Course Level - II L T P C
3 0 0 3

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

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

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

ENVIRONMENTAL AWARENESS & CONSERVATION
EA 1 Environmental Awareness and Conservation 3

GENERAL AWARENESS
GA 1 General Knowledge 4
ARMED FORCES 6
AF 1 Armed Forces, Army, CAPF, Police 6

ADVENTURE 1
AD 1 Introduction to Adventure Activities 1

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

TOTAL: 45 PERIODS

NCC Credit Course Level 2*
NX3452 (NAVAL WING) NCC Credit Course Level - II L T P C

PERSONALITY DEVELOPMENT 9
PD 3 Group Discussion: Change your mindset, Time Management, Social Skills 6
PD 5 Public Speaking 3

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

DISASTER MANAGEMENT 13
DM 1 Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation 3
DM 2 Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters 9
DM 3 Fire Service & Fire Fighting 1

ENVIRONMENTAL AWARENESS & CONSERVATION 3
EA 1 Environmental Awareness and Conservation 3

GENERAL AWARENESS 4
GA 1 General Knowledge 4

NAVAL ORIENTATION 6
AF 1 Armed Forces and Navy Capsule 3
EEZ 1 EEZ Maritime Security and ICG 3

ADVENTURE 1
AD 1 Introduction to Adventure Activities 1

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

TOTAL: 45 PERIODS

84
PERSONALITY DEVELOPMENT
PD 3  Group Discussion: Change your mindset, Time Management, Social Skills 6
PD 5  Public Speaking 3

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

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

ENVIRONMENTAL AWARENESS & CONSERVATION
EA 1  Environmental Awareness and Conservation 3

GENERAL AWARENESS
GA 1  General Knowledge 4

GENERAL SERVICE KNOWLEDGE
GSK 1  Armed Forces & IAF Capsule 2
GSK 2  Modes of Entry in IAF, Civil Aviation 2
GSK 3  Aircrafts - Types, Capabilities & Role 2

ADVENTURE
AD 1  Introduction to Adventure Activities 1

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

TOTAL: 45 PERIODS

BM3411  BIOMEDICAL INSTRUMENTATION LABORATORY  L T P C
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COURSE OBJECTIVES:
The student should be made to
- To study and design Bio amplifiers.
- To provide hands on training on Measurement of physiological parameters.

LIST OF EXPERIMENTS:
1. Design of pre amplifiers to acquire bio signals along with impedance matching circuit using
suitable IC’s

2. Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts.
3. Design of EMG amplifier
4. Design a suitable circuit to detect QRS complex and measure heart rate
5. Design of frontal EEG amplifier
6. Design of EOG amplifier to detect eye blink
7. Design a right leg driven ECG amplifier.
8. Design and study the characteristics of optical Isolation amplifier
9. Design a Multiplexer and Demultiplexer for any two biosignals.
13. Measurement and recording of peripheral blood flow
14. Design a PCB layout for any bio amplifier using suitable software tool.

TOTAL: 45 PERIODS

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

CO1: Design the amplifier for Bio signal measurements
CO2: Measure heart rate and heart sounds.
CO3: Record and analyze pulse rate and respiration rate
CO4: Measure blood pressure and blood flow
CO5: Design isolation amplifier

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BM3412  ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY  L  T  P  C
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COURSE OBJECTIVES:
The student should be made to
- To design digital logic and circuits
- To learn the function of different ICs
- To understand the applications of operation amplifier.
To learn the working of multivibrators
To design circuits for generating waveforms using ICs.

LIST OF EXPERIMENTS:
1. Inverting, non-inverting amplifier and comparator
2. Integrator and Differentiator
3. Design and analysis of active filters using opamp
4. Schmitt trigger using operational amplifier
5. Instrumentation amplifier using operational amplifier
6. RC and LC oscillators
7. Multivibrators using IC555 Timer
8. Study of logic gates, Half adder and Full adder
9. Encoder and BCD to 7 segment decoder
10. Multiplexer and demultiplexer using digital ICs
11. Universal shift register using flip flops
12. Design of mod-N counter
13. Simulation and analysis of circuits using software

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Design Combinational Circuits using logic gates
CO2: Design and implement arithmetic circuits for different applications using opamp
CO3: Design Sequential Circuits using logic gates
CO4: Design wave form generators and analyse their characteristics
CO5: Simulate and analyse circuits using ICs

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BM3551 EMBEDDED SYSTEMS AND IoMT

COURSE OBJECTIVES:
The objective of this course is to enable the student to
- Acquire knowledge and understand fundamental embedded systems design paradigms, architectures, possibilities, and challenges, both with respect to software and hardware.
- Understand the hardware architecture and features of embedded microcontrollers and peripherals.
- Understand programming aspects of embedded system design.
- Understand IoT architecture and Build simple IoT Systems using embedded target
boards.

- Understand IoMT infrastructure for healthcare applications.

UNIT I INTRODUCTION TO EMBEDDED SYSTEM DESIGN


UNIT II PERIPHERAL INTERFACING

I/O Devices-Timers and Counters- Watchdog Timers, Interrupt Controllers- A/D and D/A, Interfacing- Memory interfacing with a case study- I/O Device Interfacing with case Study- Programmed IO-Memory Mapped IO, Interfacing Protocols-SPI, I²C, USB, CAN, Ethernet/WiFi, Bluetooth

UNIT III EMBEDDED SYSTEM SOFTWARE DESIGN


UNIT IV DESIGN AND DEVELOPMENT OF IOT

Definition and characteristics of IoT, Technical Building blocks of IoT, Communication Technologies, Physical design of IoT - system building blocks - sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino), Benefits and impact of IoMT. Cybersecurity – vulnerability, penetration & encryption technologies

UNIT V INTERNET OF MEDICAL THINGS


COURSE OUTCOME:

At the end of this course, the student should be able to

CO1: Explain fundamental embedded systems design paradigms, architectures, possibilities, and challenges, both with respect to software and hardware.

CO2: Describe the hardware architecture and features of embedded microcontrollers and peripherals.

CO3: Explain software design tools and embedded system design programming phases.

CO4: Describe IoT Architectures and Build simple IoT Systems using embedded target boards.

CO5: Exhibit understanding of IoMT infrastructure for healthcare applications.
TEXT BOOKS:


REFERENCE BOOKS:


CO’s- PO’s & PSO’s MAPPING

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BM3591 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT

COURSE OBJECTIVES:
The student should be made to:

- Understand the devices for measurement of parameters related to cardiology.
- Illustrate the recording and measurement of EEG
- Demonstrate EMG recording unit and its uses.
- Explain diagnostic and therapeutic devices related to respiratory parameters.
Understand the various sensory measurements that hold clinical importance.

UNIT I CARDIAC EQUIPMENT
Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, ECG machine maintenance and troubleshooting, Cardiac Pacemaker– Internal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External, Defibrillator Protection Circuit, Cardiac ablation catheter.

UNIT II NEUROLOGICAL EQUIPMENT
Clinical significance of EEG, Multi-channel EEG recording system, Epilepsy, Evoked Potential– Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph). EEG Bio Feedback Instrumentation. EEG system maintenance and troubleshooting.

UNIT III MUSCULAR AND BIOMECHANICAL EQUIPMENT

UNIT IV RESPIRATORY MEASUREMENT AND ASSIST SYSTEM

UNIT V SENSORY DIAGNOSTIC EQUIPMENT
Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Speech, Eye Tonometer, Applanation Tonometer, slit lamp, auto refractometer.

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Describe the working and recording setup of all basic cardiac equipment.
CO2: Understand the working and recording of all basic neurological equipment’s.
CO3: Discuss the recording of diagnostic and therapeutic equipment’s related to EMG.
CO4: Explain about measurements of parameters related to respiratory system.
CO5: Describe the measurement techniques of sensory responses.

TOTAL:45 PERIODS

TEXT BOOKS

REFERENCES
COURSE OBJECTIVES:
The student should be made to:

- Acquire knowledge and understand the hardware architecture and programming aspects of embedded system design.
- Understand IoT architecture and Build simple IoT Systems using embedded target boards.
- Understand IoMT infrastructure for healthcare applications.

LIST OF EXPERIMENTS

1. Explore AVR/ARM based controllers using Embedded C.
2. Write Basic and arithmetic Programs Using Embedded C.
3. Write Embedded C program to test interrupt and timers.
4. Develop Real time applications – clock generation, waveform generation, counter using embedded C.
5. Explore different communication methods with IoT devices.
6. To interface LED/Buzzer with platform/ Arduino /Raspberry Pi. and write an embedded C program to turn on / off LED/Buzzer with specified delay.
7. To interface DC/stepper motor using relay with open platform/ Arduino /Raspberry Pi. and write an embedded C program to turn on motor if push button is pressed.
9. Develop simple application to interface DHT11 sensor with and write a program to display temperature humidity readings in LCD.
10. Develop IoMT Application using open platform/ Arduino /Raspberry Pi. and sensors such as temperature, ECG, Pulse etc.
11. Deploy IoMT applications using platforms.
12. Mini Project.

TOTAL: 45 PERIODS

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

CO1: Explain hardware architecture of embedded systems and use of software design tools.
CO2: Describe IoT Architectures and Build simple IoT Systems using embedded target boards.
CO3: Exhibit understanding of IoMT infrastructure for healthcare with simple applications.

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**BM3561** DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LAB

**COURSE OBJECTIVES:**
The student should be made to
- To demonstrate recording and analysis of different Bio potentials
- To examine different therapeutic modalities.

**LIST OF EXPERIMENTS:**
1. Measurement of visually and auditory evoked potential.
2. Galvanic skin resistance (GSR) measurement.
5. Electrical safety measurements.
7. Measurement of stimulation current waveforms used in medical stimulator.
8. Analyze the working of ESU–cutting and coagulation modes.
9. Recording of Audiogram.
10. Study the working of Defibrillator and pacemakers.
11. Study of ECG, EEG and EMG electrodes.
12. Study of ventilators and Ultrasound Scanners.
13. Study of speech signals using speech signal trainer kit.
15. Study of heart lung machine model.

**COURSE OUTCOMES:**
On successful completion of this course, the student will be able to
- CO1: Measure the different bioelectrical signals.
- CO2: Record the various physiological signals using telemetry.
- CO3: Demonstrate various diagnostic and therapeutic techniques.
- CO4: Examine the electrical safety measurements.
- CO5: Analyse the different bio signals using suitable tools.
ONLINE RESOURCES

http://bmsp-coep.vlabs.ac.in/List%20of%20experiments.html?domain=Biotechnology

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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

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.
9. Implement clustering algorithms.
10. Implement EM for Bayesian networks.
11. Build simple NN models.
12. Build deep learning NN models.

COURSE 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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COURSE OBJECTIVES:
The objective of this course is to enable the student to
- Understand the statistical methods for the design of biomedical research.
- Comprehend the fundamental of mathematical and statistical theory in the application of Healthcare.
- Apply the regression and correlation analyze in the healthcare data.
- Understand the Meta analysis and variance analysis.
- Interpret the results of the investigational methods.

UNIT I   INTRODUCTION  9
Introduction, Computers and bio statistical analysis, Introduction to probability, likelihood & odds, distribution variability. Finding the statistical distribution using appropriate software tool like R/ Python.

UNIT II  STATISTICAL PARAMETERS  9
Statistical parameters p-values, computation, level chi square test and distribution and hypothesis testing -single population proportion, difference between two population proportions, single population variance, tests of homogeneity. Testing of statistical parameters using appropriate software R / Python.

UNIT III REGRESSION AND CORRELATION ANALYSIS  9
Regression model, evaluating the regression equation, correlation model, correlation coefficient. Finding regression, correlation for the data using appropriate software like R / Python.

UNIT IV ANALYSIS OF VARIANCE  9
META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis, completely randomized design, randomized complete block design, repeated measures design, factorial experiment. Testing the variance using appropriate software tool like R / Python.

UNIT V   CASE STUDIES  9
Epidemical reading and interpreting of epidemical studies, application in community health, Case study on Medical Imaging like MRI, CT. Case study on respiratory data, Case study on ECG data.

TOTAL: 45 PERIODS

COURSE OUTCOMES
On successful completion of this course, the student will be able to
CO1: Define the new and existing statistical methodology for their research problem.
CO2: Explain p-values for different statistical test.
CO3: Analyze the biomedical research data and able to report the study results.
CO4: Enumerate the Meta analysis and variance analysis.
CO5: Describe problems of human health and disease for the interest of advancing the public’s health.

TEXT BOOKS:

REFERENCES:

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BM3652 MEDICAL IMAGE PROCESSING

COURSE OBJECTIVES
The objective of this course is to enable the student to

• Learn the fundamental concepts of medical Image Processing techniques.
• Understand the concepts of various image intensity transformation and filtering operations.
• Be familiar in the techniques of segmentation and restoration of medical images.
• Gain knowledge in medical image registration and visualization.
• Be familiar with the application of medical image analysis.

UNIT I FUNDAMENTALS OF MEDICAL IMAGE PROCESSING AND TRANSFORMS

Overview of Image Processing system and human Visual system- Image representation – pixel and voxels, Gray scale and color models- Medical image file formats- DICOM, ANALYZE 7.5, NIFTI and INTERFILE- Discrete sampling model and Quantization- Relationship between the pixels, Arithmetic and logical operations- Image quality and Signal to Noise ratio- Image Transforms- 2D DFT, DCT, KLT. Interpret the basics of image models, Digitization of images and the transformations of medical images using Matlab.
UNIT II ENHANCEMENT TECHNIQUES 9+3


UNIT III SEGMENTATION AND RESTORATION TECHNIQUES 9+3


UNIT IV REGISTRATION AND VISUALISATION 9+3

Registration–Rigid body transformation, principal axes registration, and feature based. Visualisation-Orthogonal and perspective projection in medicine, Surface based rendering, Volume visualization in medical image. Explain the significance of registration of various imaging modalities and appraise the concepts of image visualization in healthcare using Matlab.

UNIT V APPLICATIONS OF MEDICAL IMAGE ANALYSIS 9+3


TOTAL : 75 PERIODS

COURSE OUTCOMES

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

CO1: Explain and apply the fundamental concepts of image processing techniques for the analysis of medical images.

CO2: Identify and apply suitable filtering and intensity transformation techniques for given medical applications.

CO3: Identify and segment the Region of Interest from the given medical image.

CO4: Explore and apply current research in registration and visualization for medical image analysis.

CO5: Explain and apply the image compression techniques.

CO6: Design and evaluate the use of image processing fundamentals in healthcare applications, as well as their impact on health and society, and any underlying ethical issues, then communicate effectively through reflections, reports, and presentations (Target CO).

TEXT BOOKS

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Pearson Education,

REFERENCES
1. Atam P.Dhawan, Medical Image Analysis, Wiley-Interscience Publication, NJ, USA 2003

CO’s- PO’s & PSO’s MAPPING

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NCC Credit Course Level 3*
NX3651  (ARMY WING) NCC Credit Course - III  

PERSONALITY DEVELOPMENT
PD 3  Group Discussion: Team Work  9
PD 4  Career Counselling, SSB Procedure & Interview Skills  2
PD 5  Public Speaking  3

BORDER & COASTAL AREAS
BCA 2  Security Setup and Border/Coastal management in the area  4
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  23
### 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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**NCC Credit Course Level 3* (NAVAL WING) NCC Credit Course - III**

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TOTAL : 45 PERIODS

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**NCC Credit Course Level 3* (AIR FORCE WING) NCC Credit Course Level - III**

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GE3791  HUMAN VALUES AND ETHICS  L T P C
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COURSE DESCRIPTION
This course aims to provide a broad understanding about the modern values and ethical principles that have evolved and are enshrined in the Constitution of India with regard to the democratic, secular and scientific aspects. The course is designed for undergraduate students so that they could study, understand and apply these values in their day to day life.

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

UNIT I  DEMOCRATIC VALUES  6

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

**UNIT II  SECULAR VALUES**

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:
The student should be made to
- Observe medical professionals at work in the wards and the roles of Allied Health Professionals;
- Provide access to healthcare Professionals to get a better understanding of their work;
- Demonstrate patient-care in a hospital setting.

ASSESSMENT:
- Students need to complete training in any leading Multi-speciality hospital for a period of 15 days. They need to prepare an extensive report and submit to their respective course in-charges during the session.
- Out of the following departments, it is mandatory to complete training in any 10. The students can give a presentation of the remaining departments during laboratory hours.

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TOTAL : 60 PERIODS

COURSE OUTCOMES:
At the end of the course, the student should be able to:
- Advocate a patient-centred approach in healthcare
- Communicate with other health professionals in a respectful and responsible manner
- Recognize the importance of inter-professional collaboration in healthcare.
- Propose a patient-centred inter-professional health improvement plan based upon the patient’s perceived needs.
- Use the knowledge of one's own role and those of other professions to address the healthcare needs of populations and patients served.

**BM3811 PROJECT WORK / INTERNSHIP**  

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

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.

A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 300 PERIODS**

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

CBM337  BIOMATERIALS  L T P C  3 0 0 3

COURSE OBJECTIVES:
The student should be made to:

- Learn characteristics and classification of Biomaterials
- Understand different metals, ceramics and its nanomaterial’s characteristics as biomaterials
- Learn polymeric materials and its combinations that could be used as a tissue replacement implants
- Get familiarized with the concepts of Nano Science and Technology
- Understand the concept of biocompatibility and the methods for biomaterials testing

UNIT I  INTRODUCTION TO BIO-MATERIALS  9
Definition and classification of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants, wound healing, blood compatibility, Nano scale phenomena.

UNIT II  METALLIC AND CERAMIC MATERIALS  9
Metallic implants - Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion, ceramic implant – bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bio ceramics.

UNIT III  POLYMERIC IMPLANT MATERIALS  9

UNIT IV  TISSUE REPLACEMENT IMPLANTS  9

UNIT V  TESTING OF BIOMATERIALS  9
Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests, Invitro and Invivo testing; Sterilisation of implants and devices: ETO, gamma radiation, autoclaving. Effects of sterilization.

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

- CO1: Analyze different types of Biomaterials and its classification and apply the concept of nanotechnology towards biomaterials use.
- CO2: Identify significant gap required to overcome challenges and further development in metallic and ceramic materials
- CO3: Identify significant gap required to overcome challenges and further development in polymeric materials
- CO4: Create combinations of materials that could be used as a tissue replacement implant.
- CO5: Understand the testing standards applied for biomaterials.

TOTAL:45 PERIODS
TEXTBOOKS

REFERENCES

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CBM332 ARTIFICIAL ORGANS AND IMPLANTS L T P C 3 0 0 3

COURSE OBJECTIVES:
The student should be made to:

- To have an overview of artificial organs & transplants
- To describe the principles of implant design with a case study
- To explain the implant design parameters and solution in use
- To study about various blood interfacing implants
- To study about soft tissue replacement and hard tissue replacement

UNIT I ARTIFICIAL ORGANS & TRANSPLANTS 9
ARTIFICIAL ORGANS:-Introduction, outlook for organ replacements, design consideration, evaluation process.
TRANSPLANTS:-Overview, Immunological considerations, Blood transfusions, individual organs – kidney, liver, heart and lung, bone marrow, cornea.

UNIT II PRINCIPLES OF IMPLANT DESIGN 9
Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and its replacement, Tissue engineering, scaffolds, cells and regulators criteria for materials selection, Case study of organ regeneration.

UNIT III IMPLANT DESIGN PARAMETERS AND ITS SOLUTION 9
Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding

UNIT IV BLOOD INTERFACING IMPLANTS
Neural and neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.

UNIT V IMPLANTABLE MEDICAL DEVICES AND ORGANS
Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions.

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

- CO1: Gain adequate knowledge about artificial organs & transplants
- CO2: Get clear idea about implant design and its parameters and solution
- CO3: Have in-depth knowledge about blood interfacing implants
- CO4: Explain different types of soft tissue replacement and hard tissue replacement
- CO5: Assess compatibility and functioning of artificial organs inside the living system.

TOTAL: 45 PERIODS

TEXT BOOK

REFERENCES

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CBM339 BIOMEDICAL OPTICS AND BIOPHOTONICS
L T P C
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COURSE OBJECTIVES
- To acquire knowledge about the physical properties of light and optical properties of tissues.
- Learn the design and working principle of various optical components.
● Understand the principles and applications of optical biosensors.
● Understand the engineering and practical applications of optics related to diagnostic and surgical applications.
● Understand the phenomenon of laser tissue interaction and practical applications of optics related to therapeutic applications.

UNIT I  OPTICAL PROPERTIES  6

UNIT II  OPTICAL INSTRUMENTATION  6

UNIT III  OPTICAL BIOSENSORS  6

UNIT IV  APPLICATIONS OF LASERS  6
Diagnostic - Optical coherence tomography, Fluorescence, Raman, Photoacoustic tomography, Laser induced breakdown spectroscopy (LIBS), Hyperspectral imaging.
Surgical - Lasers in dentistry, Dermatology, Ophthalmology.

UNIT V  LASER TISSUE INTERACTION  6
Laser tissue interactions via photochemical, Photothermal, Photomechanical techniques, Photodynamic therapy (PDT) - Oncological and non-oncological applications, Low level laser therapy (LLLT) - Biostimulation applications.

Lab course/Mini projects/Hospital visit - Presentations (30 hours)

Students need to visit Hospitals/Research Institutes/Industry and understand the working and applications of various Optical Techniques in the Biomedical field.

● Lab course/Mini projects on interferometry techniques (Young’s double slit, Michelson and Mach-zehnder interferometry).
● Lab course/Mini projects on various spectroscopic techniques (absorption/transmission, scattering and emission spectroscopy).
● Lab course/Mini projects on optical simulations and image processing – MATLAB, COMSOL, optical softwares.
● Mini projects on Laser based Biomedical Applications
● Hospital visit to understand the working of Optical Coherence Tomography technique

Hospital visit to understand the clinical applications of Lasers used in ophthalmology, dermatology, dentistry, etc.,

30 PERIODS

TOTAL: 60 PERIODS
COURSE OUTCOMES
On successful completion of this course, the student will be able to
- CO1: Explain the various physical properties of light and optical properties of tissues.
- CO2: Consolidate the working principles of optical components.
- CO3: Discuss the various applications of biosensors in medicine.
- CO4: Summarize the diagnostic and surgical applications of lasers in medicine.
- CO5: Explain the laser tissue interaction and various therapeutic applications of lasers.

TEXT BOOKS

REFERENCES

ONLINE RESOURCES
1. https://nptel.ac.in/courses/127/105/127105225/
2. https://onlinecourses.nptel.ac.in/noc21_ge13/preview

CO’s- PO’s & PSO’s MAPPING

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CBM359 NEURAL ENGINEERING

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COURSE OBJECTIVES:
The student should be made to:
- To be familiar with the nervous system development
- To be exposed to neuronal diseases and disorders
- To be familiar with nerve reconstruction and repairing
UNIT I BASICS OF NEURON STRUCTURE AND FUNCTIONS
Nervous system development. Trophic factors, extra cellular matrix components in nervous system

UNIT II BRAIN, BRAIN STEM AND SPINAL CORD

UNIT III NEURONAL DISEASES AND DISORDERS

UNIT IV NEUROPHYSIOLOGY & NEURORADIOLOGY

UNIT V NERVE RECONSTRUCTION AND REHABILITATION
Neural plasticity; Neurological dysfunctions - Regeneration of the peripheral nervous system. Neural tissue engineering; Nerve graft; Drug delivery system in CNS. Rehabilitation: Mechanisms for Neuromotor rehabilitation; Robotics and virtual reality in physical therapy; Transcranial magnetic stimulation

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Explain the basic structure and functions of human nervous system.
CO2: Understand diseases and degeneration related to nervous system.
CO3: Analyze visualization and radiological assessment of nervous system.
CO4: Apply neural tissue engineering for rehabilitation.
CO5: Discuss about Regeneration of nervous system.

TOTAL:45 PERIODS

TEXT BOOKS

REFERENCES
COURSE OBJECTIVES:
- To study the cell types and differentiation.
- To study basics about stem cells and its applications
- To understand the methods and design involved in tissue engineering

UNIT I  INTRODUCTION TO CELL BIOLOGY  9

UNIT II  FUNDAMENTALS OF TISSUE ENGINEERING  9

UNIT III  STEM CELLS  9
Definition of stem cells – Types of stem cells – Differentiation, dedifferentiation maturation, proliferation, pleuripotency and immortalization - Sources of stem cells: Haematopoetic – Fetal - cord blood – Placenta - Bone marrow - Primordial germ cells - Cancer stem cells - Induced pleuripotent stem cells.

UNIT IV  ENGINEERING METHODS AND DESIGN  9
Soft lithography - Self-assembled monolayer, Micro contact printing, Micro fluidic patterning - Laminar flow patterning - Cell interaction with Polymer scaffolds and gels - Polymer scaffolds fabrications: Electro spinning - Solvent casting and particulate leaching - Micro fabrication of cell seeded scaffolds.

UNIT V  APPLICATION OF TISSUE ENGINEERING  9
Replacement Engineering: Bone, cartilage, skin, blood, pancreas, kidney, heart valve and liver - Regenerative engineering: Peripheral Nerve regeneration, Cardiac tissue regeneration, Muscle regeneration – Regulation, Commercialization and Patenting.

COURSE OUTCOMES:
At the end of the course, the student should be able to:
  CO1: Understand the basic concepts of tissue engineering
  CO2: Acquire ability to function on multi-disciplinary teams
  CO3: Apply the knowledge of professional and ethical responsibility in use of stem cells and gene therapy in creating tissue engineered therapies
  CO4: Design and develop different biomaterial in tissue engineering application
  CO5: Gain knowledge in research or clinical application on tissue repair/ engineering

TEXT BOOK
REFERENCES

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CBM349 GENETIC ENGINEERING LTPC 3003

COURSE OBJECTIVES:
- To discuss the gene cloning methods and the tools and techniques involved in gene cloning and genome analysis and genomics.
- To explain the heterologous expression of cloned genes in different hosts.

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY 9
Manipulation of DNA – Restriction and Modification enzymes - Design of linkers and adaptors - Characteristics of cloning and expression vectors - Introduction of recombinant DNA in to host cells and selection methods.

UNIT II DNA LIBRARIES 9
Construction of genomic and cDNA libraries, Artificial chromosomes – Bacteria, Yeast - Chromosomal walking.

UNIT III SEQUENCING AND AMPLIFICATION OF DNA 9
Maxam Gilbert’s and Sanger’s methods of DNA sequencing – PCR: Inverse PCR, Nested PCR, Allele specific PCR, Hot start PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

UNIT IV ORGANIZATION AND STRUCTURE OF GENOMES 9
Organization and structure of genomes - Genome sequencing methods: Conventional and shotgun genome sequencing methods, Next generation sequencing technologies - Ordering the genome sequence - Genetic maps and Physical maps, STS content based mapping, Hybridization mapping, Optical mapping.

UNIT V CURRENT STATUS OF GENOME SEQUENCING PROJECTS 9
Introduction to Functional genomics – Microarrays - Serial Analysis of Gene expression (SAGE), Subtractive hybridization, Comparative Genomics, Proteogenomics, Web resources for Genomics, Applications of genome analysis and genomics.
COURSE OUTCOMES:
At the end of the course, the student should be able to:

CO1: Would be aware of how to clone commercially important genes.
CO2: The students would be aware of how to produce the commercially important recombinant proteins.
CO3: Will be familiarized with gene and genome sequencing techniques
CO4: Will be aware of microarrays, Analysis of Gene expression and proteomics.
CO5: Acquire ability to function on multi-disciplinary teams

TOTAL: 45 PERIODS

TEXT BOOK

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 into design specification
• To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
• To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I BASICS OF PRODUCT DEVELOPMENT

UNIT II REQUIREMENTS AND SYSTEM DESIGN
UNIT III  DESIGN AND TESTING

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:
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CBM353 MEDICAL DEVICE DESIGN

COURSE OBJECTIVES:
The student should be made to:
- Introduce the Medical device standards and requirements.
- Illustrate the design procedure of medical devices.
- Outline the quality assessment in design.
- Describe about the design realization.
- Understand the validation and verification of various medical devices.

UNIT I NEEDS FINDING AND CONCEPT GENERATION
Safety and Risk Management - Tools, Documents and Deliverables.

UNIT II MEDICAL DEVICES STANDARDS AND REQUIREMENTS

UNIT III DESIGN ENGINEERING

UNIT IV TESTING AND VALIDATION
Basis and Types of Testing, Hardware Verification and Data Analysis, Software Verification and Data Analysis.

UNIT V DESIGN TRANSFER AND MANUFACTURING

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
- CO1: Define the medical devices standards and requirements.
- CO2: Summarise the concept of medical device development.
CO3: Recall the engineering design and project metrics.
CO4: Demonstrate the testing and validation of medical equipment.
CO5: Interpret the various design transfer and manufacturing methods.

TOTAL :45 PERIODS

TEXT BOOKS

REFERENCES

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CBM360 PATIENT SAFETY, STANDARDS AND ETHICS

COURSE OBJECTIVE:

- To understand the importance of patient safety against electrical hazards
- To explain the patient safety laws and regulations
- To understand the standards and testing of patient
- To know the patient safety specialities in clinical
- To know about the health care organization

UNIT -I EFFECTS OF ELECTRICITY
Physiological effects of electricity - important susceptibility parameters - microshock - macroshock hazards -patients electrical environment - isolated power system - conductive surfaces

UNIT II PATIENT SAFETY LAWS AND REGULATIONS

UNIT III  STANDARDS AND TESTING  9
Guidelines and safety practices to improve patient safety, Electrical safety codes and standards - IEC 60601-1 2005 standard, Basic Approaches to protection against shock, protection equipment design, Electrical safety analyser - Testing the electric system

UNIT IV  PATIENT SAFETY IN MAIN CLINICAL SPECIALITIES  9
Intensive care and Anesthesiology, safety surgery save lives, Emergency department clinical risk, Obstetric safety patient, Patient safety in internal medicine, Patient safety in Radiology.

UNIT V  MEDICAL ETHICS  9
Definition of Medical ethics, Scope of ethics in medicine, American medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities, The Doctor and The Patient, The Doctor and The Profession, Professional Independence, The Doctor And Society, Case Studies.

COURSE OUTCOME:
At the end of this course, the student will be able to
CO1: Outline the importance of patient safety against electrical hazards.
CO2: Brief out the patient safety laws and regulations
CO3: Explain the standards and testing of patient
CO4: Understand the concept of the patient safety specialities in clinical
CO5: Know about various health care organization

TEXT BOOKS:

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COURSE OBJECTIVES:
The objective of this course is to enable the student to

- To study the regulation of medical devices, process of development, ethical and quality considerations.
- To learn the various ISO standards of quality and risk management for regulatory purposes.
- To explore the process of approval and marketing of medical devices.
- To comprehend the regulatory process for medical devices in India, US, and EU.
- To familiarize with clinical evaluation and investigation of medical devices.

UNIT I  MEDICAL DEVICE REGULATIONS
History of medical device regulation, regulatory affairs professional’s roles, required competencies, medical device classification: scope, definitions, main classifications, Risk based classification, practical examples, labeling of medical devices: definition, elements, risk management, clinical evaluation and labeling, language level and intended users. Differentiating medical devices IVDs and combination products from that of pharmaceuticals.

UNIT II  ISO STANDARDS

UNIT III  IEC, REGULATORY SYSTEMS IN USA & EU
IEC international standards and conformity assessment for medical devices, Good submission process, medical device regulatory system in the USA and European Union.

UNIT IV  INDIAN REGULATORY SYSTEM
India: Medical device regulatory system: market environment, functions undertaken by DGGI, central government, FDA and state governments, guidance documents, details of key regulators, IMDRF and CDSCO, regulatory overview in India, product registration on conformity assessment, quality system regulation, technical material and labeling requirements, commercial aspects, upcoming regulation changes.

UNIT V  CLINICAL TRIALS AND DIGITAL REGULATIONS
Regulatory strategy and competitive advantage, Preclinical and Clinical Trial Design for Medical Devices in India; FDA approved devices, post-market surveillance/vigilance, Digital health regulations: Connected care, intelligent design control, reducing design time and cost with in-silico clinical trials.

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

CO1: Define and explain the basic concepts of medical device regulations.
CO2: Decipher the meaning of ISO standards from a regulatory perspective.
CO4: Discuss regulations in India
CO5: Explain the regulatory aspects of clinical trials and digital alternatives

TOTAL: 45 PERIODS
TEXTBOOKS:

REFERENCES:

ONLINE RESOURCES
1. Regulatory requirements for medical devices including in vitro diagnostics in India (Version 2.0), IIT Madras, Prof. Arun B. Ramteke, Prof. Aseem Sahu, Prof. Malay Mitra. https://nptel.ac.in/courses/127106136
3. FOOD AND DRUG ADMINISTRATION USA, http://www.fda.gov/medicaldevices/deviceregulationandguidance/default.htm

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CBM372 MEDICAL INNOVATION AND ENTREPRENEURSHIP L T P C 3 0 0 3

COURSE OBJECTIVES:
The student should be made to:
• To learn fundamentals of entrepreneurship
• To apply the methods of entrepreneurship in medical field
• To evaluate the medical devices and market trends

UNIT I CREATIVITY, INNOVATION AND IPR 9

UNIT II SCOPE FOR BIOMEDICAL ENGINEERING ENTREPRENEURSHIP 9
UNIT III NEW VENTURE

UNIT IV FINANCING THE NEW VENTURE AND GLOBALIZATION

UNIT V MARKETING FUNCTION

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Describe the role of biomedical engineers in entrepreneurship
CO2: Interpret the background for biomedical engineers in entrepreneurship
CO3: Acquire the skills and techniques required towards innovation
CO4: Categorize the resources and funding agencies and judge the right product based on market needs
CO5: Compile and quantify the opportunities and challenges

TOTAL :45 PERIODS

TEXT BOOKS

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### CBM363 RAPID PROTOTYPING L T P C 3 0 0 3

**COURSE OBJECTIVES:**
The student should be made to:
- Learn the need and fundamentals of rapid prototyping
- Understand the concepts of design and assembling of various parts
- Study the process and material selection for UV and Laser based AM
- Investigate the process of fused deposition moulding and sheet lamination
- Explore droplet formation and beam deposition process

### UNIT I INTRODUCTION 9

### UNIT II DESIGN FOR ADDITIVE MANUFACTURING 9

### UNIT III PHOTO POLYMERIZATION AND POWDER BED FUSION PROCESSES 9

### UNIT IV EXTRUSION BASED AND SHEET LAMINATION PROCESSES 9

### UNIT V PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES 9
COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Demonstrate the basics of Additive manufacturing.
CO2: Design and assembly of various parts for the desired task.
CO3: Explain the process involved in laser and UV based AM
CO4: Illustrate the process of fused deposition moulding and sheet lamination
CO5: Support design and manufacturing, case studies relevant to mass customized manufacturing, and some of the important research challenges associated with AM and its data processing tools.

TOTAL: 45 PERIODS

TEXT BOOKS

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CBM343 CLINICAL ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:
- This course will provide a basic understanding of the clinical engineering profession, qualifications, roles, activities, and expectations.
- This course will enhance students to practice medical equipment and analyze challenges with their healthcare technology.
- This course will engage the students to work as a team to address problems and errors in medical devices.
- This course will help students to design better medical devices with computerized approaches.
- This course will expose students to explore the Health Technology Management systems with medical devices and supportive services with advanced application.
UNIT – I  INTRODUCTION

UNIT – II  MEDICAL TECHNOLOGY MANAGEMENT PRACTICES
Strategic Medical Technology Planning, Scope , Clinical necessity operational support, strategic planning process – Technology assessment: Technology audit, Budget strategies, Prerequisite for medical technology assessment – Management Practice for Medical Equipment - Device evaluation, Risk reduction, Asset management, ESHTA.

UNIT – III  ESSENTIAL HEALTH CARE TECHNOLOGY PACKAGE (EHTP)

UNIT – IV  CLINICAL ENGINEERING PROGRAM INDICATOR
Clinical engineering: program services, Program database – Clinical Engineering Program management, Program indicator, Managing clinical engineering performance using program indicators – Indicator management process.

UNIT – V  ADVANCED TECHNOLOGY FOR PATIENT SAFETY
Factors Contributing to Medical Errors: Health Care Reimbursement, Health Care Failure Mode and Effect Analysis (HFMEA), Patient Safety Best Practices Model: Bar coding, Computerized Physician Order Entry (CPOE), and Clinical data repositories – Process analysis, Methodology. Computerized medical equipment management systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
At the end of the course the student will be able to:
CO1: State the role of clinical engineers and discuss the basic concepts of medical and healthcare technology
CO2: Give the program and framework to recognize the errors of medical equipment
CO3: State the issues or errors in patient safety and formulate patient safety package system
CO4: Define the problem precisely and examine the possible issues using program indicators.
CO5: Demonstrate computer based equipment with automated system by using CPOE method.

TEXT BOOKS:

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COURSE OBJECTIVES:
To Study about:
- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- The student should be made to understand the principles, practices and areas of application in Hospital management.

UNIT I  OVERVIEW OF HOSPITAL ADMINISTRATION  9
Distinction between Hospital and Industry, Challenges in Hospital Administration –Hospital Planning – Equipment Planning- AMC – Functional Planning - Current Issues in Hospital Management - Telemedicine - Bio-Medical Waste Management

UNIT II  HUMAN RESOURCE MANAGEMENT IN HOSPITAL  9

UNIT III  MARKETING RESEARCH & CONSUMER BEHAVIOUR  9
Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations - Consumer Markets & Consumer Buyer behaviour - Model of consumer behaviour - Types of buying decision behaviour - The buyer decision process - Model of business buyer behaviour - Major types of buying situations - global marketing in the medical sector - WTO and its implications.

UNIT IV  HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES  9

UNIT V  QUALITY AND SAFETY ASPECTS IN HOSPITAL  9

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Explain the principles, practices and areas of application in Hospital Management.
CO2: Understand the biomedical waste disposal concept.
CO3: Explain the importance of supportive services.
CO4: Comprehend the quality aspect specified by the international standards.
CO5: Knowledge on Hospital safety.

TOTAL:45 PERIODS
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CBM358 MEDICAL WASTE MANAGEMENT L T P C 3 0 0 3

COURSE OBJECTIVES:
The student should be made to:
• Understand the hazardous materials used in hospital and its impact on health
• Understand various waste disposal procedures and management.

UNIT I HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS 9

UNIT II BIOMEDICAL WASTE MANAGEMENT 9
Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling, collection, storage and transportation, treatment and disposal.
UNIT III HAZARDOUS MATERIALS

UNIT IV FACILITY SAFETY

UNIT V INFECTION CONTROL, PREVENTION AND PATIENT SAFETY

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Analyse various hazards, accidents and its control
CO2: Design waste disposal procedures for different biowastes
CO3: Categorise different biowastes based on its properties
CO4: Design different safety facility in hospitals
CO5: Propose various regulations and safety norms

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

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COURSE OBJECTIVE:
- To understand the concepts of Economics with respect to the demand and supply analysis.
- To analyze the theory of production and the analysis of the cost parameter by using the Elasticity.
- To manage and plan the situation with the help of the available strategies to support the decision making process.

UNIT I  INTRODUCTION TO ECONOMICS

UNIT II  DEMAND AND SUPPLY ANALYSIS

UNIT III  THEORY OF PRODUCTION AND ANALYSIS OF COST

UNIT IV  INTRODUCTION TO MANAGEMENT

UNIT V  PLANNING

TOTAL : 45 PERIODS

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

CO1: Summarize how to solve economics principles to solve economic problems in engineering discipline by satisfying the economic laws.

CO2: Discuss the demand and supply process for a market analysis using Price elasticity, Cross elasticity and Income elasticity.

CO3: Interpret short run and long run costs in the process of production for carrying out a business.

CO4: Apply managerial skills to make decisions and solve problems for achieving organizational objectives.

CO5: Express the principles of effective planning for survival and success of all organizations using standing and single use planning methods.
TEXT BOOKS:

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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CBM336 BIOSTATISTICS L T P C 2 0 2 3

COURSE OBJECTIVES
The objective of this course is to enable the student to

- Understand the statistical methods for the data.
- Comprehend the fundamental of mathematical and statistical theory in the application of biomedical field.
- Apply the regression and correlation analyze in the physiological data.
- Understand the source of Medical data
- Understand the Visual analytics of Healthcare data.

UNIT I INTRODUCTION
Introduction, Some basic concepts, Measurement and Measurement Scales, Simple random sample, Computers and medical data analysis, Introduction to probability, likelihood & odds, distribution variability.

UNIT II STATISTICAL PARAMETERS
Statistical parameters p-values, computation, level chi square test and distribution and hypothesis testing - single population proportion, difference between two population proportions, single population variance, ratio of two population variances and tests of goodness of fit, tests of independence, tests of homogeneity.

UNIT III REGRESSION AND CORRELATION ANALYSIS
Introduction, regression model, sample regression equation, evaluating the regression equation,
using the regression equation, correlation model, correlation coefficient.

UNIT IV  INTERPRETING DATA  6
Interpreting life tables clinical trials, epidemiological reading and interpreting of epidemiological studies, application in community health.

UNIT V  ANALYSIS OF VARIANCE  6
META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis, completely randomized design, randomized complete block design, repeated measures design, factorial experiment.

LAB COMPONENT  30 PERIODS
Students need to use appropriate software tools to implement the following,

1. Identify quantitative, ordinal, and categorical measurements from the data
2. Construct and interpret stem plots and histograms,
3. Construct and interpret frequency tables, calculate and interpret means, standard deviations, medians, and quartiles
4. Calculate and interpret Normal probabilities and values.
5. Calculate and interpret confidence intervals for means
6. Calculate hypothesis test means and power or sample size estimates when testing means.
7. Tests of goodness of fit tests of independence, tests of homogeneity
8. Calculate the regression equation
9. Calculate correlation coefficient
10. Interpreting life tables clinical trials
11. Calculate and interpret relative risks and confidence intervals for relative risks
12. Data can be downloaded from following or from any known data source
   https://biostat.org/data/
   https://biolincc.nhlbi.nih.gov/teaching/
   https://libguides.denison.edu/c.php?g=776168&p=5661119
   https://guides.lib.berkeley.edu/publichealth/healthstatistics/rawdata

TOTAL: 60 PERIODS

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

CO1: Define the new and existing statistical methodology for their research problem.
CO2: Explain p-values for different statistical tests.
CO3: Analyze the biomedical research data and be able to report the study results.
CO4: Describe the various sources of medical data
CO5: Demonstrate the visual analytical procedure of Medical Data.

TEXT BOOKS

4. Editors: Chandan K. Reddy, Charu C. Agarwal, Healthcare Data Analytics, CRC Press,
REFERENCES


ONLINE RESOURCES

1. https://nptel.ac.in/courses/106/107/106107220/
2. https://onlinecourses.nptel.ac.in/noc21_cs45/preview

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CBM347 FORENSIC SCIENCE IN HEALTHCARE L T P C 3 0 0 3

COURSE OBJECTIVE:
By the end of the course each student will be familiar with:
- the history of the forensic sciences and its place in popular culture
- the roles of different types of professionals involved in evaluating a crime scene and the collected evidence
- forensic microscope and Anthropology
- The Blood stain identification
- the methodology of collecting & interpreting data for fingerprint application

UNIT I BASICS OF FORENSIC SCIENCE

UNIT II OBSERVATION AND CRIME SCENE
UNIT III FORENSIC MICROSCOPE AND ANTHROPOLOGY


UNIT IV BLOOD STAIN IDENTIFICATION


UNIT V FINGERPRINT APPLICATION

Fingerprints - Fundamental Principles of Fingerprint Analysis, Classification of Fingerprints, Collection of Fingerprint Evidence, Automated Fingerprint Identification Systems (AFIS), Track marks, Case Studies.

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

- CO1: Define the significance of forensic sciences
- CO2: Observe and document crime scenes
- CO3: Determine Trauma and Diseases.
- CO4: Describe the various sources of medical data related to forensic science.
- CO5: Demonstrate the visual analytical procedure of fingerprint application.

TEXT BOOKS

REFERENCES
2. Deforest, Gansellen & Lee : Introduction to Criminalistics.

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COURSE OBJECTIVES
The objective of this course is to enable the student to

- Learn the fundamental concepts of the principles of mechanics.
- Understand the basics of biofluid mechanics.
- Review the mechanical properties of musculoskeletal elements.
- Study the biomechanics of joints and implants.
- Learn the application of biomechanics into modelling and ergonomic design.

UNIT I INTRODUCTION TO MECHANICS
Introduction – Scalars and vectors, Statics – Resolution and composition of forces, Moments, couple, Resultant, equilibrium of coplanar forces, Dynamics – Linear motion, Newton’s laws of motion, Velocity and acceleration, Kinematics – Models, Transducers Constitutive equations – Non-viscous fluid, Newtonian Viscous fluid and Hookean Elastic solid

UNIT II BIOFLUID MECHANICS
Intrinsic fluid properties, Rheological properties of blood, Pressure-flow relationship for Non-Newtonian Fluids, Fluid mechanics in straight tube, Structure of blood vessels, Material properties and modelling of Blood vessels, Heart – Cardiac muscle characterization, Native heart valves, Prosthetic heart valve fluid dynamics.

UNIT III MUSCULOSKELETAL MECHANICS

UNIT IV BIOMECHANICS OF JOINTS AND IMPLANTS
Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, Free body diagrams, Structure of joints, Types of joints, Biomechanical analysis of elbow, shoulder, spinal column, hip, knee and ankle, Lubrication of synovial joints, Gait analysis, Motion analysis using video.

UNIT V MODELLING AND ERGONOMICS
Introduction to Finite Element Analysis, finite element analysis of lumbar spine; models for voice biomechanics, Ergonomics – Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Whole body vibrations, Hand transmitted and whole-body vibrations.

LAB COMPONENT
1. MATLAB implementation of Vector algebra, force and moment calculation
2. Program used in conjunction with the EMG system to analyse muscle activation patterns.
4. Cardiovascular models.
5. Musculoskeletal models.
6. Finite element analysis.

TOTAL: 60 PERIODS
SOFTWARE TOOLS
1. MATLAB/ Python
2. CVSIM/Equivalent tools
3. OpenSim/FEBIO/ Equivalent tools.

COURSE OUTCOMES
Upon successful completion of the course, students will be able to
CO1: Understand and apply the principles of mechanics, kinetics and kinematics in the context of biological systems. Appraise the basics of biofluid mechanics as applied to heart valve design and blood vessel models.
CO2: Describe the basics of biofluid mechanics as applied to heart valve design and blood vessel models.
CO3: Describe the mechanical properties of musculoskeletal elements to develop the mathematical models of joints and implants.
CO4: Apply the knowledge of biomechanics into analysis of human joints and motion.
CO5: Apply Biomechanics principles to “real-world” problem and describe their impact on health, safety, society, environment as well as underlying legal and ethical considerations.

TEXT BOOKS

REFERENCES

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COURSE OBJECTIVES
The objective of this course is to enable the student to
• Explain the need for medical aids.
• Understand the sensory rehabilitation systems.
• Learn the use of orthopedic prosthetics and orthotics in rehabilitation.
• Understand virtual reality in rehabilitation
• Have an understanding of rehabilitation medicine and advocacy.

UNIT I INTRODUCTION TO REHABILITATION 9

UNIT II ENGINEERING CONCEPTS IN SENSORY AUGMENTATION AND SUBSTITUTION 9

UNIT III ORTHOPEDIC PROSTHETICS AND ORTHOTICS 9
Engineering concepts in motor rehabilitation, Artificial limbs- body powered, externally powered and controlled orthotics and prosthetics, Myoelectric hand and arm prosthetics. Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS).

UNIT IV VIRTUAL REALITY 9
Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

UNIT V REHABILITATION MEDICINE AND ADVOCACY 9
Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life.

COURSE OUTCOMES
Upon successful completion of the course, students will be able to
CO1: Summarize the key terminologies used by the rehabilitation team.
CO3: Design different orthotics and prosthetics for rehabilitation applications.
CO4: Summarize the need of virtual reality tools for different aids.
CO5: Appraise the legal aspects for building rehabilitation aids for the needed people.

TEXTBOOKS
REFERENCES
7. Roy A Cooper (Editor), Hisaichi Ohnabe (Editor), Douglas A. Hobson (Editor), “An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering” CRC Press, 2000

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CBM361 PHYSIOLOGICAL MODELLING L T P C 3 0 0 3

COURSE OBJECTIVES:
The student should be made to:
- To explain the application of Physiological models and vital organs.
- To Formulate the methods and techniques for analysis and synthesis of dynamic models
- To describe the dynamic models, simulate and visualize, dynamic responses of physiological models using software.
- To describe nonlinear models of physiological systems
- To compute the Simulation of physiological systems

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

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

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

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

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Explain the application of Physiological models
CO2: Describe the methods and techniques for analysis and synthesis of Linear and dynamic system
CO3: Develop differential equations to describe the compartmental physiological model
CO4: Describe Nonlinear models of physiological systems
CO5: Illustrate the Simulation of physiological systems

TOTAL:45 PERIODS

TEXT BOOKS

REFERENCES
2. MinruiFei, Shiwei Ma, Xin Li, Xin Sun, Li Jia and Zhou Su,”Advanced Computational Methods in Life System Modelling and Simulation”, Springer,2017

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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
Principle of External counter pulsation techniques, intra aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves.

UNIT II HEMODIALYSERS
Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.

UNIT III HEARING AIDS
Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT IV PROSTHETIC AND ORTHODIC DEVICES
Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthodic system, functional electrical stimulation, sensory assist devices.

UNIT V RECENT TRENDS
Transcutaneous electrical nerve stimulator, bio-feedback

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.

TOTAL: 45 PERIODS

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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CBM346 ERGONOMICS L T P C

COURSE OBJECTIVE

- To get exposed to principles of visual capabilities.
- To learn the mechanics of muscle physiology and significance of rest cycle.
- To learn spatial compatibility and the relation between control orders and control response.
- To know about the measurements and proportions of the human body.
- To be familiar with the mathematical models, analysis and design of biomedical devices using case studies.

UNIT I VISUAL AND AUDITORY ERGONOMICS


UNIT II MUSCLE PHYSIOLOGY


UNIT III CONTROLS AND DISPLAYS

Spatial compatibility and physical arrangement of displays and controls - Design of displays and controls – movement capability – rotary controls and rotor displays movement of displays orientation of the operator and movement relationships control orders and control responses – human limitations in tracking task

UNIT IV ANTHROPOMETRY

Anthropometry – anthropometric design principles – Physical work load and energy expenditure - work space envelope – factors in design of work space surfaces – principles of seat design – principles of control panel. ergonomic implications. Organization classification of human errors theories of accident causation-reducing accidents by altering behavior.

UNIT V CASE STUDIES

Case Study 1: computer design, control panel design of an electronic instrument, computer key board, hand drill etc.
Case Study 2: Biomedical Application, Design optimization of Medical Equipment.
TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course student will be able to,
CO1: Understand principles of ergonomics.
CO2: Understand the significance of posture
CO3: Learn about tracking tasks.
CO4: Learn about ergonomics and its implications to various domain
CO5: Perform case studies on electronic instruments and medical equipment.

TEXT BOOKS:

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CBM350             HAPTICS L T P C 3 0 0 3

COURSE OBJECTIVES
The objective of this course is to enable the student to
- Expose to basic principles of Haptics and their property.
- Give knowledge on machines in haptics.
- Learn types of sensors and actuators.
- Understand basic concepts of human locomotion, biomechanical analysis using Finite Element Analysis.

UNIT I HUMAN HAPTICS
Somatosensory System; Motor System, Muscle Physiology; Haptics Psychophysical experiments.
UNIT II MACHINE HAPTICS

Design Haptic devices; Human factors involved;

UNIT III HAPTIC SENSORS AND ACTUATORS

barriers in human haptics; Ergonomics.

UNIT IV COMPUTATIONAL HAPTICS

Haptic Rendering; Rigid bodies, Deformable bodies, Stability Rendering effects, Human performance and evaluation; Biomechanics of manipulation; Neuromuscular Models.

UNIT V HAPTICS FOR MEDICAL APPLICATIONS

Applications: Telemedicine; Rehabilitation; Medical Simulations for education

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the laws of principles of haptics for human
CO2: Discuss the behavior of machines in haptics
CO3: Analyse the suitable sensor and actuator for haptics
CO4: Identify suitable computation for haptics
CO5: Describe the finite element analysis, design the work station depending upon the haptics

TEXT BOOKS:


REFERENCE BOOKS:

CBM335  BIOSIGNAL PROCESSING  L T P C

COURSE OBJECTIVES:
The student should be made to:
- To study the characteristics of different biosignals
- To learn linear and non-linear filtering techniques to extract desired information
- To understand various techniques for automated classification and decision making to aid diagnosis

UNIT I  BIOSIGNAL AND SPECTRAL CHARACTERISTICS  9

UNIT II  TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION  9

UNIT III  ADAPTIVE FILTERING AND WAVELET DETECTION  9
Filtering – LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in ECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT IV  BIOSIGNAL CLASSIFICATION AND RECOGNITION  9

UNIT V  TIME FREQUENCY AND MULTIVARIATE ANALYSIS  9
Time frequency representation, spectrogram, Wigner distribution, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA,ICA.
COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Preprocess the Biosignals.
CO2: Analyze biosignals in time domain & to estimate the spectrum.
CO3: Apply wavelet detection techniques for biosignal processing.
CO4: Classify Biosignals using neural networks and statistical classifiers.
CO5: Extract the features using multivariate component analysis.

TOTAL: 45 PERIODS

TEXT BOOKS

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CBM371 COMPUTER VISION L T P C 2 0 2 3

COURSE OBJECTIVES:
- To review image processing techniques for computer vision.
- To understand various features and recognition techniques
- To learn about histogram and binary vision
- Apply three-dimensional image analysis techniques
- Study real world applications of computer vision algorithms

UNIT I INTRODUCTION 6
UNIT II FEATURE EXTRACTION 6
Feature Extraction - Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis - Image Pyramids and Gaussian derivative filters, Gabor Filters.

UNIT III COLOR IMAGES, BINARY VISION 6

UNIT IV 3D VISION 6

UNIT V MOTION 6

30 PERIODS

PRACTICALS:
1. Document Image Analysis
2. Biometrics based Recognition
3. Object Recognition
4. Object Tracking
5. Medical Image Analysis
6. Content-Based Image Retrieval
7. Video Data Processing

30 PERIODS

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: explain low level processing of image and transformation techniques applied to images.
CO2: develop the feature extraction and object recognition methods
CO3: apply Histogram transform for detection of geometric shapes like line, ellipse and objects.
CO4: illustrate 3D vision process and motion estimation techniques.
CO5: apply vision techniques to real time applications.

TOTAL: 60 PERIODS

TEXT BOOKS

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CBM366 SPEECH AND AUDIO SIGNAL PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES
The objective of this course is to enable the student to
- Provide students with basic knowledge about speech production and hearing.
- Understand time-frequency analysis concepts.
- Learn fundamentals of audio coding and transform coders.
- Understand time and frequency domain methods for speech processing.
- Study linear predictive analysis of speech.

UNIT I MECHANICS OF SPEECH AND AUDIO

UNIT II TIME-FREQUENCY ANALYSIS: FILTER BANKS AND TRANSFORMS

UNIT III AUDIO CODING AND TRANSFORM CODERS

UNIT IV TIME AND FREQUENCY DOMAIN
Time domain parameters of Speech signal – Methods for extracting the parameters: Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy Short
Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods


UNIT V LINEAR PREDICTIVE ANALYSIS

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students will be able to
CO1: Examine auditory models to design perceptual audio quality measure.
CO2: Design analysis-by-synthesis model for speech perception.
CO3: Analyze and design algorithms for speech and audio coding.
CO4: Analyze and design algorithms for extracting parameters from the speech signal.
CO5: Implement pitch detection and formant analysis in speech signals.

TEXT BOOKS

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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  9

UNIT II  COMPUTED TOMOGRAPHY  9

UNIT III  MAGNETIC RESONANCE IMAGING  9
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  9

UNIT V  RADIATION THERAPY AND RADIATION SAFETY  9

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

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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

UNIT II ELECTROPHYSIOLOGICAL SOURCES

UNIT III FEATURE EXTRACTION METHODS
UNIT IV  FEATURE TRANSLATION METHODS
Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization–
Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

UNIT V  APPLICATIONS OF BCI
Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback
and control - External device control, Case study: Brain actuated control of mobile Robot.

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

TOTAL: 45 PERIODS

TEXT BOOKS
1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain-Computer Interfaces:

REFERENCES

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CBM340  BIOMETRIC SYSTEMS  L T P C
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COURSE OBJECTIVES:
To Study about:
- To introduce the relevance of this course to the existing technology through
demonstrations, case studies, simulations, contributions of scientist,
national/international policies with a futuristic vision along with socio-economic impact
and issues.
- To understand the general principles of design of biometric systems and the underlying
trade-offs.
- To study the technologies of fingerprint, iris, face and speech recognition.
- To study of evaluation of biometrics systems.
UNIT I  INTRODUCTION TO BIOMETRICS
Introduction and background – biometric technologies – passive biometrics – active biometrics – Biometric characteristics, Biometric applications – Biometric Authentication systems - Taxonomy of Application Environment, Accuracy in Biometric Systems- False match rate- False non match rate- Failure to enroll rate- Derived metrics-Biometrics and Privacy.

UNIT II  FINGERPRINT TECHNOLOGY
History of fingerprint pattern recognition - General description of fingerprints- fingerprint sensors, fingerprint enhancement, Feature Extraction- Ridge orientation, ridge frequency, fingerprint matching techniques- correlation based, Minutiae based, Ridge feature based, fingerprint classification, Applications of fingerprints, Finger scan- strengths and weaknesses, Evaluation of fingerprint verification algorithms.

UNIT III  FACE RECOGNITION AND HAND GEOMETRY

UNIT IV  IRIS RECOGNITION
Introduction, Anatomical and Physiological underpinnings, Iris sensor, Iris representation and localization- Daugman and Wilde’s approach, Iris matching, Iris scan strengths and Weaknesses, System performance, future directions.

UNIT V  VOICE SCAN AND MULTIMODAL BIOMETRICS
Voice scan, speaker features, short term spectral feature extraction, Mel frequency cepstral coefficients, speaker matching, Gaussian mixture model, NIST speaker Recognition Evaluation Program, Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy, examples of multimodal biometric systems, Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC).

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Demonstrate the principles of biometric systems.
CO2: Develop fingerprint recognition technique.
CO3: Design face recognition and hand geometry system.
CO4: Design iris recognition system.
CO5: Develop speech recognition and multimodal biometric systems.

TOTAL:45 PERIODS

TEXT BOOKS

REFERENCES
2. L C Jain, I Hayashi, S B Lee, U Halici, “Intelligent Biometric Techniques in Fingerprint and


### CO’s-PO’s & PSO’s MAPPING

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#### CBM354 COMMUNICATION SYSTEMS

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#### COURSE OBJECTIVES:

The student should be made to:

- To study the various analog and digital modulation techniques
- To study the principles behind various error control coding
- To study the various digital communication techniques

### UNIT I ANALOG MODULATION

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – Angle modulation – PM and FM – Modulators and Demodulators

### UNIT II RECEIVER CHARACTERISTICS

Noise sources and types – Noise figure and noise temperature – Noise in cascaded systems – Single tuned receivers – Super heterodyne receivers

### UNIT III INFORMATION THEORY


### UNIT IV BANDPASS SIGNALING

Geometric representation of signals – Correlator and matched filter – ML detection – generation and detection, PSD, BER of coherent BPSK, BFSK, QPSK – Principles of QAM – Structure of non-coherent receivers – BFSK, DPSK

### UNIT V ERROR CONTROL CODING TECHNIQUES

Channel coding theorem – Linear block codes – Hamming codes – Cyclic codes (CRC) – Convolutional codes – Viterbi decoding (Soft/Hard decision decoding).

#### 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: Apply analog modulation techniques.
CO3: Apply digital modulation techniques.
CO4: Knowledge on various types of noises during transmission.
CO5: Analyze various error control coding techniques.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

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CBM370 WEARABLE DEVICES L T P C 3 0 0 3

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 9

UNIT IV SMART TEXTILE 9

UNIT V APPLICATIONS OF WEARABLE SYSTEMS 9
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

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

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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 arrythmias 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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CBM369 VIRTUAL REALITY AND AUGMENTED REALITY IN HEALTHCARE L T P C 3 0 0 3

COURSE OBJECTIVES
The objective of this course is to enable the student to
- Introduce the relevance of this course to the existing technology through demonstrations, case studies and applications with a futuristic vision along with socio-economic impact and issues
- Understand virtual reality, augmented reality and using them to build Biomedical engineering applications
- Know the intricacies of these platform to develop PDA applications with better optimality.
- Learn the various applications of VR.
- Learn the possibilities of implementing target-specific VR applications on mobile.

UNIT I INTRODUCTION 9

UNIT II VR DEVELOPMENT PROCESS 9
Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model management.

UNIT III CONTENT CREATION CONSIDERATIONS 9
Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment

UNIT IV VR ON THE WEB & VR ON THE MOBILE 10
UNIT V APPLICATIONS

Medical applications - military applications - robotics applications - Advanced Real time Tracking - other applications - games, movies, simulations, therapy

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Analyze and Design a system or process to meet given specifications with realistic engineering constraints.

CO2: Identify problem statements and function as a member of an engineering design team.

CO3: Analyze the implications and issues pertaining to VR

CO4: Propose technical documents and give technical oral presentations related to design VR mini project results.

CO5: Develop simple and portable VR applications using appropriate software.

TEXT BOOKS


REFERENCES


ONLINE RESOURCES

1. http://www.vrtechnology.org/resources.html

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COURSE OBJECTIVES:
- Learn the key principles for telemedicine and health
- Understand teledemical technology.
- Know telemedical standards, mobile telemedicine and its applications

UNIT I  FUNDAMENTALS OF TELEMEDICINE  6

UNIT II  TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE  6
Audio, video, still images, text and data, internet, air/wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare.

UNIT III  ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE  6
Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment - data protection & security, jurisdictional issues.

UNIT IV  PICTURE ARCHIVING AND COMMUNICATION SYSTEM  6
Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical issues, PACS architecture.

UNIT V  APPLICATIONS OF TELEMEDICINE  6
Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery.

PRACTICALS:
1. Porting sensor data on mobile devices
2. IoT for healthcare monitoring
3. Porting medical data on cloud platform
4. Cloud computing applications in health informatics
5. Study of telemedicine tools
6. Design of an application for mobile devices

COURSE OUTCOMES:
CO1: To analyze the benefits and limitations of telemedicine.
CO2: To apply multimedia technologies in telemedicine.
CO3: To explain protocols behind encryption techniques for secure transmission of data.
CO4: To develop radiology based information system.
CO5: To apply telemedicine in various healthcare domains.

TEXT BOOKS

REFERENCES

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CBM356 MEDICAL INFORMATICS

Preamble:
- To study the applications of information technology in health care management.
- 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 - Computerized ECG, EEG and EMG, 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 - History taking by computer, Dialogue with the computer, 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

Neurocomputers and Artificial Neural Networks application, Expert system - General model of CMD, Computer–assisted decision support system - production rule system, Cognition model, Semantic networks, Decision analysis in clinical medicine - computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V  RECENT TRENDS IN MEDICAL INFORMATICS

Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health - Medical education and healthcare information, computer assisted instruction in medicine.

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:

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CBM334  BIO MEMS
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COURSE OBJECTIVES

The objective of this course is to enable the student to

- Provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- Understand various mechanical and thermal sensors and actuators and their principles of operation at the micro scale level.
- Understand various electrostatic and piezoelectric sensors and actuators at the micro scale level.
● Introduce microfluidic systems.
● Know on the applications of MEMS in different field of medicine.

UNIT I MEMS MATERIALS AND FABRICATION  6
Semiconductor materials; photo lithography; doping; thin film growth and deposition; CVD and Ion Implantation, metallization; wet and dry etching; silicon micromachining; metal MEMS processes; submicron optical lithography; electron beam lithography; soft lithography and printing.

UNIT II MECHANICAL AND THERMAL SENSORS AND ACTUATORS  6
Mechanical sensors and actuators – beam and cantilever – microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flowsensor.

UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATOR  6
 Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor.

UNIT IV MICROFLUIDIC SYSTEMS  6
Laminar flow in circular conduits, fluid flow in micro conduits, in submicrometer and nanoscale. microfluidic components (filters, mixers, valves, and pumps)

UNIT V APPLICATIONS OF BIOMEMS  6
CAD for MEMS, DNA sensor, MEMS based drug delivery, Biosensors- sensors for glucose, uric acid, urea and triglyceride sensor. Introduction to the MATLAB/Simulink/ CAD tool for modelling/simulations of bioelectronics systems.

TOTAL: 30 Theory+15 lab PERIODS

LABORATORY EXPERIMENTS
1. Modeling and Simulation of MEMS sensors Using MATLAB (SIMULINK) such as Accelerometer, Current and Voltage Sensor.
2. Design of 3D CAD of BIOMEMS sensors.
3. Analysis of 3D CAD of BIOMEMS sensor.

COURSE OUTCOMES
On successful completion of this course, the student will be able to
CO1: Summarize various MEMS fabrication techniques.
CO2: Elucidate different types of mechanical and thermal sensors and actuators and their principles of operation at the micro Scale level.
CO3: Describe different types of various electrostatic and piezoelectric sensors and actuators and their principles of operation at the micro Scale level.
CO4: Explain microfluidic systems
CO5: Illustrate MEMS in different field of medicine.

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CBM344 CRITICAL CARE AND OPERATION THEATRE EQUIPMENT

COURSE OBJECTIVES:
The student should be made to:
- To offer clear understanding of various intensive care equipment and their working.
- To understand the necessity of different operation theatre equipment.
- To know about different dialyzers and ventilators.

UNIT I INTENSIVE CARE UNIT EQUIPMENT
Suction apparatus, Different types; Sterilizers, Chemical, Radiation, Steam for small and large units. ICU ventilators. Automated drug delivery systems, Infusion pumps, components of drug infusion system, closed loop control infusion system, implantable infusion system. BMD Measurements – SXA – DXA - Quantitative ultrasound bone densitometer

UNIT II CRITICAL CARE EQUIPMENT
Defibrillators, Hemodialysis Machine, Different types of Dialyzers, Membranes, Machine controls and measurements. Heart Lung Machine, different types of oxygenators, peristaltic pumps, Incubators.

UNIT III OPERATION THEATRE EQUIPMENT

UNIT IV CENTRALISED SYSTEMS
PATIENT SAFETY

Patient electrical safety, Types of hazards, Natural protective mechanisms against electricity, Leakage current, Inspection of grounding and patient isolation, Hazards in operation rooms, ICCU and IMCUs, Opto couplers and Pulse transformers.

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Apply the knowledge acquired, in designing new monitoring devices for ICU and assist the medical personnel's during emergency situations
CO2: Suggest suitable surgical instruments and operational devices.
CO3: Compare the various techniques for clinical diagnosis, therapy and surgery, and its recent methods
CO4: Assess the merits of the operation theatre equipment based on its applications
CO5: Design the devices for the particular application based on given specifications.

TOTAL: 45 PERIODS

TEXT BOOKS

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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:

REFERENCES:
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CBM365 ROBOTICS IN MEDICINE

L T P C
3 0 0 3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Get introduced to the fundamental of robotics and position analysis
- Learn about Parallel robots, different types of motions and force analysis
- Know the basics of trajectory planning, Motion control systems and actuators
- Have an insight into various sensors and vision systems
- Be acquainted to Fuzzy control and Applications of Robotics in Medicine

UNIT I FUNDAMENTALS AND POSITION ANALYSIS

Fundamentals – Classification, Advantages and disadvantages, Components, Degrees of freedom, Joints, Coordinates, Reference frames, Programming modes, Characteristics, Workspace, Languages, Collaborative robots, Position analysis – Robots as mechanisms, Conventions, Transformations, Forward and inverse kinematics, Denavit Hartenberg Representation, Degeneracy and Dexterity, Screw based robots, Position analysis of Articulated robot Case studies

UNIT II PARALLEL ROBOTS, DIFFERENTIAL MOTIONS AND FORCE ANALYSIS

Parallel robots – Physical characteristics, Forward and Inverse Kinematic approaches, Planar and Spatial parallel robots, Differential relationships. The Jacobian, Large scale motions, Frame vs Robot, Differential motions and change, Hand frame, Operator, Jacobian and Inverse for Screw based and Parallel Robots, Differential operator, Lagrangian mechanics, Moments of Inertia, Dynamic Equations of Multiple DOF Robots, Static force analysis, Transformation of forces and moments between coordinate frames Case studies

UNIT III TRAJECTORY PLANNING, MOTION CONTROL SYSTEMS AND ACTUATORS

Path and Trajectory, Joint Space and Cartesian Space Descriptions and Trajectory Planning, Cartesian, Trajectory Recording, Basics, Block diagrams, Laplace Transform, Block diagram Algebra, Transfer Functions, Characteristic equation, Steady state error, Root locus, Proportional, Integral and Derivative controllers, Compensators, Bode, Loops, Multiple IO systems, Control - State space and Digital, Nonlinear systems, Characteristics of Hydraulic, Pneumatic, Electric motors, Other actuators, Speed reduction Case studies
UNIT IV  SENSORS, IMAGE PROCESSING AND ANALYSIS WITH VISION SYSTEMS  9

UNIT V  FUZZY CONTROL AND APPLICATIONS IN MEDICINE  8
Fuzzy control - Crisp vs Fuzzy, Sets, Inference rules, Defuzzification, Simulation, Applications in Biomedical Engineering, Applications in rehabilitation, Nanobots in medicine, Clinical diagnosis and Surgery – Cardiac and abdominal procedures with teleoperated robots, Orthopedic surgery with cooperative robots Case studies

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students will be able to
CO1: Describe the fundamental of robotics and position analysis
CO2: Outline the functioning of parallel robots, different types of motions and force analysis.
CO3: Portray the basics of trajectory planning, Motion control systems and actuators.
CO4: Recognize and explain the use of various sensors and vision systems in robotics.
CO5: Employ Fuzzy control in robotics and apply it to Robotics in Medicine

TEXT BOOKS

REFERENCES

ONLINE RESOURCES
2. https://onlinecourses.nptel.ac.in/noc21_me49/preview

CO’s- PO’s & PSO’s MAPPING

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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 9
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 9
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 9

UNIT IV DENTAL CARE EQUIPMENT 9

UNIT V HEAT & PHOTON THERAPY EQUIPMENT 9
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, CO2laser, 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

REFERENCES

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CBM331 ADVANCEMENTS IN HEALTHCARE TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES:
The student should be made to:
- Understand the needs for wearable devices and the technology
- Learn the concepts in digital health care and digital hospitals
- Apply the tools in design, testing and developing digital health care equipment

UNIT I DIGITAL HEALTH
Digital Health: Requirements and best practices, Laws and regulations in Digital health, Ethical issues, barriers and strategies for innovation.

UNIT II DIGITAL RADIOLOGY
Digital radiology for digital hospital, picture archiving and communication, system integration, digital history of radiology, medical image archives, storage and networks.

UNIT III E-HEALTH
E-Health: Health care networking, medical reporting using speech recognition, physiological tests and functional diagnosis with digital methods, tele-consultation in medicine and radiology.
UNIT IV  M-HEALTH CARE AND WEARABLE DEVICES

Introduction to mobile healthcare devices-economy-average length of stay in hospital, outpatient care, health care costs, mobile phones, 4G, smart devices, wearable devices, Uptake of e-health and m-health technologies. Standards, system Design and case study.

UNIT V  MODALITY AND STANDARDS FOR INTER-OPERABILITY


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

CO1: Interpret the need for digital methods of handling medical records
CO2: Explain the digital radiology
CO3: Modify the tools and methods for work flow in E-Health
CO4: Identify the available technology for wearable healthcare devices
CO5: Compare various standards for inter-operability of devices, quality and safety standards for developing healthcare systems

TOTAL:45 PERIODS

TEXT BOOKS


REFERENCES


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SOFT CORE – MANAGEMENT

GE371 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

UNIT II PLANNING

UNIT III ORGANISING

UNIT IV DIRECTING

UNIT V CONTROLLING
System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.
CO2: Have same basic knowledge on international aspect of management.
CO3: Ability to understand management concept of organizing.
CO4: Ability to understand management concept of directing.
CO5: Ability to understand management concept of controlling.
TEXT BOOKS:

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GE3752 TOTAL QUALITY MANAGEMENT L T P C
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COURSE OBJECTIVES:
• Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
• Explain the TQM Principles for application.
• Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
• Describe Taguchi’s Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
• Illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES
UNIT III  TQM TOOLS & TECHNIQUES I

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

UNIT V  QUALITY MANAGEMENT SYSTEM

COURSE OUTCOMES:
CO1: Ability to apply TQM concepts in a selected enterprise.
CO2: Ability to apply TQM principles in a selected enterprise.
CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.
CO5: Ability to apply QMS and EMS in any organization.

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TEXT BOOK:

REFERENCES:
GE3753 ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING L T P C

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

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

UNIT II PRODUCTION AND COST ANALYSIS

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

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

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

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GE3754 HUMAN RESOURCE MANAGEMENT L T P C
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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


TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

TEXT BOOKS:

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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GE3755 KNOWLEDGE MANAGEMENT

COURSE OBJECTIVES:

The student should be made to:
- Learn the Evolution of Knowledge management.
- Be familiar with tools.
- Be exposed to Applications.
- Be familiar with some case studies.

UNIT I INTRODUCTION

Introduction: An Introduction to Knowledge Management - The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.
UNIT II CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING

UNIT III KNOWLEDGE MANAGEMENT-THE TOOLS
Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.

UNIT IV KNOWLEDGE MANAGEMENT APPLICATION
Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).

UNIT V FUTURE TRENDS AND CASE STUDIES
Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the student should be able to:
- CO1: Understand the process of acquire 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
Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg’s Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

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

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

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

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

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

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

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

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

CO4 Discuss the organizational theory in professional organization.

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

TEXTBOOKS:

REFERENCES:

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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

COURSE 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 L T P C 3 0 0 0

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

UNIT I HAZARDS, VULNERABILITY AND DISASTER RISKS
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - -, Inter relations between Disasters and Sustainable development Goals

UNIT II DISASTER RISK REDUCTION (DRR)
Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT
Components of Disaster Management – Preparedness of rescue and relief, mitigation,
rehabilitation and reconstruction - Disaster Risk Management and post disaster management – Compensation and Insurance - Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT

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

TOTAL : 45 PERIODS

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

REFERENCES

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

MX3085 WELL-BEING WITH TRADITIONAL PRACTICES- YOGA, AYURVEDA AND SIDDHA L T P C

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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 handle every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

Unit I HEALTH AND ITS IMPORTANCE

Health: Definition - Importance of maintaining health - More importance on prevention than treatment

Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional health.


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

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI - Importance and actions to be taken
UNIT II           DIET

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.


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

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

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

UNIT III       ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH           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:
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guildford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001
1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
2. Simple lifestyle modifications to maintain health https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.
3. Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html
7. BMI https://www.hsph.harvard.edu/nutritionsource/healthy-weight/
   https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations
8. Yoga https://www.healthifyme.com/blog/types-of-yoga/
   https://yogamedicine.com/guide-types-yoga-styles/
   Ayurveda : https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda
10. CAM : https://www.hindawi.com/journals/ecam/2013/376327/
11. Preventive herbs : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/

COURSE OUTCOMES:
After completing the course, the students will be able to:
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

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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, Dharmapal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

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

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

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

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

TOTAL : 45 PERIODS

MX3087  POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY  L T P C  3 0 0 0

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

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.

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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                    L T P C
3  0  0 0

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:

- Understand the basic concept of safety.
- Obtain knowledge of Statutory Regulations and standards.
- Know about the safety Activities of the Working Place.
- Analyze on the impact of Occupational Exposures and their Remedies
- Obtain knowledge of Risk Assessment Techniques.

TEXTBOOKS
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

REFERENCES
5. Society of Safety Engineers, USA

ONLINE RESOURCES

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

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<tr>
<th>Course Outcome(s)</th>
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1 - low, 2 - medium, 3 - high, '-' - no correlation
OPEN ELECTIVE I

OAS351 SPACE SCIENCE

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

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

UNIT II PLANT LOCATION AND LAYOUT

UNIT III WORK SYSTEM DESIGN & ERGONOMICS

UNIT IV STATISTICAL QUALITY CONTROL
UNIT V  PRODUCTION PLANNING AND CONTROL  


TOTAL: 45 PERIODS

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

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:

Food resources (plant, animal, microbes); Overview of current production systems; constraints and

UNIT-II NUTRIENTS AND FOOD ADDITIVES: 9


UNIT-III NANO FOOD TECHNOLOGY: 9

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: 9


UNIT-V CONSUMERS ON GM FOODS AND CONTEMPORARY ISSUES: 9

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

OCE351 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT  L T P C
3 0 0 3

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
- carry out scoping and screening of developmental projects for environmental and social assessments
• explain different methodologies for environmental impact prediction and assessment
• plan environmental impact assessments and environmental management plans
• 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 9

UNIT V      OTHER TYPES OF ENERGY 9
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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1 - low, 2 - medium, 3 - high, ‘-‘ - no correlation
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

Unit Operation, Measurement and Control: - Transport of solid, liquid and gases - Evaporators – Crystallizers-Dryers.

UNIT - II COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -II

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 petrochemical 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:**


3. [https://www.chemstations.com/CHEMCAD/](https://www.chemstations.com/CHEMCAD/)


5. [https://www.cocosimulator.org/](https://www.cocosimulator.org/)

6. [https://dwsim.fossee.in/](https://dwsim.fossee.in/)

**CO’s-PO's & PSO's MAPPING**

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<th>PO, PSO, CO</th>
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1- low, 2-medium, 3-high, “-“- no correlation
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 9

UNIT II  TREES AND CONNECTIVITY 9
Bridges – Trees – Characterization and properties of trees – Cut vertices – Connectivity.

UNIT III TRAVERSABILITY 9

UNIT IV PLANARITY AND COLOURING 9

UNIT V OPTIMIZATION GRAPH ALGORITHMS 9

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
CO’s-PO’s & PSO’s MAPPING

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

CCS355 NEURAL NETWORKS AND DEEP LEARNING

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

TOTAL: 60 PERIODS

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

<table>
<thead>
<tr>
<th>CO’s</th>
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### CCW332  DIGITAL MARKETING  

**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  
Online Market space - Digital Marketing Strategy - Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.

### UNIT II  SEARCH ENGINE OPTIMISATION  

### UNIT III  E- MAIL MARKETING  
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  
UNIT V  DIGITAL TRANSFORMATION

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

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

1. Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: Pearson Education;
7. Pulizzi,J Beginner's Guide to Digital Marketing , Mcgraw Hill Education

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

<table>
<thead>
<tr>
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OPEN ELECTIVE II

OIE352 RESOURCE MANAGEMENT TECHNIQUES L T P C 3 0 0 3

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 9

UNIT II DUALITY AND NETWORKS 9

UNIT III INTEGER PROGRAMMING 9
Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming.

UNIT IV CLASSICAL OPTIMISATION THEROY: 9

UNIT V OBJECT SCHEDULING: 9
Network diagram representation – Critical path method – Time charts and resource leveling – PERT.

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

CO’s- PO’s & PSO’s MAPPING

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

TOTAL: 45 PERIODS
TEXT BOOK:

REFERENCES:

OMG351 FINTECH REGULATION L T P C
3 0 0 3

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
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

UNIT III CROWDFUNDING AND DIGITAL ASSETS

UNIT IV MARKETPLACE LENDING AND MOBILE PAYMENTS

UNIT V ANTI-MONEY LAUNDERING AND CYBERSECURITY
Reporting requirements under the Bank Secrecy Act, Patriot Act, Panalties for violating the BSA, Virtual currencies and the Bank Secrecy Act, Cybersecurity Frameworks, Cybersecurity Act of 2015, Contractual and Self Regulatory obligations.
REFERENCES
6. Lee Reiners, FinTech Law and Policy, 2018

OFD351 HOLISTIC NUTRITION

UNIT I NUTRITION AND HEALTH
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
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
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
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
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.
2. Food, Nutrition and Diet Therapy – by Krause and Mahan 1996, Publisher- W.B. Saunders,
   ISBN: 0721658350
   Published by National Institute of Nutrition, Indian Council of Medical Research, 1989

AI3021 IT IN AGRICULTURAL SYSTEM  L  T  P  C
3 0 0 3

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 9
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 9
Artificial light systems, management of crop growth in greenhouses, simulation of CO₂
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 9
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 9
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 9
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>
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<td>PO2 Problem Analysis</td>
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<td>PO3 Design/ Development of Solutions</td>
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<td>PO5 Modern Tool Usage</td>
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OEI352 INTRODUCTION TO CONTROL ENGINEERING  

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, Rootlocus and Bodettechniques, Concept and construction, frequency response.

UNIT - V STATE SPACE TECHNIQUE  
State vectors–state space models-Digital Controllers–design aspects.
SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)  

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  

CO’s- PO’s & PSO’s MAPPING

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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  9
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  9

UNIT III  NANOTECHNOLOGY IN CANCER THERAPY  9

UNIT IV  NANOTECHNOLOGY IN COSMETICS  9

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

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
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
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
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
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

TOTAL: 60 PERIODS

TEXT BOOKS


REFERENCES

2. by Mitesh Soni

CO’s- PO’s & PSO’s MAPPING

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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

UNIT II AUTOMATION PROCESS ACTIVITIES
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
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

30 PERIODS

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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**COURSE**

**OPEN ELCTIVE III**

**OHS351**

**ENGLISH FOR COMPETITIVE EXAMINATIONS**

**L T P C**

**3 0 0 3**

**Course Description:**
Students aspiring to take up competitive exams of which the English language is a vital component will find this course useful. Designed for students in the higher semesters, the course will help students to familiarise themselves with those aspects of English that are tested in these examinations.
COURSE OBJECTIVES:
- To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defence) and the international level (GRE, TOEFL, IELTS).
- To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests.
- To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing.
- To improve students’ confidence to express their ideas and opinions in formal contexts
- To create awareness of accuracy and precision in communication

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

TOTAL: 45 PERIODS

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

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:

REFERENCEBOOKS:
1. Educational Testing Service - The Official Guide to the GRE Revised General Test, Tata
3. R Rajagopalan- General English for Competitive Examinations, McGraw Hill Education (India)

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 \hspace{1cm} ENVIRONMENTAL CONCERNS \hspace{1cm} 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 \hspace{1cm} ROLE OF NGOS \hspace{1cm} 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 \hspace{1cm} SUSTAINABLE DEVELOPMENT \hspace{1cm} 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 \hspace{1cm} NGO’S FOR SUSTAINABILITY \hspace{1cm} 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 \hspace{1cm} LEGAL FRAMEWORKS \hspace{1cm} 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
- CO 3 present strategies for NGOs in attaining sustainable development
- CO 4 recognize the importance of providing energy, food security and health equity to all members of the society without damaging the environment
- CO 5 understand the environmental legislations
REFERENCES

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

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

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

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

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

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

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 9
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 9

UNIT – III WIND ENERGY 9

UNIT – IV BIO-ENERGY 9

UNIT – V OCEAN AND GEOTHERMAL ENERGY 9

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

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OME354 APPLIED DESIGN THINKING L T P C 3 0 0 3

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 9
Exploring Human-centered Design - Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy-building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] - Case studies

UNIT II ENDUSER-CENTRIC INNOVATION 9
Importance of customer-centric innovation - Problem Validation and Customer Discovery - Understanding problem significance and problem incidence - Customer Validation. Target user,
User persona & user stories. Activity: Customer development process - Customer interviews and field visit

UNIT III APPLIED DESIGN THINKING TOOLS
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/startup-failure-is-like-true-lie-7812cdfe9b85
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

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Apply the fundamental concepts and principles of reverse engineering in product design and development.
CO2: Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
CO3: Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.
CO4: Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
CO5: Analyze the various legal aspect
CO6: Applications of reverse engineering in product design and development.

TEXT BOOKS:

REFERENCES:

OPR351 SUSTAINABLE MANUFACTURING

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

UNIT – I ECONOMIC SUSTAINABILITY

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

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

UNIT – IV  MANUFACTURING STRATEGY FOR SUSTAINABILITY  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

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

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the student will be able to
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.
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OAS352 SPACE ENGINEERING L T P C
3 0 0 3

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
Degrees of freedom of aircraft motions - stable, unstable and neutral stability - concept of static stability - Hooke’s Law- brittle and ductile materials - moment of inertia - section
UNIT V   SPACE APPLICATIONS
History of space research - spacecraft trajectories and basic orbital manoeuvres - six orbital elements - Kepler’s laws of orbits - Newton’s law of gravitation.

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCE:

OIM351   INDUSTRIAL MANAGEMENT   L T P C
3 0 0 3

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

UNIT I   INTRODUCTION

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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COURSE OBJECTIVES

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

UNIT I  INTRODUCTION

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

UNIT III  SPECIAL CONTROL PROCEDURES
Warning and modified control limits, control chart for individual measurements, multi-vari chart, X-chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

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

UNIT V  ACCEPTANCE SAMPLING
The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS2500 standards.

TOTAL: 45 PERIODS

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

CO’s-PO’s & PSO’s MAPPING

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OSF351 FIRE SAFETY ENGINEERING

COURSE OBJECTIVES

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

UNIT I INHERENT SAFETY CONCEPTS
Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires; Spread of fire in rooms, within building and between buildings. Effect of temperature on the properties of structural materials- concrete, steel, masonry and wood; Behavior of non-structural materials on fire-plastics, glass, textile fibres and other house hold materials.

UNIT II PLANT LOCATIONS
Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; Fire resistance test on structural elements-standard heating condition, Indian standard test method, performance criteria.

UNIT III WORKING CONDITIONS
Fire separation between building- principle of calculation of safe distance. Design principles of fire resistant walls and ceilings; Fire resistant screens- solid screens and water curtains; Local barriers; Fire stopped areas-in roof, in fire areas and in connecting structures; Fire doors- Low combustible, Non-combustible and Spark-proof doors; method of suspension of fire doors; Air-tight sealing of doors;

UNIT IV FIRE SEVERITY AND REPAIR TECHNIQUES
Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards; Fire protection of structural elements - Wooden, Steel and RCC.. Reparability of fire damaged structures- Assessment of damage to concrete, steel, masonry and timber structures, Repair techniques- repair methods to reinforced concrete Columns, beams and slabs, Repair to steel structural members, Repair to masonry structures.

UNIT V WORKING AT HEIGHTS

TOTAL : 45 PERIODS

233
COURSE OUTCOMES
On completion of the course the student will be able to
CO1: Understand the effect of fire on materials used for construction
CO2: Understand the method of test for non-combustibility and fire resistance; and will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.
CO3: To understand the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.
CO4: To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.
CO5: Describe the safety techniques and improve the analytical and intelligence to take the right decision at right time.

TEXT BOOKS

REFERENCES:

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OML351 INTRODUCTION TO NON-DESTRUCTIVE TESTING

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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
- Understanding the basic importance of NDT in quality assurance.
- Imbibing the basic principles of various NDT techniques, its applications, limitations, codes and standards.
• Equipping themselves to locate a flaw in various materials, products.
• Applying 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  9
Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting.

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

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

UNIT IV  ULTRASONIC TESTING & AET  9
Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, calibration.

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
CO1: Realize the importance of NDT in various engineering fields.
CO2: Have a basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures.
CO3: Calibrate the instrument and inspect for in-service damage in the components by means of Eddy current testing as well as Thermography testing.

CO4: Differentiate various techniques of UT and AET and select appropriate NDT methods for better evaluation.

CO5: Interpret the results of Radiography testing and also have the ability to analyse the influence of various parameters on the testing.

TEXT BOOKS:

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OMR351  MECHATRONICS
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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
• Selecting sensors to develop mechatronics systems.
• Explaining the architecture and timing diagram of microprocessor, and also interpret and develop programs.
• Designing appropriate interfacing circuits to connect I/O devices with microprocessor.
• Applying PLC as a controller in mechatronics system.
• Designing and develop the apt mechatronics system for an application.

UNIT – I  INTRODUCTION AND SENSORS

UNIT – II 8085 MICROPROCESSOR 9

UNIT – III PROGRAMMABLE PERIPHERAL INTERFACE 9

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

UNIT – V ACTUATORS AND MECHATRONICS SYSTEM DESIGN 9

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Select sensors to develop mechatronics systems.
CO2: Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.
CO3: Design appropriate interfacing circuits to connect I/O devices with microprocessor.
CO4: Apply PLC as a controller in mechatronics system.
CO5: Design and develop the apt mechatronics system for an application.

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TEXT BOOKS
REFERENCES

ORA351  FOUNDATION OF ROBOTICS  L  T  P  C
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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 EFECTORS
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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TEXT BOOKS:

REFERENCES:
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

COURSE OBJECTIVES:
- To introduce the concepts of remote sensing processes and its components.
- To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation.

UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION
9

UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL
9

UNIT III ORBITS AND PLATFORMS
9
Motions of planets and satellites – Newton’s law of gravitation - Gravitational field and potential - Escape velocity - Kepler’s law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Lagrange Orbit.

UNIT IV SENSING TECHNIQUES
9

UNIT V DATA PRODUCTS AND INTERPRETATION
9
Photographic and digital products – Types, levels and open source satellite data products — selection and procurement of data– Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification

TOTAL: 45 PERIODS
COURSE OUTCOMES:
On completion of the course, the student is expected to
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>PSO2</td>
<td>Critical analysis of Geoinformatics Engineering problems and innovations</td>
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<td>PSO3</td>
<td>Conceptualization and evaluation of Design solutions</td>
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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  9
Benefits of urban agriculture- economic benefits, environmental benefits, social and cultural benefits, educational, skill-building and job training benefits, health, nutrition and food accessibility benefits.

UNIT II  VERTICAL FARMING  9

UNIT III  SOIL LESS CULTIVATION  9
Hydroponics, aeroponics, aquaponics: merits and limitations, costs and Challenges, backyard gardens-tactical gardens-street landscaping-forest gardening, greenhouses, urban beekeeping

UNIT IV  MODERN CONCEPTS  9
Growth of plants in vertical pipes in terraces and inside buildings, micro irrigation concepts suitable for roof top gardening, rain hose system, Green house, polyhouse and shade net system of crop production on roof tops

UNIT V  WASTE MANAGEMENT  9
Concept, scope and maintenance of waste management-recycle of organic waste, garden waste-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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1 - low, 2 - medium, 3 - high, '-' - no correlation

OEN351 DRINKING WATER SUPPLY AND TREATMENT

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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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 machines
- To understand the basics of power converters
- To know the concepts of controlling DC and AC drive systems
- To understand the architecture and power train components.
- To impart knowledge on vehicle control for standard drive cycles of hybrid electrical vehicles (HEVs)

UNIT I ROTATING POWER CONVERTERS

UNIT II STATIC POWER CONVERTERS
Working and Characteristics of Power Diodes, MOSFET and IGBT. Working of uncontrolled rectifiers, controlled rectifiers (Single phase and Three phase), DC choppers, single and three phase inverters, Multilevel inverters and Matrix Converters.

UNIT III CONTROL OF DC AND AC MOTOR DRIVES
Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, Transformation theory, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives

UNIT IV HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS
UNIT V       MECHANICS OF HYBRID ELECTRIC VEHICLES AND CONTROL OF VEHICLES

Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of HEV's - motor torque and power rating and battery capacity. HEV supervisory control - Selection of modes - power split mode - parallel mode - engine brake mode - regeneration mode - series parallel mode

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Able to understand the principles of conventional and special electrical machines.
CO2: Acquired the concepts of power devices and power converters
CO3: Able to understand the control for DC and AC drive systems.
CO4: Learned the electric vehicle architecture and power train components.
CO5: Acquired the knowledge of mechanics of electric vehicles and control of electric vehicles.

CO’s-PO’s & PSO’s MAPPING

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REFERENCES:

OEI353       INTRODUCTION TO PLC PROGRAMMING

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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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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, thermoset based and elastomer based-
influence of size, shape and role of interface in composites applications.

UNIT IV  NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES  10
Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice-clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.

UNIT V APPLICATIONS OF NANO MATERIALS  9
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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<td>CO2</td>
<td>acquire knowledge about the different types of nano material synthesis</td>
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<td>CO3</td>
<td>describes about the shape, size, structure of composite nano materials and their interference</td>
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<td>CO4</td>
<td>understand the different characterization techniques for nanomaterials</td>
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<td>CO5</td>
<td>develop a deeper knowledge in the application of nanomaterials in different fields</td>
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Overall CO 3 2 2 1 3 3 1 1 1 1 1 3 2 1 1

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

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

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1To 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, seaweeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.

UNIT II METHODS OF FOOD HANDLING AND STORAGE 9
Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.
UNIT III  LARGE-SCALE FOOD PROCESSING  12
Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying. Dehydration of fruits, vegetables, milk, animal products etc; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods.

UNIT IV  FOOD WASTES IN VARIOUS PROCESSES  6
Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment.

UNIT V  FOOD HYGIENE  9
Food related hazards – Biological hazards – physical hazards – microbiological considerations in foods. Food adulteration – definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene; Training& Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant; use of sanitizers, detergents, heat, chemicals, Cleaning of equipment and premises.

COURSE OUTCOMES:
On completion of the course the students are expected to
CO1 Be aware of the different methods applied to processing foods.
CO2 Be able to understand the significance of food processing and the role of food and beverage industries in the supply of foods.

TEXT BOOKS/REFERENCES:

OPY352  IPR FOR PHARMA INDUSTRY  L T P C
3 0 0 3

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

UNIT I  INTRODUCTION- INTELLECTUAL PROPERTY RIGHTS  9
Introduction, Types of Intellectual Property Rights - patents, plant varieties protection, geographical indicators, copyright, trademark, trade secrets.
UNIT II PATENTS 9
Patents-Objective, Introduction, Requirement for patenting- Novelty, Inventive step (Non-obviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, compulsory license.

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

UNIT IV ENFORCEMENT AND PRACTICAL ASPECTS OF IPR 9

UNIT V INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY 9

TOTAL:45 PERIODS

TEXT BOOKS:

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

COURSE OUTCOME
The student will be able to
C1 Understand and differentiate the categories of intellectual property rights.
C2 Describe about patents and procedure for obtaining patents.
C3 Distinguish plant variety, traditional knowledge and geographical indications under IPR.
C4 Provide the information about the different enforcements and practical aspects involved in protection of IPR.
C5 Provide different organizations role and responsibilities in the protection of IPR in the
international level.

C6 Understand the interrelationships between different Intellectual Property Rights on International Society

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

OTT351 BASICS OF TEXTILE FINISHING

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

UNIT I RESIN FINISHING

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

UNIT III SOIL RELEASE AND ANTISTATIC FINISHES

UNIT IV MECHANICAL FINISHES

UNIT V STIFFENING AND SOFTENING
Concept of stiffening and softening of textile materials. Mechanism in the weight reduction of PET. Concept of Micro encapsulation techniques in finishing process, Nano finish, Plasma Treatment and Bio finishing.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of the course, the students will be able to Understand the
 CO: 2 Concept of Flame proof & flame retardancy, waterproof and water repellent,
      Antimicrobial finishes.
 CO: 3 Concept of Soil Release, Anti Pilling, UV Protection and Antistatic finishes.
 CO: 4 Concept of Mechanical finishing.
 CO: 5 Basics of Micro encapsulation techniques, Nano finish, Plasma Treatment.

TEXT BOOKS:

REFERENCES:
1. Microencapsulation in finishing, Review of progress of Colouration, SDC, 2001 62

OTT352 INDUSTRIAL ENGINEERING FOR GARMENT INDUSTRY L T P C
3 0 0 3

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
Definition, purpose, procedure, equipments, techniques. Time study - Definition, basics of time study- equipments. Time study forms, Stop watch procedure. Predetermined motion time standards (PMTS). Time Study rating, calculation of standard time, Performance rating – relaxation and other allowances. Calculation of SAM for different garments, GSD.

UNIT V WORK STUDY APPLICATION
Application of work study techniques in cutting, stitching and packing in garment industry. Workaids in sewing, Pitch diagram, Line balancing, Capacity planning, scientific method of training.

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

TOTAL: 45 PERIODS

TEXTBOOKS:

REFERENCES

CO’s-PO’s & PSO’s MAPPING:

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<th>Course Outcomes</th>
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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

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 - calculation

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
Knitting – classification, principle, types of fabrics; nonwoven process – classification, principle,
types of fabrics.

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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<td>Classify fibres and production of natural fibres</td>
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<td>Regenerated and synthetic fibres</td>
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### OPE351

**INTRODUCTION TO PETROLEUM REFINING AND PETROCHEMICALS**

| LTPC | 3 0 0 3 |

**COURSE OBJECTIVE:**

The course is aimed to

Gain knowledge about petroleum refining process and production of petrochemical products.

### UNIT I

**ORIGIN, FORMATION AND REFINING OF CRUDE OIL**


### UNIT II

**CRACKING**

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

### UNIT III

**REFORMING AND HYDROTREATING**


### UNIT IV

**INTRODUCTION TO PETROCHEMICALS**

Petrochemicals - Cracking of Naphtha and Feed stock gas for the production of Ethylene, Propylene, Isobutylene and Butadiene. Production of Acetylene from Methane, and Extraction of Aromatics.

### UNIT V

**PRODUCTION OF PETROCHEMICALS**

Production of Petrochemicals like Dimethyl Terephthalate(DMT), Ethylene Glycol, Synthetic...
glycerine, Linear Alkyl Benzene (LAB), Acrylonitrile, Methyl Methacrylate (MMA), Vinyl Acetate Monomer, Phthalic Anhydride, Maleic Anhydride, Phenol, Acetone, Methanol, Formaldehyde, Acetaldehyde, Pentaerythritol and production of Carbon Black.

TOTAL: 45 PERIODS

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

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

UNIT II ELECTRICAL SYSTEMS
UNIT III THERMAL SYSTEMS

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

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

TOTAL: 45 PERIODS

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  9

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Ability to find out the correlation between various processing techniques with product properties.
CO2: Understand the major plastics processing techniques used in moulding (injection, blow, compression, and transfer), extrusion, thermoforming, and casting.
CO3: Acquire knowledge on additives for plastic compounding and methods employed for the same
CO4: Familiarize with the machinery and ancillary equipment associated with various plastic processing techniques.
CO5: Select an appropriate processing technique for the production of a plastic product

REFERENCES

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

COURSE OBJECTIVES :
• To understand the basic properties of signal & systems
• To know the methods of characterization of LTI systems in time domain
• To analyze continuous time signals and system in the Fourier and Laplace domain
• To analyze discrete time signals and system in the Fourier and Z transform domain

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

UNIT III  LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS  9

UNIT IV  ANALYSIS OF DISCRETE TIME SIGNALS  9
Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT)– Properties of DTFT - Z Transform & Properties

UNIT V  LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS  9

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

CO’s-PO’s & PSO's MAPPING

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COURSE OBJECTIVES:

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

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

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

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

UNIT IV  FEEDBACK AMPLIFIERS AND OSCILLATORS

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

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

TEXT BOOKS:
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OMA352 OPERATIONS RESEARCH L T P C
3 0 0 3

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 9

UNIT II TRANSPORTATION AND ASSIGNMENT PROBLEMS 9

UNIT III INTEGER PROGRAMMING 9

UNIT IV DYNAMIC PROGRAMMING PROBLEMS 9
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:

REFERENCES :

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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  9
Groups: Definition - Properties - Homomorphism - Isomorphism - Cyclic groups - Cosets - Lagrange's theorem.
Rings: Definition - Sub rings - Integral domain - Field - Integer modulo n - Ring homomorphism.

UNIT II  FINITE FIELDS AND POLYNOMIALS  9
Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.

UNIT III  DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS  9
Division algorithm - Base-b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM.

UNIT IV  DIOPHANTINE EQUATIONS AND CONGRUENCES  9
Linear Diophantine equations – Congruence’s – Linear Congruence’s - Applications : Divisibility tests - Modular exponentiation - Chinese remainder theorem – 2x2 linear systems.

UNIT V  CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS  9
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:

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OMA354 LINEAR ALGEBRA

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

UNIT I MATRICES AND SYSTEM OF LINEAR EQUATIONS

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

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

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

UNIT V EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION

TOTAL : 45 PERIODS
COURSE OUTCOMES:
After the completion of the course the student will be able to
CO1: Test the consistency and solve system of linear equations.
CO2: Find the basis and dimension of vector space.
CO3: Obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
CO4: Find orthonormal basis of inner product space and find least square approximation.
CO5: Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

TEXT BOOKS

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

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

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:
COURSE OBJECTIVE:

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

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

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

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

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

UNIT V  PRODUCTS FROM MICROBES  9
Fermented products – Fermented Beverages, Curd, Cheese, Mushroom, Agricultural products – Biopesticide, Biofertilizers, Vermi compost, Pharmaceutical products - Antibiotics, Vaccines

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

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

UNIT III  AMINO ACIDS AND PROTEIN.

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

UNIT V  VITAMINS AND HORMONES

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
COURSE OBJECTIVES:

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

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

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

UNIT III  BIO-MEMBRANE TRANSPORT  9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

TEXTBOOKS:
REFERENCES:

OPEN ELECTIVE IV

OHS352 PROJECT REPORT WRITING 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

TOTAL:45 PERIODS

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

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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

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  
9
Laplace and Poisson’s equations in a rectangular region: Five point finite difference schemes - Leibmann’s iterative methods - Dirichlet’s and Neumann conditions – Laplace equation in polar coordinates: Finite difference schemes.

UNIT V  
FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS  
9

TOTAL : 45 PERIODS

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

CO’s-PO’s & PSO’s MAPPING

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

OMA357 QUEUEING AND RELIABILITY MODELLING  L T P C

3 0 0 3

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 9

UNIT II MARKOVIAN QUEUEING MODELS 9
Markovian queues – Birth and death processes – Single and multiple server queueing models – Little’s formula - Queues with finite waiting rooms.

UNIT III ADVANCED QUEUEING MODELS 9
M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and M/Er/1 as special cases – Series queues – Open Jackson networks.
UNIT IV   SYSTEM RELIABILITY

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

TOTAL: 45 PERIODS

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

REFERENCES

CO’s-PO’s & PSO’s MAPPING

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1 - low, 2 - medium, 3 - high, '-' - no correlation
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.
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 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:
CME343  NEW PRODUCT DEVELOPMENT  

L  T  P  C
3  0  0  3

COURSE OBJECTIVES
- To introduce the fundamental concepts of the new product development
- To develop material specifications, analysis and process.
- To Learn the Feasibility Studies & reporting of new product development.
- To study the New product qualification and Market Survey on similar products of new product development
- To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model

UNIT – I  FUNDAMENTALS OF NPD  

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

UNIT – III  ESSENTIALS OF NPD  

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

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

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

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

CO2: Discuss the Material specification standards, analysis and fabrication, manufacturing process.

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 PROTYPING TECHNIQUES

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

Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human Factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Color theory - Design process flow, wireframes,
best practices in the industry - User engagement ethics - Design alternatives

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

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

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES
At the end of the course, learners will be able to:
CO1: Create quick UI/UX prototypes for customer needs
CO2: Develop web application to test product traction / product feature
CO3: Develop 3D models for prototyping various product ideas
CO4: Built prototypes using Tools and Techniques in a quick iterative methodology

TEXT BOOKS

REFERENCES
COURSE OBJECTIVES:
At the end of this course the student should be able to
- Learn about the precision machine tools
- Learn about the macro and micro components.
- Understand handling and operating of the precision machine tools.
- Learn to work with miniature models of existing machine tools/robots and other instruments.
- Learn metrology for micro system

UNIT I INTRODUCTION TO MICROSYSTEMS
Design, and material selection, micro-actuators: hydraulic, pneumatic, electrostatic/magnetic etc. for medical to general purpose applications. Micro-sensors based on Thermal, mechanical, electrical properties; micro-sensors for measurement of pressure, flow, temperature, inertia, force, acceleration, torque, vibration, and monitoring of manufacturing systems.

UNIT II FABRICATION PROCESSES FOR MICRO-SYSTEMS:
Additive, subtractive, forming process, microsystems-Micro-pumps, micro-turbines, micro engines, micro-robot, and miniature biomedical devices

UNIT III INTRODUCTION TO PRECISION ENGINEERING
Machine tools, holding and handling devices, positioning fixtures for fabrication/assembly of microsystems. Precision drives: inch worm motors, ultrasonic motors, stick-slip mechanism and other piezo-based devices.

UNIT IV PRECISION MACHINING PROCESSES
Precision machining processes for macro components - Diamond turning, fixed and free abrasive processes, finishing processes.

UNIT V METROLOGY FOR MICRO SYSTEMS
Metrology for micro systems - Surface integrity and its characterization.

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:
3. Whitehouse, D. J., Handbook of Surface Metrology, Institute of Physics Publishing,
OMF354 COST MANAGEMENT OF ENGINEERING PROJECTS

COURSE OBJECTIVES:
- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT – I INTRODUCTION TO COSTING CONCEPTS
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT – II INTRODUCTION TO PROJECT MANAGEMENT
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning, Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts

UNIT – III PROJECT EXECUTION AND COSTING CONCEPTS
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing

UNIT – IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL

UNIT – V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

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.
techniques.

CO5: Become familiar with quantitative techniques in cost management.

TEXT BOOKS:

REFERENCES:

AU3002 BATTERIES AND MANAGEMENT SYSTEM

COURSE OBJECTIVES:
• The objective of this course is to make the students to understand the working and characteristics of different types of batteries and their management.

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

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

UNIT III BATTERY MODELLING

UNIT IV BATTERY STATE ESTIMATION

UNIT V BMS ARCHITECTURE AND REAL TIME COMPONENTS
Battery Management System- need, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex Ray-
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 BatteryModel or Simulation.  
- **CO4**: Estimate State-of-Charges in a Battery Pack.  
- **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*

**AU3008 SENSORS AND ACTUATORS**

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COURSE OBJECTIVES:

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

UNIT I INTRODUCTION TO MEASUREMENTS AND SENSORS


UNIT II VARIABLE RESISTANCE AND INDUCTION SENSORS

Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT

UNIT III VARIABLE AND OTHER SPECIAL SENSORS

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

UNIT IV AUTOMOTIVE ACTUATORS

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

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

TEXT BOOKS:

REFERENCES:

OAS353  SPACE VEHICLES

COURSE OBJECTIVES:
- To interpret the missile space stations, space vs earth environment.
- To explain the life support systems, mission logistics and planning.
- To deploy the skills effectively in the understanding of space vehicle configuration designs.
- 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 L T P C 3 0 0 3

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.

UNITI 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:

OIM 353
PRODUCTION PLANNING AND CONTROL
COURSE OBJECTIVES:
- To understand the concept of production planning and control act work study,
- To apply the concept of product planning,
- To analyze the production scheduling,
- To apply the Inventory Control concepts.
- To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

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

UNIT II
WORK STUDY
Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study - work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III
PRODUCT PLANNING AND PROCESS PLANNING
Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning-Steps in process planning-Quantity determination in batch production-Machine capacity, balancing-Analysis of process capabilities in a multi product system.

UNIT IV
PRODUCTION SCHEDULING
Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling-Batch production scheduling-Product sequencing – Production Control systems-
UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC
Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures.
Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL : 45 PERIODS

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

TEXT BOOKS:

REFERENCES

CO’s-PO’s & PSO’s MAPPING

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COURSE OBJECTIVE:

- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm’s competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
- Relate the interdependence of the operations function with the other key functional areas of a firm.
- Teach analytical skills and problem-solving tools to the analysis of the operations problems.
- Apply scheduling and Lean Concepts for improving System Performance.

UNIT I  INTRODUCTION TO OPERATIONS MANAGEMENT  9
Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy - Strategic fit, framework; Supply Chain Management

UNIT II  FORECASTING, CAPACITY AND FACILITY DESIGN  9

UNIT III  DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS  9

UNIT IV  MATERIALS MANAGEMENT  9

UNIT V  SCHEDULING AND PROJECT MANAGEMENT  9
Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson’sAlgorithm – Gantt charts; personnel scheduling in services.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

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

CO3: The students will able to Formulate and Assess Aggregate Planning strategies and...
Material Requirement Plan.

**CO4:** The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.

**CO5:** The students will be able to apply scheduling and Lean Concepts for improving System Performance.

### CO’s- PO’s & PSO’s MAPPING

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### TEXT BOOKS

### REFERENCES

OSF352 INDUSTRIAL HYGIENE

### 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
Occupational Health and Environment Safety Management System, ILO and EPA Standards Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.

UNIT III : OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION

UNIT IV : OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT

UNIT V : INDUSTRIAL HAZARDS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students able to
CO1: Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems
CO2: Specify designs that avoid occupation related injuries
CO3: Define and apply the principles of work design, motion economy, and work environment design.
CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.
CO5: Acknowledge the impact of workplace design and environment on productivity

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

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

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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

Design principles - Process design development - types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares- new concepts in safety design and operation - Pressure vessel testing standards- Inspection techniques for boilers and reaction vessels.

UNIT IV SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS

Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards - standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures - condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

UNIT V  SAFETY AND ANALYSIS

Safety vs reliability- quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students able to

CO1 Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.

CO2 Develop thorough knowledge about safety in the operation of chemical plants.

CO3 Apply the principles of safety in the storage and handling of gases.

CO4 Identify the conditions that lead to reaction hazards and adopt measures to prevent them.

CO5 Develop thorough knowledge about

TEXT BOOK


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

- Understanding the importance of various materials used in electrical, electronics and magnetic applications
- Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
- Gaining knowledge on the selection of suitable materials for the given application
- Knowing the fundamental concepts in Semiconducting materials
- Getting equipped with the materials used in optical and optoelectronic applications.

UNIT- I DIELECTRIC MATERIALS
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

UNIT – II MAGNETIC MATERIALS
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis

UNIT – III SEMICONDUCTOR MATERIALS
Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on specific superconducting materials; comments on fabrication and engineering applications.

UNIT – IV MATERIALS FOR ELECTRICAL APPLICATIONS
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetallic 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
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:

REFERENCE BOOKS:

CO’s-PO’s & PSO’s MAPPING

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OML353  NANOMATERIALS AND APPLICATIONS  L T P C
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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:

- Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications
- Gaining knowledge on dimensionality effects on different properties of nanomaterials
- Getting acquainted with the different processing techniques employed for fabricating nanomaterials
- Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
- Acquiring knowledge on different applications of nanomaterials in different disciplines of
UNIT I  NANOMATERIALS  9
Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.

UNIT II THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS  9
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.

UNIT III PROCESSING  9
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.

UNIT IV STRUCTURAL CHARACTERISTICS  9
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis

UNIT V APPLICATIONS  9
Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
CO1: Evaluate nanomaterials and understand the different types of nanomaterials
CO2: Recognise the effects of dimensionality of materials on the properties
CO3: Process different nanomaterials and use them in engineering applications
CO4: Use appropriate techniques for characterising nanomaterials
CO5: Identify and use different nanomaterials for applications in different engineering fields.

TEXT BOOKS:

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

OMR352 HYDRAULICS AND PNEUMATICS

COURSE OBJECTIVES:
1. To knowledge on fluid power principles and working of hydraulic pumps
2. To obtain the knowledge in hydraulic actuators and control components
3. To understand the basics in hydraulic circuits and systems
4. To obtain the knowledge in pneumatic and electro pneumatic systems
5. To apply the concepts to solve the trouble shooting

UNIT – I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS

UNIT – II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS

UNIT – III HYDRAULIC CIRCUITS AND SYSTEMS
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT – IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS
UNIT – V TROUBLE SHOOTING AND APPLICATIONS


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

TEXT BOOKS


REFERENCES


OMR353 SENSORS L T P C 3 0 0 3

COURSE OBJECTIVES:

1. To learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics.
2. To understand basic working principle, construction, Application and characteristics of displacement, speed and ranging sensors.
3. To understand and analyze the working principle, construction, application and characteristics of force, magnetic and heading sensors.
4. To learn and analyze the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors.
5. To familiarize students with different signal conditioning circuits design and data acquisition system.

UNIT – I  SENSOR CLASSIFICATION, CHARACTERISTICS AND SIGNAL TYPES  9

UNIT – II  DISPLACEMENT, PROXIMITY AND RANGING SENSORS  9

UNIT – III  FORCE, MAGNETIC AND HEADING SENSORS  9

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

UNIT – V  SIGNAL CONDITIONING  9

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors. They can also analyze the sensor response.
CO2: Analyze and select suitable sensor for displacement, proximity and range measurement.
CO3: Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.
CO4: Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.
CO5: Select and design suitable signal conditioning circuit with proper compensation and linearizing element based on sensor output signal.
CO’s-PO’s & PSO’s MAPPING

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TEXT BOOKS

REFERENCES

ORA352 CONCEPTS IN MOBILE ROBOTS

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COURSE OBJECTIVES
1. To introduce mobile robotic technology and its types in detail.
2. To learn the kinematics of wheeled and legged robot.
3. To familiarize the intelligence into the mobile robots using various sensors.
4. To acquaint the localization strategies and mapping technique for mobile robot.
5. To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT – I INTRODUCTION TO MOBILE ROBOTICS

UNIT – II KINEMATICS
Kinematic Models – Representation of Robot – Forward Kinematics – Wheel and Robot
Constraints – Degree of Mobility and Steerability – Manoeuvrability – Workspace – Degrees of Freedom – Path and Trajectory Considerations – Motion Controls - Holonomic Robots

UNIT – III PERCEPTION

UNIT – IV LOCALIZATION

UNIT – V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS

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:
COOURE OBJECTIVES:

1. To impart knowledge on basics of propulsion system and ship dynamic movements
2. To educate them on basic layout and propulsion equipment’s
3. To impart basic knowledge on performance of the ship
4. To impart basic knowledge on Ship propeller and its types
5. To impart knowledge on ship rudder and its types

UNIT I    BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS       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,
ster 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
Propeller dimension, Propeller and its types – fixed propeller, control pitch propeller, kort nozzle,
ducted propeller, voith schneider, Parts of propeller, 3 blade - 5 blade - 6 blade propellers and its
advantages, propeller boss hub, crown nut, propeller skew, pitch of propeller - Thrust creation by

UNIT V    BASICS OF RUDDER                                   9
Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings- Rudder
pintle - Rudder types- Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits
of various types of rudders, Propeller and rudder interaction, Rudder stopper, movement of
rudders, Basic construction of Rudder

COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
CO1: Explain the basics of propulsion system and ship dynamic movements
CO2: Familiarize with various components assisting ship stabilization.
CO3: Demonstrate the performance of the ship.
CO4: Classify the Propeller and its types, Materials etc.
CO5: Categories the Rudder and its types, design criteria of rudder.

TOTAL: 45 PERIODS
**TEXT BOOKS:**
1. GP. Ghose, “Basic Ship propulsion”, 2015

**REFERENCES BOOKS:**

**CO’s-PO’s & PSO’s MAPPING**

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**OMV351**

**MARINE MERCHANT VESSELS**

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**COURSE OBJECTIVES:**
At the end of the course, students are expected to acquire
1. Knowledge on basics of Hydrostatics
2. Familiarization on types of merchant ships
3. Knowledge on Shipbuilding Materials
4. Knowledge on marine propeller and rudder
5. Awareness on governing bodies in shipping industry

**UNIT I**

**INTRODUCTION TO HYDROSTATICS**

- Density, relative density - Displacement –Pressure –centre of pressure

**UNIT II**

**TYPES OF SHIP**

- General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers - Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gascarriers - Chemical tankers - Passenger ships

**UNIT III**

**SHIPBUILDING MATERIALS**

- Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys, Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced Composites
UNIT IV MARINE PROPELLER AND RUDDER
Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its effects on propeller

UNIT V GOVERNING BODIES FOR SHIPPING INDUSTRY
Role of IMO (International Maritime Organization), SOLAS (International Convention for the Safety of Life at Sea), MARPOL (International Convention for the Prevention of Pollution from Ships), MLC (Maritime Labour Convention), STCW 2010 (International Convention on Standards of Training, Certification and Watch keeping for Seafarers), Classification societies Administration authorities

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, students would
CO1: Acquire Knowledge on floatation of ships
CO2: Acquire Knowledge on features of various ships
CO3: Acquire Knowledge of Shipbuilding Materials
CO4: Acquire Knowledge to identify the different types of marine propeller and rudder
CO5: Understand the Roles and responsibilities of governing bodies

TEXT BOOKS:
2. Dr.DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006

REFERENCES:
2. MARPOL Consolidated Edition, Bhandakar Publications, 2018

OMV352 ELEMENTS OF MARINE ENGINEERING
COURSE OBJECTIVES:
At the end of the course, students are expected to
1. Understand the role of Marine machinery systems
2. Be familiar with Marine propulsion machinery system
3. Acquaint with Marine Auxiliary machinery system
4. Have acquired basics of Marine Auxiliary boiler system
5. Be aware of ship propellers and steering system

UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS
Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air
compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems

UNIT II  MARINE PROPULSION MACHINERY SYSTEM  9
Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system

UNIT III  MARINE AUXILIARY MACHINERY SYSTEM  9
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications

UNIT IV  MARINE BOILER SYSTEM  9
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories

UNIT V  SHIP PROPELLERS AND STEERING MECHANISM  9
Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear

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:

REFERENCES:
1. Alan L.Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006
2. A.S.Tambwekar, “Naval Architecture and Ship Construction”, The Institute of Marine Engineers (India), Mumbai, 2015
### COURSE OBJECTIVES:
1. To understand the basics of drone concepts
2. To learn and understand the fundamentals of design, fabrication and programming of drone
3. To impart the knowledge of an flying and operation of drone
4. To know about the various applications of drone
5. To understand the safety risks and guidelines of fly safely

### UNIT – I INTRODUCTION TO DRONE TECHNOLOGY
9
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

### UNIT – II DRONE DESIGN, FABRICATION AND PROGRAMMING
9
Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

### UNIT – III DRONE FLYING AND OPERATION
9
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications

### UNIT – IV DRONE COMMERCIAL APPLICATIONS
9
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

### UNIT – V FUTURE DRONES AND SAFETY
9
The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

### TOTAL: 45 PERIODS

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

- **CO1:** Know about a various type of drone technology, drone fabrication and programming.
- **CO2:** Execute the suitable operating procedures for functioning a drone
- **CO3:** Select appropriate sensors and actuators for Drones
- **CO4:** Develop a drone mechanism for specific applications
- **CO5:** Createthe programs for various drones
## CO’s-PO’s & PSO’s MAPPING

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## TEXT BOOKS

## REFERENCES

## OGI352 GEOGRAPHICAL INFORMATION SYSTEM

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## UNIT I FUNDAMENTALS OF GIS


## UNIT II SPATIAL DATA MODELS


## UNIT III DATA INPUT AND TOPOLOGY

Scanner - Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input –

UNIT IV DATA QUALITY AND STANDARDS
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards – Interoperability - OGC - Spatial Data Infrastructure

UNIT V DATA MANAGEMENT AND OUTPUT

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

<table>
<thead>
<tr>
<th>PO</th>
<th>Graduate Attribute</th>
<th>Course Outcome</th>
<th>Average</th>
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<tbody>
<tr>
<td>PO1</td>
<td>Engineering Knowledge</td>
<td>CO1 3 CO2 3 CO3 3 CO4 3 CO5 3</td>
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<td>PO2</td>
<td>Problem Analysis</td>
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<td>PO3</td>
<td>Design/Development of Solutions</td>
<td>CO1 3 CO2 3 CO3 3 CO4 3 CO5 3</td>
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<td>PO4</td>
<td>Conduct Investigations of Complex Problems</td>
<td>CO1 3 CO2 3 CO3 3 CO4 3 CO5 3</td>
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<td>PO5</td>
<td>Modern Tool Usage</td>
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<td>PO6</td>
<td>The Engineer and Society</td>
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<td>PO7</td>
<td>Environment and Sustainability</td>
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<td>PO8</td>
<td>Ethics</td>
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<td>PO9</td>
<td>Individual and Team Work</td>
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<td>PO10</td>
<td>Communication</td>
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<td>PO11</td>
<td>Project Management and Finance</td>
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<tr>
<td>PO12</td>
<td>Life-long Learning</td>
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</table>
PSO 1  Knowledge of Geoinformatics discipline  3 3 3 3 3 3
PSO 2  Critical analysis of Geoinformatics Engineering problems and innovations  3 3 3 3 3 3
PSO 3  Conceptualization and evaluation of Design solutions  3 3 3 3 3 3

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
Entrepreneur Development(ED): Concept of entrepreneur and entrepreneurship assessing overall business environment in Indian economy- Entrepreneurial and managerial characteristics- Entrepreneurship development programmers (EDP)-Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment.

UNIT II AGRIPRNEURSHIP IN GLOBAL ARENA: LEGAL PERSPECTIVE
Importance of agribusiness in Indian economy - International trade-WTO agreements- Provisions related to agreements in agricultural and food commodities - Agreements on Agriculture (AOA)- Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS).

UNIT III ENTREPRENEURSHIP MANAGEMENT: FINANCIAL PERSPECTIVE

UNIT IV ENTREPRENEURIAL OPPORTUNITIES: ECONOMIC GROWTH PERSPECTIVE
Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country- Overview of Indian social, political system and their implications for decision making by individual entrepreneurs- Economic system and its implication for decision making by individual entrepreneurs.
UNITV ENTREPRENEURIAL PROMOTION MEASURES AND GOVERNMENT SUPPORT

Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis-
Government schemes and incentives for promotions of entrepreneurship. Government policy on
small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract
framing (CF) and Joint Venture (JV), public-private
partnerships (PPP) - overview of agricultural engineering industry, characteristics of Indian farm
machinery industry.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Judge about agricultural finance, banking and cooperation
CO2: Evaluate basic concepts, principles and functions of financial management
CO3: Improve the skills on basic banking and insurance schemes available to customers
CO4: Analyze various financial data for efficient farm management
CO5: Identify the financial institutions

TEXT BOOKS

REFERENCES

CO’s-PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
<th>Overall correlation of COs with POs</th>
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<td>PO1 Engineering Knowledge</td>
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<td>PO2 Problem Analysis</td>
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<td>PO3 Design/ Development of Solutions</td>
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<td>PO4 Conduct Investigations of Complex Problems</td>
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<td>PO5 Modern Tool Usage</td>
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<td>PO6 The Engineer and Society</td>
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<td>PO7 Environment and sustainability</td>
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<td>PO8 Ethics</td>
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<td>PO10 Communication</td>
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<td>PO11</td>
<td>Project management and finance</td>
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<td>PO12</td>
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<tr>
<td>PSO1</td>
<td>To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill</td>
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<tr>
<td>PSO2</td>
<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>PSO3</td>
<td>To inculcate entrepreneurial skills through strong Industry-Institution linkage.</td>
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</table>

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

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.

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.

OEE353 INTRODUCTION TO CONTROL SYSTEMS L T P C 3 0 0 3

COURSE OBJECTIVES
- To impart knowledge on various representations of systems.
- To familiarize time response analysis of LTI systems and steady state error.
- To analyze the frequency responses and stability of the systems
- To analyze the stability of linear systems in frequency domain and time domain
- To develop linear models mainly state variable model and transfer function model
UNIT I MATHEMATICAL MODELS OF PHYSICAL SYSTEMS
Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction–Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS & ROOTLOCUSTECHNIQUE

UNIT III FREQUENCY RESPONSE ANALYSIS
Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV STABILITY CONCEPTS & ANALYSIS

UNIT V STATE VARIABLE ANALYSIS
Concept of state – State Variable & State Model – State models for linear & continuous time systems–Solution of state & output equation–controllability & observability.

TOTAL : 45 PERIODS

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.
OEI354  INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS  LT P C

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

UNIT I  INTRODUCTION

UNIT II  AUTOMATION COMPONENTS
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT III  COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS
Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

UNIT IV  PROGRAMMABLE LOGIC CONTROLLERS
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT V  DISTRIBUTED CONTROL SYSTEM
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL: 45 PERIODS
SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)  
1. Market survey of the recent PLCs and comparison of their features.  
2. Summarize the PLC standards  
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)  

COURSE OUTCOMES:  
Students able to  
CO1 Design a signal conditioning circuits for various application (L3).  
CO2 Acquire a detail knowledge on data acquisition system interface and DCS system (L2).  
CO3 Understand the basics and Importance of communication buses in applied automation Engineering (L2).  
CO4 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.(L3)  
CO5 Able to develop a PLC logic for a specific application on real world problem. (L5)

TEXT BOOKS:  

REFERENCES:  

List of Open Source Software/ Learning website:  
1. https://archive.nptel.ac.in/courses/108/105/108105062/  
2. https://nptel.ac.in/courses/108105063  

<table>
<thead>
<tr>
<th>CO's- PO's &amp; PSO's MAPPING</th>
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<td>CO4</td>
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<td>CO5</td>
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325
OCH353  ENERGY TECHNOLOGY  L T P C

UNIT I  INTRODUCTION  8
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources

UNIT II  CONVENTIONAL ENERGY  8
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III  NON-CONVENTIONAL ENERGY  10
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV  BIOMASS ENERGY  10
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT V  ENERGY CONSERVATION  9
Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the students will be able to
CO1: Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.
CO2: Students will excel as professionals in the various fields of energy engineering
CO3: Compare different renewable energy technologies and choose the most appropriate based on local conditions.
CO4: Explain the technological basis for harnessing renewable energy sources.
CO5: Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.
TEXT BOOKS

REFERENCES

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

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<td>CO1</td>
<td>Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.</td>
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<td>CO2</td>
<td>Students will excel as professionals in the various fields of energy engineering</td>
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<tr>
<td>CO3</td>
<td>Compare different renewable energy technologies and choose the most appropriate based on local conditions.</td>
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<td>CO4</td>
<td>Explain the technological basis for harnessing renewable energy sources.</td>
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<tr>
<td>CO5</td>
<td>Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level</td>
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OVERALL CO 2 2 1 3 3 2 2 1 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

COURSE OBJECTIVE:
- To enable the students to analyze properties of a surface and correlate them to structure, chemistry, and physics and surface modification technique.

UNIT I SURFACE STRUCTURE AND EXPERIMENTAL PROBES
Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, absorbate structure, Band and Vibrational structure, Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy

UNIT II ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT SURFACES
Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods

UNIT III LIQUID INTERFACES
Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells

UNIT IV HETEROGENEOUS CATALYSIS
Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, Fishcher-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:
COURSE OBJECTIVES
The course aims to
- acquaint and equip the students with different techniques of measurement of engineering properties.
- make the students understand the nature of food constituents in the design of processing equipment

UNIT I
Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.

UNIT II
Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foammat dryers

UNIT III
Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger’s, Kick’s and Bond’s equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, 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 lo.w- 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, centrifugaf 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 electrodialysis, gel filtration, ion exchange, per-evaporation and osmotic dehydration.

TOTAL: 45 PERIODS

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

TEXTBOOKS:

OFD355 FOOD SAFETY AND QUALITY REGULATION

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

OPY353 NUTRACEUTICALS L T P C 3 0 0 3

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

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

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

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

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

TOTAL: 45 PERIODS

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

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

COURSE OUTCOME - NUTRACEUTICALS

| CO 1 | acquire knowledge about the Nutraceuticals and functional foods, their classification and benefits. |
| CO 2 | acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes |
| CO 3 | attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods. |
| CO 4 | distinguish the various In vitro and In vivo assessment of Antioxidant activity of compounds from plant sources. |
| CO 5 | gain information about the health benefits of various functional foods and nutraceuticals |
in the prevention and treatment of various lifestyle diseases.

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

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

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<th>Course outcome</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 dying- 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.

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<th>Course Outcomes</th>
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<td>CO1 Classification of fibres and production of natural fibres</td>
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1 - low, 2 - medium, 3 - high, '-' - no correlation
COURSE OBJECTIVES
- To enable the students to learn about the types of fibre and its properties

UNIT I  INTRODUCTION TO TEXTILE FIBRES
Definition of various forms of textile fibres - staple fibre, filament, bicomponent fibres. Classification of Natural and Man-made fibres, essential and desirable properties of Fibres. Production and cultivation of Natural Fibers: Cotton, Silk, Wool -Physical and chemical structure of the above fibres.

UNIT II  REGENERATED FIBRES
Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel, Tencel

UNIT III  SYNTHETIC FIBRES
Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass, carbon. Introduction to spin finishes and texturization

UNIT IV  SPECIALITY FIBRES
Properties and end uses of high tenacity and high modulus fibres, high temperature and flame retardant fibres, Chemical resistant fibres

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

TOTAL : 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the student would be able to
CO1: Understand the process sequence of various fibres
CO2: Understand the properties of various fibres

TEXT BOOKS:

REFERENCES:
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  9
Anthropometry, specification sheet, pattern making – principles, basic pattern set drafting, grading, marker planning, spreading & cutting

UNIT II  TYPES OF SEAMS, STITCHES AND FUNCTIONS OF NEEDLES  9
Different types of seams and stitches; single needle lock stitch machine – mechanism and accessories; needle – functions, special needles, needlepoint

UNIT III  COMPONENTS AND TRIMS USED IN GARMENT  9
Sewing thread-construction, material, thread size, packages, accessories – labels, linings, interlinings, wadding, lace, braid, elastic, hook and loop fastening, shoulder pads, eyelets and laces, zip fasteners, buttons

UNIT IV  GARMENT INSPECTION AND DIMENSIONAL CHANGES  9
Raw material, in process and final inspection; needle cutting; sewability of fabrics; strength properties of apparel; dimensional changes in apparel due to laundering, dry-cleaning, steaming and pressing.

UNIT V  GARMENT PRESSING, PACKING AND CARE LABELING  9
Garment pressing – categories and equipment, packing; care 336abelling of apparels

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 careabelling

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

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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

OPE353  INDUSTRIAL SAFETY  L T P C  3 0 0 3

COURSE OBJECTIVES:
- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen’s Compensation and other laws) enacted for the protection of employees health at work settings
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I  INTRODUCTION
Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.

UNIT II  OCCUPATIONAL HEALTH AND HYGIENE
UNIT III  WORKPLACE SAFETY AND SAFETY SYSTEMS  9

UNIT IV  HAZARDS AND RISK MANAGEMENT  9

UNIT V  ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT  9

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

OPE354  UNIT OPERATIONS IN PETRO CHEMICAL INDUSTRIES  L T P C
3 0 0 3

COURSE OBJECTIVES:
• To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.

UNIT I  FLUID MECHANICS CONCEPTS  9
Fluid definition and classification of fluids, types of fluids, Rheological behaviour of fluids & Newton’s Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems),Basic equations of fluid flow - Continuity equation, Euler’s equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits - Hagen Poiseuille equation (no derivation). Flow through stagnant fluids – theory of Settling and Sedimentation – Equipment (cyclones, thickeners) Conceptual numericals.

UNIT II  FLOW MEASUREMENTS & MECHANICAL OPERATIONS  9
Different types of flow measuring devices (Orifice meter, Venturimeter, Rotameter) with derivations, flow measurements –. Pumps – types of pumps (Centrifugal & Reciprocating pumps), Energy calculations and characteristics of pumps. Size reduction–characteristics of comminute products, sieve analysis, Properties and handling of particulate solids – characterization of solid particles, average particle size, screen analysis- Conceptual numerical of differential and

UNIT III CONDUCTIVE & CONVECTIVE HEAT TRANSFER 9
Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).

UNIT IV BASICS OF MASS TRANSFER 9

UNIT V MASS TRANSFER OPERATIONS 9
Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction). Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method. Drying- drying operations, batch and continuous drying. Conceptual numerical.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the student will be able to:
CO1: State and describe the nature and properties of the fluids.
CO2: Study the different flow measuring instruments, the principles of various size reductions, conveying equipment’s, sedimentation and mixing tanks.
CO3: Comprehend the laws governing the heat and mass transfer operations to solve the problems.
CO4: Design the heat transfer equipment suitable for specific requirement.

TEXTBOOK(S)
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008

REFERENCE BOOKS
2. Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996
COURSE OBJECTIVES

- Understand the advantages, disadvantages and general classification of plastic materials
- To know the manufacturing, sources, and applications of engineering thermoplastics
- Understand the basics as well as the advanced applications of various plastic materials in the industry
- To understand the preparation methods of thermosetting materials
- Select suitable specialty plastics for different end applications

UNIT I  INTRODUCTION TO PLASTIC MATERIALS

Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermosetting behavior, amorphous polymers, crystalline polymers and cross-linked structures. General purpose thermoplastics/ Commodity plastics: manufacture, structure, properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene, polyvinyl chloride-compounding, formulation, polypropylene (PP)

UNIT II  ENGINEERING THERMOPLASTICS AND APPLICATIONS

Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides, PMMA, polyphenylene oxide, thermoplastic polyurethane (PU)

UNIT III  THERMOSETTING PLASTICS

Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.

UNIT IV  MISCELLANEOUS PLASTICS FOR END APPLICATIONS

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

UNIT V  PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS

Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers- poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications

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

TOTAL: 45 PERIODS
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
Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact strength, resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic fatigue, ageing properties, Basic concepts of stress and strain, short term tests: Viscoelastic behavior (simple models: Kelvin model for creep and stress relaxation, Maxwell-Voigt model, strain recovery and dynamic response), Effect of structure and composition on mechanical properties, Behavior of reinforced polymers

UNIT III THERMAL RHEOLOGICAL PROPERTIES
Thermal properties: Transition temperatures, specific heat, thermal conductivity, co-efficient of thermal expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness temperature, thermal stability and flammability. Product testing: Plastic films, sheeting, pipes, laminates, foams, containers, cables and tubes.
UNIT IV ELECTRICAL AND OPTICAL PROPERTIES 9
Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and power factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric coefficient, dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive index, haze, gloss, clarity, birefringence.

UNIT V ENVIRONMENTAL AND CHEMICAL RESISTANCE 9

COURSE OUTCOMES
- Understand the relevance of standards and specifications.
- Summarize the various test methods for evaluating the mechanical properties of the polymers.
- To know the thermal, electrical & optical properties of polymers.
- Identify various techniques used for characterizing polymers.
- Distinguish the processability tests used for thermoplastics, thermosets and elastomers.

REFERENCES

COURSE OBJECTIVES
- To introduce the interdisciplinary approach of water management.
- To develop knowledge base and capacity building on IWRM.

UNIT I OVERVIEW OF IWRM 9

UNIT II WATER USE SECTORS: IMPACTS AND SOLUTION 9
Water users: People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management.
UNIT III  WATER ECONOMICS  
Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management - PPP experiences through case studies.

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

UNIT V  IMPLEMENTATION OF IWRM  
Barriers to implementing IWRM - Policy and legal framework - Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.

TOTAL: 45 PERIODS

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).

OEC353  VLSI DESIGN  
L T P C  3 0 0 3

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

UNIT I MOS TRANSISTOR PRINCIPLES
MOS logic families (NMOS and CMOS), Ideal and Non Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor DC transfer Characteristics ,small signal analysis of MOSFET.

UNIT II COMBINATIONAL LOGIC CIRCUITS

UNIT III SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES

UNIT IV INTERCONNECT, MEMORY ARCHITECTURE
Interconnect Parameters – Capacitance, Resistance, and Inductance, Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks.

UNIT V DESIGN OF ARITHMETIC BUILDING BLOCKS
Arithmetic Building Blocks: Data Paths, Adders-Ripple Carry Adder, Carry-Bypass Adder, Carry Select Adder, Carry-Look Ahead Adder, Multipliers, Barrel Shifter, power and speed tradeoffs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course the student will be able to
CO1: Understand the working principle and characteristics of MOSFET
CO2: Design Combinational Logic Circuits
CO3: Design Sequential Logic Circuits and Clocking systems
CO4: Understand Memory architecture and interconnects
CO5: Design of arithmetic building blocks.

TEXTBOOKS

REFERENCES
**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 - Benefitis of composting, Role of microorganisms in composting - Factors affecting the composting process - Waste Materials for Composting, Fundamentals of composting process - Composting technologies, Composting systems – Nonreactor Composting, Reactor composting - Compost Quality

**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

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

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

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

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

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

TOTAL: 45 PERIODS

TEXT BOOKS:
REFERENCES:

OBT357  BIOTECHNOLOGY IN HEALTH CARE  L T P C  3 0 0 3

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

UNIT I  PUBLIC HEALTH  9

UNIT II  CLINICAL DISEASES  9
Communicable diseases: Chickenpox / Shingles, COVID-19, Tuberculosis, Hepatitis B, Hepatitis C, HIV / AIDS, Influenza, Swine flu. Non Communicable diseases: Diabetes mellitus, atherosclerosis, fatty liver, Obesity, Cancer

UNIT III  VACCINOLOGY  9
History of Vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems. Instruments related to monitoring of temperature, sterilization, environment.

UNIT IV  OUTPATIENT & IN PATIENT SERVICES  9
Radiotherapy, Nuclear medicine, surgical units, OT Medical units, G & Obs. units Pediatric, neonatal units, Critical care units, Physical medicine & Rehabilitation, Neurology, Gastroenterology, Endoscopy, Pulmonology, Cardiology.

UNIT V  BASICS OF IMAGING MODALITIES  9

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE BOOKS
LEARNING OBJECTIVES
1. To acquire the knowledge of the decision areas in finance.
2. To learn the various sources of Finance.
3. To describe about capital budgeting and cost of capital.
4. To discuss on how to construct a robust capital structure and dividend policy.
5. To develop an understanding of tools on Working Capital Management.

UNIT I  INTRODUCTION TO FINANCIAL MANAGEMENT
Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of money- Risk and return concepts.

UNIT II  SOURCES OF FINANCE
Long term sources of Finance -Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc

UNIT III  INVESTMENT DECISIONS:
Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV  FINANCING AND DIVIDEND DECISION
Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - - Determinants of Dividend Policy

UNIT V  WORKING CAPITAL DECISION

TEXT BOOKS

REFERENCES
2. Prasanna Chandra, Financial Management,
COURSE OBJECTIVES:
1. Describe the investment environment in which investment decisions are taken.
2. Explain how to Value bonds and equities
3. Explain the various approaches to value securities
4. Describe how to create efficient portfolios through diversification
5. Discuss the mechanism of investor protection in India.

UNIT1: THE INVESTMENT ENVIRONMENT
The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.

UNIT2: FIXED INCOME SECURITIES
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.

UNIT3: APPROACHES TO EQUITY ANALYSIS
Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT4: PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India

UNIT5: INVESTOR PROTECTION
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors’ awareness and activism

REFERENCES

COURSE OBJECTIVES
• Understand the Banking system in India
• Grasp how banks raise their sources and how they deploy it
• Understand the development in banking technology
• Understand the financial services in India
• Understand the insurance Industry in India

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM
Overview of Banking system – Structure – Functions – Banking system in India - Key Regulations in Indian Banking sector – RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT II MANAGING BANK FUNDS/ PRODUCTS

UNIT III DEVELOPMENT IN BANKING TECHNOLOGY

UNIT IV FINANCIAL SERVICES

UNIT V INSURANCE

REFERENCES:

TOTAL : 45 PERIODS

CMG334 INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS
3 0 0 3

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

UNIT III Ethereum
Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network

UNIT IV WEB3 AND HYPERLEDGE

UNIT V EMERGING TRENDS

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

CMG335 FINTECH PERSONAL FINANCE AND PAYMENTS

UNIT I CURRENCY EXCHANGE AND PAYMENT

UNIT II DIGITAL FINANCE AND ALTERNATIVE FINANCE
A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity,. Introduction to the concept of Initial Coin Offering

UNIT III INSURETECH
InsurTech Introduction , Business model disruption AI/ML in InsurTech ● IoT and InsurTech ●Risk Modeling ,Fraud Detection Processing claims and Underwriting Innovations in Insurance Services
UNIT IV PEER TO PEER LENDING 9
P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies , Concept of Crowdfunding Crowdfunding Architecture and Technology ,P2P and Crowdfunding unicorns and business models , SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations

UNIT V REGULATORY ISSUES 9

TOTAL : 45 PERIODS

REFERENCE
5. IIBF, Digital Banking, Taxmann Publication, 2016

CMG336 INTRODUCTION TO FINTECH LT P C 3 0 0 3

COURSE OBJECTIVES:
1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I INTRODUCTION 9
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 9
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  
L T P C  
3 0 0 3

COURSE OBJECTIVES  
- To develop and strengthen the entrepreneurial quality and motivation of learners.  
- To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.  
- To apply the principles and theories of entrepreneurship and management in Technology oriented businesses.  
- To empower the learners to run a Technology driven business efficiently and effectively
UNIT I INTRODUCTION TO ENTREPRENEURSHIP
Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development.

UNIT II BUSINESS OWNERSHIP & ENVIRONMENT

UNIT III FUNDAMENTALS OF TECHNOPRENEURSHIP
Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends

UNIT IV APPLICATIONS OF TECHNOPRENEURSHIP
Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship — Success Stories of Technopreneurs - Case Studies

UNIT V EMERGING TRENDS IN ENTREPRENEURSHIP

TOTAL45 : PERIODS

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

TEXT BOOKS:
2) Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning,

REFERENCES :
CMG338 TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS

COURSE OBJECTIVES

- To develop and strengthen the Leadership qualities and motivation of learners.
- To impart the Leadership skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of Team Building in managing Technology oriented businesses.
- To empower the learners to build robust teams for running and leading a business efficiently and effectively.

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

UNIT II MANAGING AND DEVELOPING EFFECTIVE TEAMS
Team-based organisations - Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.

UNIT III INTRODUCTION TO LEADERSHIP
Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership - Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment.

UNIT IV LEADERSHIP IN ORGANISATIONS

UNIT V LEADERSHIP EFFECTIVENESS
**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**

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**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


UNIT IV PROMOTION AND DISTRIBUTUION MANAGEMENT


UNIT V CONTEMPORARY ISSUES IN MARKETING MANAGEMENT


COURSE OUTCOMES:

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

CO1 Have the awareness of marketing management process
CO 2 Understand the marketing environment
CO 3 Acquaint about product and pricing strategies
CO 4 Knowledge of promotion and distribution in marketing management.
CO 5 Comprehend the contemporary marketing scenarios and offer solutions to marketing issues.

REFERENCES:

COURSE OBJECTIVES:
1. To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
2. To create an awareness of the roles, functions and functioning of human resource department.
3. To understand the methods and techniques followed by Human Resource Management practitioners.

UNIT I INTRODUCTION TO HRM

UNIT II HUMAN RESOURCE PLANNING
HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation-Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends

UNIT III RECRUITMENT AND SELECTION
Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources - eRecruitment - Selection Process- Selection techniques - eSelection- Interview Types- Employee Engagement.

UNIT IV TRAINING AND EMPLOYEE DEVELOPMENT

UNIT V CONTROLLING HUMAN RESOURCES

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


UNIT II INTRODUCTION TO VENTURE FINANCING


UNIT III SOURCES OF DEBT FINANCING


UNIT IV SOURCES OF EQUITY FINANCING

Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.

UNIT V METHODS OF FUND RAISING FOR NEW VENTURES


COURSE OUTCOMES:

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

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:
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.

CMG344 CONSTITUTION OF INDIA L T P C
3 0 0 3

UNIT-I
1. Constitutional Development Since 1909 to 1947
3. Constituent Assembly

UNIT-II
1. Fundamental Rights
2. Fundamental Duties
3. Directive Principles of State Policy

UNIT-III
1. President
2. Parliament
3. Supreme Court

UNIT-IV
1. Governor
2. State Legislature
3. High Court

UNIT-V
1. Secularism
2. Social Justice
3. Minority Safeguards

TOTAL: 45 PERIODS

REFERENCES:
4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi

CMG345  PUBLIC PERSONNEL ADMINISTRATION  L T P C  3 0 0 3

UNIT-I  (9)
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

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

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

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

UNIT-V  (9)
1. Employer Employee Relations
2. Wage and Salary Administration
3. Allowances and Benefits

REFERENCES:
1. Stahl Glean O: Public Personnel Administration
4. Dwivedi O.P and Jain R.B: India’s Administrative state.
7. Davar R.S. Personnel Management & Industrial Relations

TOTAL: 45 PERIODS

CMG346  ADMINISTRATIVE THEORIES  L T P C  3 0 0 3

UNIT I  (9)
Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration

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

UNIT III
Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design.

UNIT IV
Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making

UNIT V
Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard, Peter Drucker

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

TOTAL: 45 PERIODS
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

CMG348      PUBLIC POLICY ADMINISTRATION       L T P C
            3 0 0 3

UNIT-I (9)

UNIT-II (9)
Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System’s Approach – Dror’s Optimal Model

UNIT-III (9)

UNIT-IV (9)
Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.

UNIT-V (9)
Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.

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

TOTAL: 45 PERIODS

CMG349      STATISTICS FOR MANAGEMENT       L T P C
            3 0 0 3

VERTICAL 4: BUSINESS DATA ANALYTICS

365
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 - PARAMETIRC TESTS
Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.

UNIT IV NON-PARAMETRIC TESTS

UNIT V CORRELATION AND REGRESSION

TOTAL: 45 PERIODS

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:

CMG350                   DATAMINING FOR BUSINESS INTELLIGENCE                   L T P C
3  0 0 3

COURSE OBJECTIVES :
• To know how to derive meaning form huge volume of data and information.
To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION
Data mining, Text mining, Web mining, Data ware house.

UNIT II DATA MINING PROCESS
Datamining process – KDD, CRISP-DM, SEMMA
Prediction performance measures

UNIT III PREDICTION TECHNIQUES
Data visualization, Time series – ARIMA, Winter Holts,

UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES
Classification, Association, Clustering.

UNIT V MACHINE LEARNING AND AI
Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization

TOTAL: 45 PERIODS

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. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
7. G. K. Gupta, Introduction to Data mining with Case Studies, Prentice hall of India, 2011
9. Elizabeth Vitt, Michael 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

TOTAL: 45 PERIODS

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

COURSE OBJECTIVE:
- To showcase the opportunities that exist today to leverage the power of the web and social media

UNIT I - MARKETING ANALYTICS
Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT II - COMMUNITY BUILDING AND MANAGEMENT
History and Evolution of Social Media - Understanding Science of Social Media - Goals for using Social Media - Social Media Audience and Influencers - Digital PR - Promoting Social Media Pages - Linking Social Media Accounts - The Viral Impact of Social Media.

UNIT III - SOCIAL MEDIA POLICIES AND MEASUREMENTS
Social Media Policies - Etiquette, Privacy - ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV - WEB ANALYTICS
Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT V - SEARCH ANALYTICS
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

TOTAL: 45 PERIODS

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

REFERENCES:
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004

CMG353 OPERATION AND SUPPLY CHAIN ANALYTICS
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 an 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:
UNIT I - CORPORATE FINANCE ANALYSIS 9
Basic corporate financial predictive modelling - Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.

UNIT II - FINANCIAL MARKET ANALYSIS 9
Estimation and prediction of risk and return ( bond investment and stock investment) –Time series- examining nature of data, Value at risk, ARMA, ARCH and GARCH.

UNIT III - PORTFOLIO ANALYSIS 9
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.

UNIT IV - TECHNICAL ANALYSIS 9

UNIT V - CREDIT RISK ANALYSIS 9
Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.

TOTAL: 45 PERIODS

COURSE OUTCOME

- The learners should be able to perform financial analysis for decision making using excel, Python and R.

REFERENCES:

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

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

COURSE OBJECTIVE:
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
Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and
COURSE OUTCOME:
On completion of the course, the student is expected to be able to
CO1 Understand the environment sustainability goals at global and Indian scenario.
CO2 Understand risks in development of projects and suggest mitigation measures.
CO3 Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
CO4 Explain Life Cycle Analysis and life cycle cost of construction materials.
CO5 Explain the new technologies for maintenance of infrastructure projects.

REFERENCES:
5. New Building Materials and Construction World magazine
7. Munier N, "Introduction to Sustainability", Springer2005

CO’s- PO’s & PSO’s MAPPING

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<tr>
<th>CO’s</th>
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COURSE OBJECTIVES:
• To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.

UNIT I AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS  9
Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT  9
Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT III WATER MANAGEMENT  9
Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT IV ENERGY AND WASTE MANAGEMENT  9
Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS  9
Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS

COURSE OUTCOME
• On completion of the course, the student is expected to be able to
CO1 Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture

CO2 Discuss the sustainable ways in managing soil health, nutrients, pests and diseases

CO3 Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources

CO4 Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas

CO5 Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

REFERENCES:
1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020

CO’s-PO’s & PSO’s MAPPING - SUSTAINABLE AGRICULTURE PRACTICES

<table>
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1 – Low; 2 – Medium; 3 – High; '*' – No correlation

CES333 SUSTAINABLE BIOMATERIALS L T P C 3 0 0 3

COURSE OBJECTIVES
- To Impart knowledge of biomaterials and their properties
- To learn about Fundamentals aspects of Biopolymers and their applications
- To learn about bioceramics and biopolymers
- To introduce the students about metals as biomaterials and their usage as implants
- To make the students understand the significance of bionanomaterials and its applications.

UNIT-I INTRODUCTION TO BIOMATERIALS 9
Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials- Biocompatibility-Hydrogels-pyrolic carbon for long term medical implants-textured and porous...
materials - Bonding types - crystal structure - imperfection in crystalline structure - surface properties and adhesion of materials – strength of biological tissues - performance of implants - tissue response to implants - Impact and Future of Biomaterials

UNIT-II BIO POLYMERS
Molecular structure of polymers - Molecular weight - Types of polymerization techniques – Types of polymerization reactions - Physical states of polymers - Common polymeric biomaterials - Polyethylene - Polymethylmethacrylate (PMMA) - Polylactic acid (PLA) - Polycaprolactone (PCL) - Other biodegradable polymers - Polyurethanes - Reactions polymers for medical purposes - Collagens - Elastins - Cellulose and derivatives - Synthetic polymeric membranes and their biological applications

UNIT-III BIO CERAMICS AND BIOCOMPOSITES
General properties - 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 NANOBIOIMATERIALS

TOTAL : 45 PERIODS

COURSE OUTCOMES
CO1: Students will gain familiarity with Biomaterials and they will understand their importance.
CO2: Students will get an overview of different biopolymers and their properties
CO3: Students gain knowledge on some of the important Bioceramics and Biocomposite materials
CO4: Students gain knowledge on metals as biomaterials
CO5: Students gain knowledge on the importance of nanobiomaterials in biomedical applications.

REFERENCES

CES334 MATERIALS FOR ENERGY SUSTAINABILITY L T P C
3 0 0 3

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
dimensional Graphene, organic or Small molecule-based solar cells materials - copperphthalocyanine and perylenetetracarboxylicbis - benzine – fullerenes - boron subphthalocyanine-tin (II) phthalocyanine

UNIT-V SUPERCAPACITORS
Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL : 45 PERIODS

COURSE OUTCOMES
CO1: Students will acquire knowledge about energy sustainability.
CO2: Students understand the principles of different electrochemical devices.
CO3: Students learn about the working of fuel cells and their application.
CO4: Students will learn about various Photovoltaic applications and the materials used.
CO5: The students gain knowledge on different types of supercapacitors and the performance of various materials

REFERENCES
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh
- 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

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

TEXT BOOKS

REFERENCE BOOKS
1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

CES336  ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS  L T P C
3 0 0 3
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) & RISKASSESSMENT


UNIT V: AUTOMATED DATA ACQUISITION AND PROCESSING

Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks -Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion of this course, the students will know

| CO1 | Basic concepts of environmental standards and monitoring. |
| CO2 | the ambient air quality and water quality standards; |
| CO3 | the various instrumental methods and their principles for environmental monitoring |
| CO4 | The significance of environmental standards in monitoring quality and sustainability of the environment. |
| CO5 | the various ways of raising environmental awareness among the people. |
| CO6 | Know the standard research methods that are used worldwide for monitoring |
the environment.

**TEXTBOOKS**
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and soil wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc

**REFERENCES**
1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.

**CO’s-PO’s & PSO’s MAPPING**

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

**CES337 INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT**

**COURSE OBJECTIVES:**
1. To create awareness on the energy scenario of India with respect to world
2. To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation
3. Familiarisation on the concept of sustainable development and its benefits
4. Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development
5. Acquainting with energy policies and energy planning for sustainable development

**UNIT I ENERGY SCENARIO**
Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security

**UNIT II ENERGY AND ENVIRONMENT**
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution –
Environmental standards - measurement and controls

UNIT III SUSTAINABLE DEVELOPMENT

UNIT IV RENEWABLE ENERGY TECHNOLOGY

UNIT V ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
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 L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
2. To create awareness on energy audit and its impacts
3. To acquaint the techniques adopted for performance evaluation of thermal utilities
4. To familiarise on the procedures adopted for performance evaluation of electrical utilities
5. To learn the concept of sustainable development and the implication of energy usage

UNIT I ENERGY AND ENVIRONMENT
Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT II ENERGY AUDITING
Need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES
Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression

UNIT IV ENERGY CONSERVATION IN ELECTRICAL UTILITIES
Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

UNIT V SUSTAINABLE DEVELOPMENT

TOTAL : 45 PERIODS

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