PROGRAM EDUCATIONAL OBJECTIVES (PEOs)
I. Graduates are able to develop, evaluate, and find solutions to challenges in manufacturing and industrial engineering.
II. Graduates will be qualified to find work in the manufacturing sector and become specialists in product and process design for environmentally responsible production.
III. Graduates become Production Engineering entrepreneurs via academic research and industry.
IV. To gain knowledge and experience in the fields of Materials, Management and Manufacturing respectively.
V. Communicate well, lead ethically, and behave responsibly with Lifelong learning which helps graduates adapt to changing technology.

PROGRAM OUTCOMES (POs)

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<th>Graduate Attribute</th>
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<td>1</td>
<td>Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.</td>
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<tr>
<td>2</td>
<td>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.</td>
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<tr>
<td>3</td>
<td>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.</td>
</tr>
<tr>
<td>4</td>
<td>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.</td>
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<tr>
<td>5</td>
<td>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.</td>
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<tr>
<td>6</td>
<td>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.</td>
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<tr>
<td>7</td>
<td>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.</td>
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<tr>
<td>8</td>
<td>Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.</td>
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<tr>
<td>9</td>
<td>Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.</td>
</tr>
<tr>
<td>10</td>
<td>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.</td>
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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.

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.

I. PROGRAM SPECIFIC OUTCOMES (PSOs)

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<td>1</td>
<td>Knowledge of the Production system includes being familiar with both fundamental and advanced techniques.</td>
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<td>The knowledge necessary for the design, analysis, and development of production processes, automation systems, and quality control systems.</td>
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<td>3</td>
<td>Knowledge on the application of materials, manufacturing processes, and production systems, as well as the creation of an ideal solution to accomplish continuous improvement in order to meet the requirements of industry and society, constitutes the foundation of continuous improvement.</td>
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PEO’s – PO’s & PSO’s MAPPING:

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**Notes:**
- NCC: National Cadet Corps
- Credit Course Levels: 1, 2, 3
- Summer internship***
- Mandatory Course-I*
- Professional Elective I to VIII
- Open Elective I to III
- Mechatronics Laboratory
- Computer Integrated Manufacturing
- Ethics and Human values
- Total Quality Management
- Open Elective – I to IV**
- Ethical and Professional Training
ANNA UNIVERSITY, CHENNAI  
NON-AUTONOMOUS AFFILIATED COLLEGES  
REGULATIONS 2021  
CHOICE BASED CREDIT SYSTEM  
B.E. PRODUCTION ENGINEERING  
CURRICULUM AND SYLLABI FOR I TO VIII SEMESTERS  
SEMESTER I

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*Skill Based Course

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

* Skill Based Course
### SEMESTER III

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\(^*\) Skill Based Course

### SEMESTER IV

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

### Semester VI

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*Open Elective – I shall be chosen from the emerging technologies

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

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

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

**Open Elective – II shall be chosen from the emerging technologies

***Open Elective III and IV (Shall be chosen from the list of open electives offered by other Programmes

**SEMESTER VIII / VII**

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

**TOTAL: 165 CREDITS**
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*Mandatory Courses are offered as Non-Credit courses

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*Mandatory Courses are offered as Non-Credit courses
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<td><strong>TOOL ENGINEERING</strong></td>
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<td>Electrical Drives and Actuators</td>
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<td>Smart Materials for Manufacturing</td>
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<td>Unconventional Machining Processes</td>
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<td>Business Process Re-Engineering</td>
<td>Micromachining and Fabrication</td>
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**Registration of Professional Elective Courses from Verticals:**

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

VERTICAL 1 : ROBOTICS AND AUTOMATION

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VERTICAL 3–MATERIALS PROCESSING TECHNIQUES

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

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

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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)

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

**VERTICAL 1: FINTECH AND BLOCK CHAIN**

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**VERTICAL 2: ENTREPRENEURSHIP**

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IP3151  INDUCTION PROGRAMME

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

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

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

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

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

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

(i) Physical Activity

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

(ii) Creative Arts

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

(iii) Universal Human Values

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

(iv) Literary Activity

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

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.
(vi) Lectures by Eminent People

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

(vii) Visits to Local Area

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

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**HS3152** PROFESSIONAL ENGLISH - I

**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?

**INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION**

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Why/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).
UNIT II  NARRATION AND SUMMATION 9
Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar –Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT III  DESCRIPTION OF A PROCESS / PRODUCT 9
Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

UNIT IV  CLASSIFICATION AND RECOMMENDATIONS 9
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 9
Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Function words.

TOTAL : 45 PERIODS

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

CO-PO & PSO MAPPING

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

TEXT BOOKS:
1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
REFERENCE BOOKS:

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

MA3151 MATRICES AND CALCULUS

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

UNIT - I MATRICES

UNIT - II DIFFERENTIAL CALCULUS

UNIT - III FUNCTIONS OF SEVERAL VARIABLES

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

UNIT - V MULTIPLE INTEGRALS

TOTAL: 60 PERIODS
COURSE OUTCOMES:
At the end of the course the students will be able to
- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools in solving various application problems.
- Able to use differential calculus ideas on several variable functions.
- Apply different methods of integration in solving practical problems.
- 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 :

PH3151  ENGINEERING PHYSICS  L T P C  3 0 0 3

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

UNIT I  MECHANICS
UNIT II  ELECTROMAGNETIC WAVES  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 an infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

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

TOTAL : 45 PERIODS

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

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

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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1-Low,2-Medium,3-High,”-“-no correlation
Note: the average value of this course to be used for program articulation matrix.
COURSE OBJECTIVES:

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

UNIT I: WATER AND ITS TREATMENT


UNIT II: NANO CHEMISTRY

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

UNIT III: PHASE RULE AND COMPOSITES

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

UNIT IV: FUELS AND COMBUSTION


UNIT V: ENERGY SOURCES AND STORAGE DEVICES

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

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

GE3151 PROBLEM SOLVING AND PYTHON PROGRAMMING

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

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING

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

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.
UNIT IV  LISTS, TUPLES, DICTIONARIES  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 exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter’s age validation, Marks range validation (0-100).

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, students will be able to
CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs.
CO3: Write simple Python programs using conditionals and looping for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, dictionaries etc.
CO6: Read and write data from/to files in Python programs.

TEXT BOOKS:

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

COs- PO's & PSO's MAPPING

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1 - low, 2 - medium, 3 - high, '-' - no correlation
TEXT-CUM-REFERENCE BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. 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)
5. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
6. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
UNIT I LANGUAGE AND LITERATURE

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

UNIT III FOLK AND MARTIAL ARTS
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, 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
2. தமிழியத்துறை – பூந்தொனை புலிய விளைவு. (விளைவு புக்கலம்).
3. தமிழியம் – தமிழிய பொருளாதாரம் கொண்ட தமிழிய தங்க தந்தாசன் (தமிழியத்துறை தங்க தந்தாசன்).
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) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
COURSE OBJECTIVES:
- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:
Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building – operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter’s age validity, student mark range validation)
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
On completion of the course, students will be able to:
CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Implement programs in Python using conditionals and loops for solving problems.
CO4: Deploy functions to decompose a Python program.
CO5: Process compound data using Python data structures.
CO6: Utilize Python packages in developing software applications.

TEXT BOOKS:

REFERENCES:
5. https://www.python.org/
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 as an active participant in each part of all lab exercises.

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

TOTAL: 30 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students should be able to
- Understand the functioning of various physics laboratory equipment.
- Use graphical models to analyze laboratory data.
- Use mathematical models as a medium for quantitative reasoning and describing physical reality.
- Access, process and analyze scientific information.
- Solve problems individually and collaboratively.
CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

COURSE OBJECTIVES:
- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles

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

TOTAL : 30 PERIODS

### CO-PO & PSO MAPPING

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1-low, 2-medium, 3-high, "-"- no correlation
COURSE OUTCOMES:
- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques.
- To analyse and determine the composition of alloys.
- To learn simple method of synthesis of nanoparticles.
- To quantitatively analyse the impurities in solution by electroanalytical techniques.

TEXT BOOK:

GE3172 ENGLISH LABORATORY

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

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

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

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

TOTAL: 30 PERIODS
LEARNING OUTCOMES:
At the end of the course, learners will be able
- To listen and comprehend complex academic texts
- To speak fluently and accurately in formal and informal communicative contexts
- To express their opinions effectively in both oral and written medium of communication

**CO-PO & PSO MAPPING**

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

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**

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

**MAKING COMPARISONS**

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

**UNIT II**

**EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING**

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

**UNIT III**

**PROBLEM SOLVING**

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

**UNIT IV**

**REPORTING OF EVENTS AND RESEARCH**

UNIT V THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY

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

TOTAL : 30 PERIODS

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

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

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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.

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

REFERENCE BOOKS:

ASSESSMENT PATTERN
Two internal assessments and an end semester examination to test students’ reading and writing skills along with their grammatical and lexical competence.
COURSE OBJECTIVES:
- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

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

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

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

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

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

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

TEXT BOOKS:
REFERENCES:

PH3251
MATERIALS SCIENCE

COURSE OBJECTIVES:
- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instil knowledge on physics of semiconductors, determination of charge carriers and device applications
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

UNIT I CRYSTALLOGRAPHY

UNIT II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS

UNIT III SEMICONDUCTORS AND TRANSPORT PHYSICS
UNIT IV  OPTICAL PROPERTIES OF MATERIALS

UNIT V  NANOELECTRONIC DEVICES

COURSE OUTCOMES:
At the end of the course, the students should be able to
- know basics of crystallography and its importance for varied materials properties
- gain knowledge on the electrical and magnetic properties of materials and their applications
- understand clearly of semiconductor physics and functioning of semiconductor devices
- understand the optical properties of materials and working principles of various optical devices
- appreciate the importance of functional nanoelectronic devices.

TEXT BOOKS:

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.
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

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


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


COURSE OUTCOMES:

After completing this course, the students will be able to

1. Compute the electric circuit parameters for simple problems
2. Explain the working principle and applications of electrical machines
3. Analyze the characteristics of analog electronic devices
4. Explain the basic concepts of digital electronics
5. Explain the operating principles of measuring instruments

TEXT BOOKS:

REFERENCES:

### Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial

GE3251 ENGINEERING GRAPHICS

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

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

**UNIT I PLANE CURVES**
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 \hspace{1cm} PROJECTION OF SOLIDS AND FREEHAND SKETCHING \hspace{1cm} 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 \hspace{1cm} PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES \hspace{1cm} 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 \hspace{1cm} ISOMETRIC AND PERSPECTIVE PROJECTIONS \hspace{1cm} 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

- Use BIS conventions and specifications for engineering drawing.
- Construct the conic curves, involutes and cycloid.
- Solve practical problems involving projection of lines.
- Draw the orthographic, isometric and perspective projections of simple solids.
- Draw the development of simple solids.

TEXT BOOKS:


REFERENCES:


Publication of Bureau of Indian Standards:


Special points applicable to University Examinations on Engineering Graphics:

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

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

**GE3252**

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### Chapter I

**3**

- Concept of Tamil Literature - Evolution of Tamil Literature - Tamil Literature and Tamil Society - Tamil Literature and Tamil Spirituality.

### Chapter II

**3**

- Tamil Literature and Tamil Society - Tamil Literature and Tamil Society - Tamil Literature and Tamil Society - Tamil Literature and Tamil Society.

### Chapter III

**3**

- Tamil Literature and Tamil Society - Tamil Literature and Tamil Society - Tamil Literature and Tamil Society - Tamil Literature and Tamil Society.

### Chapter IV

**3**

- Tamil Literature and Tamil Society - Tamil Literature and Tamil Society - Tamil Literature and Tamil Society - Tamil Literature and Tamil Society.

### Chapter V

**3**

- Tamil Literature and Tamil Society - Tamil Literature and Tamil Society - Tamil Literature and Tamil Society - Tamil Literature and Tamil Society.

TOTAL: 15 PERIODS
TEXT-CUM-REFERENCE BOOKS

1. தமிழ் மற்றும் தெனியார் – வல்லியம்ப்புறப்புருத்து – புதுச்சேரி. பி. புரியல் (தமிழ் பொடும்: தமிழில் மற்றும் தெனியார் வல்லியம்ப் புறப்புருத்து பெற்றோருடன் பயிற்சியிலை பல்கலைக்கால கூட்டம்).
2. கல்வித் தமிழ் – மதுசிமர். தில்லு. (தமிழ் பி. புரியல்).
3. சிறுமி – வாணிக நிதி -சுண்ணம் தவறுநயக்க வேட்டு தருண்டிக்கு விளக்கம் (தமிழ் பொடும்: தமிழ் பிரசுரம்).
4. புதுச்சேரி – அமைக்களது தவறுநயக்கு விளக்கம். (தமிழ் பொடும்: தமிழ் பிரசுரம்).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

GE3252 TAMILS AND TECHNOLOGY

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<th>WEAVING AND CERAMIC TECHNOLOGY</th>
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<td>Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.</td>
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<td>UNIT III</td>
<td>MANUFACTURING TECHNOLOGY</td>
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<td>AGRICULTURE AND IRRIGATION TECHNOLOGY</td>
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<td>UNIT V</td>
<td>SCIENTIFIC TAMIL &amp; TAMIL COMPUTING</td>
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TOTAL : 15 PERIODS
TEXT-CUM-REFERENCE BOOKS:
1. சமூகத்துறைமார் - மக்கள் பணபொடும் - இலக்கணம். (சமூகப் பணபொடும் மக்கள்
    மற்றும் சமூகத்துறைமார் பலகையில்).
2. கணினித் தமிழ் - முமனவர் இல.சுந்தரம். (விகடன் பிரசுரம்).
3. இலங்கையிய தமிழக மன்னரின் சாகத்து வாழ்கள் (தமிழ்நூல் பலகையில்).
4. பொருள்துறை - ஆண்டுதோறு சமூகம். (தமிழ்நூல் பலகையில்).
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### NCC CREDIT COURSE LEVEL I *

**NX3251**

**ARMY WING**

**NCC CREDIT COURSE LEVEL - I**

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**TOTAL: 30 PERIODS**
### NCC CREDIT COURSE LEVEL 1*

**NX3252**

**(NAVAL WING) NCC CREDIT COURSE LEVEL - I**

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### NATIONAL INTEGRATION AND AWARENESS

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### PERSONALITY DEVELOPMENT

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### SOCIAL SERVICE AND COMMUNITY DEVELOPMENT

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<td>SS 7</td>
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**TOTAL : 30 PERIODS**
### NCC CREDIT COURSE LEVEL 1*

**NX3253**

**(AIR FORCE WING) NCC CREDIT COURSE LEVEL – I**

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### 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

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES

WELDING WORK:
   a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
   b) Practicing gas welding.
BASIC MACHINING WORK:
  a) (simple) Turning.
  b) (simple) Drilling.
  c) (simple) Tapping.

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

SHEET METAL WORK:
  a) Making of a square tray

FOUNDRY WORK:
  a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

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

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

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

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. 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.
2. Wire various electrical joints in common household electrical wire work.
3. 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.
4. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

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

TOTAL = 60 PERIODS
COURSE OBJECTIVES:
- To train the students in conducting load tests on electrical machines
- To gain practical experience in characterizing electronic devices
- To train the students to use DSO for measurements.

LIST OF EXPERIMENTS
1. Verification of ohms and Kirchhoff’s Laws.
2. Load test on DC Shunt Motor.
3. Load test on Self Excited DC Generator
4. Load test on Single phase Transformer
5. Load Test on Induction Motor
6. Characteristics of PN and Zener Diodes
7. Characteristics of BJT, SCR and MOSFET
8. Half wave and Full Wave rectifiers
9. Study of Logic Gates
10. Implementation of Binary Adder and Subtractor
11. Study of DSO

COURSE OUTCOMES:
After completing this course, the students will be able to
1. Use experimental methods to verify the Ohm’s and Kirchhoff’s Laws.
2. Analyze experimentally the load characteristics of electrical machines.
3. Analyze the characteristics of basic electronic devices.
4. Use DSO to measure the various parameters.

Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial

OBJECTIVES
- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To be able to communicate effectively through writing.

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-during forecasts and scenarios-talking about purchasing-discussing advantages and disadvantages-making comparisons-discussing likes and dislikes-making comparisons-discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.

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

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

TOTAL: 60 PERIODS

LEARNING OUTCOMES
- Speak effectively in group discussions held in a formal/semi formal contexts.
- Write emails and effective job applications.

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-PO & PSO MAPPING

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

MA3351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
3 1 0 4

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  9+3
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  9+3
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  9+3
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  9+3

UNIT V  Z-TRANSFORMS AND DIFFERENCE EQUATIONS  9+3

TOTAL: 60 PERIODS

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

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- 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.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:
1. To Learn the use scalar and vector analytical techniques for analyzing forces in statically determinate structures.
2. To introduce the equilibrium of rigid bodies, vector methods and free body diagram.
3. To study and understand the distributed forces, surface, loading on beam and intensity.
4. To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems.
5. To develop basic dynamics concepts – force, momentum, work and energy;

UNIT – I    STATICS OF PARTICLES

UNIT – II    EQUILIBRIUM OF RIGID BODIES

UNIT III    DISTRIBUTED FORCES
Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV    FRICTION
The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.

UNIT V    DYNAMICS OF PARTICLES

TOTAL : 45 PERIODS
OUTCOMES:
At the end of the course the students would be able to
1. Illustrate the vector and scalar representation of forces and moments
2. Analyse the rigid body in equilibrium
3. Evaluate the properties of distributed forces
4. Determine the friction and the effects by the laws of friction
5. Calculate dynamic forces exerted in rigid body

TEXT BOOKS:

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

PR3351 THERMODYNAMICS AND THERMAL ENGINEERING L T P C

3 0 0 3

COURSE OBJECTIVES:
1. To impart knowledge of basic principles of thermodynamics via real world engineering examples.
2. To analyse and evaluate air standard cycles.
3. To analyse and evaluate Steam power cycles.
4. Summarize the governing concepts of Refrigeration and Air conditioning.
5. To introduce various modes of heat transfer, related to real time scenarios of thermodynamics applied in engineering practice.

UNIT – I BASICS OF THERMODYNAMICS

UNIT – II AIR STANDARD CYCLE
Otto, Diesel, Dual and Brayton cycles - Air standard efficiency and Mean effective pressure.
UNIT – III VAPOUR POWER CYCLES

UNIT – IV COMPRESSORS AND JET PROPULSION

UNIT – V HEAT TRANSFER
Conduction in simple plane, radial and composite walls – Basics of Convective heat transfer - Fundamentals of Radioactive heat transfer – Flow through heat exchangers (LMTD and NTU).

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Will demonstrate understanding of the nature of the thermodynamic processes for pure substances and interpret the Laws of Thermodynamics
CO2: Will analyses and evaluate air standard cycles
CO3: Will understand the vapour power cycles.
CO4: Will learn the air compressors for pneumatic applications and aircraft vehicle
CO5: Will get exposed to the basics and modes of heat transfer.

Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS:

REFERENCES:
PR3301  MACHINING PROCESSES AND MACHINE TOOLS  L  T  P  C
3  0  0  3

COURSE OBJECTIVES:
1. To provide students with fundamental knowledge and principles in material removal processes.
2. To understand the fundamentals aspects of metal cutting principles by studying various machining processes.
3. To study the constructional features and various operations related to milling, drilling and grinding.
4. To know the factors influencing the processes and their applications.
5. To recommend appropriate manufacturing process when provided a set of functional requirements and constraints.

UNIT – I  LATHE

UNIT – II  SHAPER, PLANER and SLOTTING

UNIT – III  DRILLING

UNIT – IV  MILLING

UNIT – V  GRINDING

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Explain the features and applications of lathe, milling, drilling and grinding machines
CO2: Discuss the features and applications of reciprocating machine tools and like shaper, planer and slotting machine.
CO3: Explain the machine tool structures and machining economics.
CO4: Explain the working principles of various machines used in manufacturing.
CO5: Identify the appropriate production process and machines.
### Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial

### TEXT BOOKS:

### REFERENCES:

### COURSE OBJECTIVES:
1. To impart knowledge on the various microstructural features of metallic materials.
2. To illustrate the role of heat treatment on microstructure and properties.
3. To desire the various non-ferrous alloys and their applications.
4. To introduce the concepts of mechanical behaviour of the materials.
5. To describe the properties and applications of polymers and ceramics.

### UNIT – I MICROSTRUCTURAL DEVELOPMENT AND METALLOGRAPHY

### UNIT – II HEAT TREATMENT AND KINETICS
UNIT - III  NON-FERROUS METALS

UNIT - IV  DEFORMATION AND FAILURE OF METALS

UNIT - V  NON-METALLIC MATERIALS
Polymers- Thermo, Thermoset Polymers, Co and mixed Polymers- Commodity Polymers, PE, PS,PVS PMMA, PC, PET, ABS- Engineering Polymers, PA, PPS, PI, PFE- Natural and Synthetic rubbers, Elastomers- Adhesives- Ceramics- Natural and Synthetic Ceramic- Feldspar, Corundum, Garnet- WC, TC,TiC, Si3N4,Al2O3, CBN, PCD, Uses of abrasives and cutting tools.

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Identify the microstructural features of ferrous materials.
CO2: Relate the heat treatment, microstructure and properties.
CO3: Understand the properties and uses of nonferrous alloys.
CO4: Correlate the mechanical behavior with the mechanisms of strengthening.
CO5: Suggest suitable polymer and ceramic for a given application.

Mapping of COs with POs and PSOs

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TEXT BOOKS:
COURSE OBJECTIVES:
1. To introduce the students about properties of the fluids, behaviour of fluids under static conditions.
2. To impart basic knowledge of the dynamics of fluids and boundary layer concept.
3. To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends.
4. To exposure to the significance of boundary layer theory and its thicknesses.
5. To expose the students to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 10+3
Properties of fluids – Fluid statics - Pressure Measurements - Buoyancy and floatation - Flow characteristics - Eulerian and Lagrangian approach - Concept of control volume and system - Reynold’s transportation theorem - Continuity equation, energy equation and momentum equation - Applications.

UNIT II FLOW THROUGH PIPES AND BOUNDARY LAYER 9+3
Reynold’s Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 8+3
Fundamental dimensions - Dimensional homogeneity - Rayleigh’s method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT IV TURBINES 9+3

UNIT V PUMPS 9+3
Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies – Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and its variations - Work saved by fitting air vessels - Rotary pumps.

TOTAL: 60 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to
1. Understand the properties and behaviour in static conditions. Also, to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics
2. Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also, to understand the concept of boundary layer and its thickness on the flat solid surface.
3. Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies
4. Explain the working principles of various turbines and design the various types of turbines.
5. Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps

TEXT BOOKS:
REFERENCES:

MF3361 MACHINING TECHNOLOGY LABORATORY

COURSE OBJECTIVES:
- To Study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines etc.
- To equip with the practical knowledge required in the core industries.
- To prepare the process planning sheets for all the operations and then follow the sequences during the machining processes.

LIST OF EXPERIMENTS
1. Lathe: Facing, Plain turning, Step Turning
2. Lathe: Taper Turning, Threading, Knurling
3. Lathe: Multi start Threading, Burnishing
4. Shaper: Cube
5. Shaper: Cube, V-Block
6. Drilling: Counter sinking, Counter Boring, Tapping
7. Milling Vertical: Surfacing, Pocket Milling
8. Milling Horizontal: Polygonal shape milling
9. Grinding: Surface & Cylindrical grinding
10. Slotting: Machining an internal spline
11. Tool angle grinding with tool and Cutter Grinder
12. Measurement of cutting forces in Milling / Turning Process

COURSE OUTCOMES:
Upon the completion of this course the students will be able to
- Select appropriate turning process to obtain finished components.
- Select appropriate milling process to obtain finished components.
- Select appropriate shaper and slotting process to obtain finished components.
- Select appropriate grinding process to obtain optimum surface finish.
- Coordinate various machining process in sequence to get desired design in final components.

TOTAL: 60 PERIODS
COURSE OBJECTIVES:
1. To study the testing methods and quantifying techniques for the mechanical properties of engineering materials.
2. To study the property changes by various heat treatments.
3. To gain practical knowledge in Microstructural analysis of various steels, cast iron, Nonferrous Materials and Heat-Treated steels.

LIST OF EXPERIMENTS
1. Cooling curve- Pure metal and alloy (Pb-Sn).
2. Specimen preparation for macro – examination.
7. Tension test of mild steel.
8. Torsion test of mild steel.
11. Compression test for Helical spring.
12. Fatigue test
13. Creep test.

TOTAL: 60 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Awareness of procedure and methods of testing materials for evaluation of mechanical properties.
CO2: Experience in metallographic techniques and familiarization of microstructure of typical ferrous and non-ferrous alloys.
CO3: Ability to interpret the experimental results in relation with the applications.
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**GE3361**

**PROFESSIONAL DEVELOPMENT**

**OBJECTIVES:**

- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely accepted 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

**10 Hours**

**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

**10 Hours**
Protecting data and Securing the workbook

**MS POWERPOINT:** 10 Hours

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

**TOTAL: 30 PERIODS**
OUTCOMES:
On successful completion the students will be able to

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

PR3401 METAL CASTING TECHNOLOGY     L   T   P   C
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COURSE OBJECTIVES:
1. To impart knowledge about principles/methods of casting with detail design of gating/riser system needed for casting, defects in cast objects and requirements for achieving better casting.
2. To understand the basic principle, procedure and applications of various Foundry and Welding methods.
3. To inculcate the principle, thermal and metallurgical aspects during solidification of metal and alloys.
4. To impart knowledge to the students about the principles of melting and pouring.
5. To impart knowledge on casting design.

UNIT – I CASTING PROCESSES

UNIT – II SPECIAL CASTING PROCESSES

UNIT – III SOLIDIFICATION PROCESS

UNIT – IV MELTING AND POURING

UNIT – V CASTING DESIGN
Solidification of pure metals and alloys-shrinkage in cast metals-design of sprue, runner, gate and risers-problems in design and manufacture of thin and unequal sections - design for directional solidification, minimum distortion and for overall economy - design problems of L,T,V,X and Y junctions.

TOTAL: 45 PERIODS
COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand the process of Pattern making, Moulding and core making
CO2: Analyze the thermal, metallurgical aspects during solidification in casting and welding and their role on quality of cast or weld objects.
CO3: Understand the process of solidification of casting process.
CO4: The student will be able to melt and pour metals.
CO5: The student will be able design cast alloys.

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TEXT BOOKS:

REFERENCES:

PR3451 MATERIALS JOINING TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To study SMAW, GMAW, GTAW, Oxy-acetylene welding and resistance spot welding processes.
2. To study the various types of resistance welding process.
3. To study the various solid state welding process.
4. To study advanced welding process.
5. To study the various welding design and testing methods.

UNIT – I GAS AND ARC WELDING PROCESSES 9
Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, shieldeed metal arc welding, Submerged arc welding, TIG and MIG welding, Plasma arc welding and Electro slag welding processes - advantages, limitations and applications.

UNIT – II RESISTANCE WELDING PROCESSES 9
Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications.
UNIT – III  SOLID STATE WELDING PROCESSES  9
Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications.

UNIT – IV  OTHER WELDING PROCESSES  9

UNIT – V  DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS  9
Various weld joint designs – Welding defects – causes and remedies - Weldability of Aluminium, Copper, and Stainless steels. Destructive and nondestructive testing of weldments.

TOTAL: 45 PERIODS

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

CO1: To understand the basic working principles SMAW, GMAW, GTAW, Oxy-acetylene welding and resistance spot welding processes
CO2: To know the various types of the resistance welding process
CO3: To familiarise about the various solid state welding process
CO4: To know the advanced welding process
CO5: To apply the various welding design and testing methods

Mapping of COs with POs and PSOs

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TEXT BOOKS:

REFERENCES:

ML3391  MECHANICS OF SOLIDS  L T P C
3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:

1. Applying the principle concepts behind stress, strain and deformation of solids for various engineering applications.
2. Analyzing the transverse loading on beams and stresses in beam for various engineering applications.
3. Understanding the torsion principles on shafts and springs for various engineering applications.
4. Acquiring knowledge on the deflection of beams for various engineering applications.
5. Interpreting the thin and thick shells and principal stresses in beam for various engineering applications.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

UNIT III TORSION 9
Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts – Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, – Closed and Open Coiled helical springs – springs in series and parallel, carriage springs.

UNIT IV DEFLECTION OF BEAMS 9
Slope, Deflection and Radius of Curvature – Methods of Determination of Slope and Deflection- Double Integration method – Macaulay’s method – Area moment Theorems for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell’s reciprocal theorems.

UNIT V THICK & THIN SHELLS & PRINCIPAL STRESSES 9
Stresses in thin cylindrical shell due to internal pressure, circumferential and longitudinal stresses and deformation in thin cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame’s theory – Application of theories of failure – Stresses on inclined planes –principal stresses and principal planes – Mohr’s circle of stress.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the principle concepts behind stress, strain and deformation of solids for various engineering applications.
2. Analyze the transverse loading on beams and stresses in beam for various engineering applications.
3. Solve problems based on the torsion principles involved in shafts and springs for various engineering applications.
4. Interpret the results of the deflection of beams.
5. Analyze the thin and thick shells and principal stresses in beam for various engineering applications.

TEXT BOOKS:

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

**CO1**: To understand the fundamentals of pneumatics and hydraulics and its principles.
CO2: To understand constructional and operational features about the hydraulic and pneumatic drives system.
CO3: To identify pneumatic and hydraulic components and their functions.
CO4: To design basic and advanced pneumatic and hydraulic circuits for industrial applications.
CO5: To understand the basic concepts, elements and functions of Programmable Logic Controller.

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TEXT BOOKS:

REFERENCES:

MR3451 KINEMATICS AND DYNAMICS OF MACHINERY L T P C 4 0 0 4

COURSE OBJECTIVES:
1. To understand the basic components and layout of linkages in the assembly of a system/machine and also learn about the mechanisms
2. To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.
3. To learn about the concepts in friction
4. To understand the principles in force analysis
5. To learn about the basic concept of static and dynamic balancing and vibration

UNIT I KINEMATIC OF MACHINES 12

UNIT II GEARS AND GEAR TRAINS 12
UNIT III  FRICITION
Sliding and Rolling Friction angle – friction in threads – Friction Drives – Belt and rope drives.

UNIT IV  FORCE ANALYSIS

UNIT V  BALANCING AND VIBRATION

COURSE OUTCOMES
At the end of the course, the student able to:
CO1: Recognize the basic terminologies of kinematics and dynamics of machines
CO2: Interpret the various concepts of kinematics and dynamics including forces and frictions
CO 3: Show the motions parameters on the various mechanisms, gears and gear trains.
CO 4: Apply the mechanism, gears and gear train for the design of new machines.
CO 5: Analyze the working of various mechanism, gears and gear train.

TEXT BOOKS:

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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

OUTCOMES:
At the end of the course the students would be able to
1. Understand the nature and its impacts on human life.
2. The students have the knowledge and awareness of Environmental Pollution.
3. Understanding of the energy sources and scientific concepts/principles behind them
4. Understand the concepts of the Sustainability and Management
5. Understand the Sustainability Practices and socio economical changes

TOTAL: 30 PERIODS
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**PERSONALITY DEVELOPMENT**

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**LEADERSHIP**

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**DISASTER MANAGEMENT**

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**ENVIRONMENTAL AWARENESS & CONSERVATION**

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**GENERAL AWARENESS**

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**NAVAL ORIENTATION**

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**ADVENTURE**

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**BORDER & COASTAL AREAS**

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**TOTAL: 45 PERIODS**
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PR3411  FOUNDRY AND WELDING LABORATORY  L  T  P  C
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COURSE OBJECTIVES:
1. To train the students to make the simple joints by various welding techniques.
2. To train the students to make the simple standard grill structures.
3. To train the students in the area of non-ferrous metal casting with the simple shapes.
4. To study the basic requirements of given moulding sand by standard tests.
5. To train the students to make the simple casting demonstration.

WELDING
1. Welding of basic joints using gas and arc welding.
2. Welding of pipes in different positions.
3. GTAW / GMAW of ferrous and non-ferrous metals.

FOUNDRY
1. Green and Dry Strength of Moulding sand.
2. Permeability testing.
3. Determining the clay content.
4. Sieve analysis of dry silica sand.
5. Determining the moisture content.

TOTAL: 60 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: The students would gain practical knowledge on welding of simple weld joints.
CO2: The students would gain practical knowledge on making simple grill.
CO3: The students to understand the casting procedure of different methods and quality of moulding sand tests.

Mapping of COs with POs and PSOs

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<th>COs/POs &amp; PSOs</th>
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1 – Slight, 2 – Moderate, 3 – Substantial

PR3412  DYNAMICS OF MACHINES LABORATORY  L  T  P  C
0  0  4  2

COURSE OBJECTIVES:
1. To supplement the principles learnt in kinematics and Dynamics of Machinery.
2. To understand how certain measuring devices are used for dynamic testing.

LIST OF EXPERIMENTS
1. a) Study of gear parameters.
b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
2. a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.
b) Kinematics of single and double universal joints.
3. a) Determination of Mass moment of inertia of Fly wheel and Axle system.
b) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.

4. Motorized gyroscope – Study of gyroscopic effect and couple.
5. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
6. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
b) Multi degree freedom suspension system – Determination of influence coefficient.
8. a) Determination of torsional natural frequency of single and Double Rotor systems – Undamped and Damped Natural frequencies. b) Vibration Absorber – Tuned vibration absorber.
8. Vibration of Equivalent Spring mass system – undamped and damped vibration.
11. a) Balancing of rotating masses.
b) Balancing of reciprocating masses.
12. a) Transverse vibration of Free-Free beam – with and without concentrated masses.
b) Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.
c) Determination of transmissibility ratio using vibrating table.

TOTAL: 60 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Ability to demonstrate the principles of kinematics and dynamics of machinery.
CO2: Ability to use the measuring devices for dynamic testing.
CO3: Ability to develop models.

Mapping of COs with POs and PSOs

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CE3481 STRENGTH OF MATERIALS AND FLUID MACHINERY LABORATORY

1. To study the mechanical properties of metals, wood and spring by testing in laboratory.
2. To verify the principles studied in fluid mechanics and machinery theory by performing experiments in laboratory.

UNIT - I STRENGTH OF MATERIALS

LIST OF EXPERIMENTS
1. Tension test on mild steel rod
2. Torsion test on mild steel rod
3. Hardness test on metal (Rockwell and Brinell Hardness)
4. Compression test on helical spring
5. Deflection test on carriage spring

UNIT - II FLUID MECHANICS AND MACHINES LABORATORY

LIST OF EXPERIMENTS
1. (a) Determination of coefficient of discharge of a venturimeter
   (b) Determination of friction factor for flow through pipes
2. (a) Determination of metacentric height
   (b) Determination of forces due to impact of jet on a fixed plate
3. Characteristics of centrifugal pumps
4. Characteristics of reciprocating pump
5. Characteristics of Pelton wheel turbine

TOTAL: 60 PERIODS

OUTCOMES: On completion of the course, the student is expected to be able to
1. Determine the tensile, torsion and hardness properties of metals by testing
2. Determine the stiffness properties of helical and carriage spring
3. Apply the conservation laws to determine the coefficient of discharge of a
   venturimeter and finding the friction factor of given pipe
4. Apply the fluid static and momentum principles to determine the metacentric
   height and forces due to impact of jet
5. Determine the performance characteristics of turbine, rotodynamic pump and
   positive displacement pump.

COURSE OBJECTIVES:
To understand the concept of engineering metrology.
To familiarize the metrology instruments used for linear and angular measurements.
To learn about the surface texture and measuring instruments.
To learn about the metrology of screw threads and gears.
To introduce the concepts of Laser and computer applications in metrology.

UNIT – I FUNDAMENTALS OF MEASUREMENT
Definition of Engineering metrology – Line, end and wave length standards of measurement –
Errors in measurements – Limits, fits, tolerance and gauge design – Inter changeability and
selective assembly – Accuracy, precision and Calibration of instruments – Light interference and
interferometry – Measurement of absolute length using interferometers.

UNIT – II LINEAR AND ANGULAR MEASURING SYSTEMS
Linear and Angular measuring systems. Slip gauges, micrometers, verniers, dial gauges and
surface plates – Concept of comparators mechanical, electrical, optical and pneumatic
 comparators – Angular measuring systems – angle gauges – Sine bar – Precision spirit level,
Autocollimators – Angle dekkor – Clinometers – Straightness and flatness measurement using
precision level and auto collimators.

UNIT – III MEASUREMENT OF SURFACE TEXTURE AND MEASURING INSTRUMENTS
Surface texture – Definitions – types of surface texture – surface texture measurement methods
- Comparison – Profilometer – Surface texture measuring instruments – Measurement of run-out
and concentricity straightness, flatness and alignment errors – Tool makers microscope – Optical and Laser Alignment telescope – Metroscope.

UNIT – IV

METROLOGY OF SCREW THREADS AND GEARS 9
Metrology of screw threads and gears Internal and external screw threads – terminology - measurement of various elements of screw threads – thread micrometer two wire and three wire -methods, gear terminology - measurement of various elements of gears - pitch circle method, constant chord method, base tangent method – plug method – Rolling gear tester.

UNIT – V

LASER METROLOGY AND COMPUTER AIDED METROLOGY 9

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand the principles of Engineering Metrology.
CO2: Identify appropriate metrology equipment for measuring linear and angular measurements.
CO3: Apply the suitable equipment to measure the surface textures.
CO4: Identify appropriate methodology to measure the parameters of screw threads and gears.
CO5: Employ the advanced metrology equipments.

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:
To study the functional aspects of different pneumatic components and its usage in circuits.
To study the functional aspects of different hydraulic components and its usage in circuits.
To train the students in designing different pneumatic circuits for different application.
To train the students in designing different hydraulic circuits for different application.
To train the student in designing of PLC circuits using hydraulic circuit applications.

LIST OF EXPERIMENTS
Study and use of pneumatic and hydraulic elements.
Simulation of speed control circuits in a hydraulic trainer.
Simulation of hydraulic circuits in a hydraulic trainer.
Simulation of single and double acting cylinder circuits using different directional control values.
One shot and regenerative pneumatic circuits.
Sequencing of pneumatic circuits.
Simulation of Electro-pneumatic latch circuits.
Simulation of Logic pneumatic circuits.
Simulation of electro pneumatic sequencing circuits.
Simulation of PLC based electro pneumatic sequencing circuits.
Simulation of pneumatic circuits using PLC.

TOTAL: 60 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand the operational features of pneumatic and hydraulic elements and simulate PLC based electro pneumatic circuits.
CO2: Select and apply different pneumatics components to design fluid power circuit and Electro-pneumatic latch circuits.
CO3: Select and apply different hydraulic components to design fluid power circuit.

Mapping of COs with POs and PSOs

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COURSE OBJECTIVES:
- To practice various measurement methods.
- To get acquainted with the instruments used for linear and angular measurements.
- To learn about the form measurements.
- To familiarize with surface texture measurements.
- To get acquainted with the advanced instruments such as machine vision system and CMM.
LIST OF EXPERIMENTS
1. Measurements of angle using Sine bar and bevel protractor.
7. Measurements of Surface Roughness.
11. Measurements using CMM.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
CO1: Carry out various types of measurements using different instruments.
CO2: Use the most appropriate equipment for the given application.
CO3: Choose the best method to accomplish various types of form measurements.
CO4: Carry out the measurements related to screw thread and gears.
CO5: Use the advanced equipment’s such as machine vision system and CMM.

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PR3601 METAL FORMING TECHNOLOGY

COURSE OBJECTIVES:
- Students will gain knowledge on the mechanism involved in plastic deformation and parameter representation.
- Students will read and understand the forging and rolling process and its recent technology.
- Students will read and understand the extrusion and drawing process and its recent technology.
- Student will have knowledge on various sheet metal forming process.
- Students will study the recent advancement and Special techniques in metal forming processes.

UNIT I FUNDAMENTALS OF METAL FORMING

UNIT II FORGING AND ROLLING
UNIT III EXTRUSION AND DRAWING PROCESSES 9

UNIT IV SHEET METAL FORMING PROCESSES 9

UNIT V RECENT ADVANCES 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
CO1: Understand the fundamental mechanics of metal forming processes
CO2: Ability to understand the principle, classification, equipment used and applications of Rolling and Forging Processes
CO3: Ability to understand the principle, classification, equipment used and applications of Extrusion and Drawing Processes
CO4: Understand the principle, procedure of various sheet metal forming processes
CO5: Awareness about the recent advances in technology of metal forming.

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TEXT BOOKS:

REFERENCES:
### NCC Credit Course Level 3*

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

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#### PERSONALITY DEVELOPMENT
- **PD 3**  
  Group Discussion: Team Work  
  
- **PD 4**  
  Career Counselling, SSB Procedure & Interview Skills  
  
- **PD 5**  
  Public Speaking  
  
#### BORDER & COASTAL AREAS
- **BCA 2**  
  Security Setup and Border/Coastal management in the area  
  
- **BCA 3**  
  Security Challenges & Role of cadets in Border management  
  
#### ARMED FORCES
- **AF 2**  
  Modes of Entry to Army, CAPF, Police  
  
#### COMMUNICATION
- **C 1**  
  Introduction to Communication & Latest Trends  
  
#### INFANTRY
- **INF 1**  
  Organisation of Infantry Battalion & its weapons  
  
#### MILITARY HISTORY
- **MH 1**  
  Biographies of Renowned Generals  
  
- **MH 2**  
  War Heroes - PVC Awardees  
  
- **MH 3**  
  Study of Battles - Indo Pak War 1965, 1971 & Kargil  
  
- **MH 4**  
  War Movies  
  
**TOTAL: 45 PERIODS**

### NCC Credit Course Level 3*

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

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- **PD 5**  
  Public Speaking  
  
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  Security Setup and Border/Coastal management in the area  
  
- **BCA 3**  
  Security Challenges & Role of cadets in Border management  
  
#### NAVAL ORIENTATION
- **NO 3**  
  Modes of Entry - IN, ICG, Merchant Navy  
  
- **AF 2**  
  Naval Expeditions & Campaigns  
  
#### NAVAL COMMUNICATION
- **NC 1**  
  Introduction to Naval Communications  
  
- **NC 2**  
  Semaphore  
  
#### NAVIGATION
- **N 1**  
  Navigation of Ship - Basic Requirements  
  
- **N 2**  
  Chart Work  
  
#### SEAMANSHIP
- **MH 1**  
  Introduction to Anchor Work  
  
- **MH 2**  
  Rigging Capsule  
  
- **MH 3**  
  Boatwork - Parts of Boat  
  
- **MH 4**  
  Boat Pulling Instructions  
  
- **MH 5**  
  Whaler Sailing Instructions  
  
#### FIRE FIGHTING FLOODING & DAMAGE CONTROL
- **FFDC 1**  
  Fire Fighting  
  
- **FFDC 2**  
  Damage Control  
  
#### SHIP MODELLING
- **SM**  
  Ship Modelling Capsule  
  
**TOTAL: 45 PERIODS**
## NCC Credit Course Level 3*

**NX3653 (AIR FORCE WING) NCC Credit Course Level - III**

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

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

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

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

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

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

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

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

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

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

**TOTAL : 45 PERIODS**
COURSE OBJECTIVES:
- To establish hands-on experience in sheet metal forming, bulge forming and Super plastic forming.
- To get hands on experience in machining gear, V-block, dovetail, etc.
- To study tool wear, acceptance test for machine tool.

METAL FORMING LAB
LIST OF EXPERIMENTS
2. Erichsen cupping Test.
5. Water hammer forming.
7. Determination of strain rate sensitivity index of given specimen.
8. Superplastic forming studies on Pb-Sn alloys.
10. Forward Extrusion process.
12. Simulation studies on metal forming.

SPECIAL MACHINES LAB
LIST OF EXPERIMENTS
1. Gear Hobbing.
2. Spur Gear
3. Helical Gear
5. V-Block
6. Dove Tail
7. Centerless Cylindrical Grinding.
9. Spur Gear
10. Tool and Cutter Grinding
11. Tool Wear Studies.
13. EDM.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
CO1: Students will gain practical knowledge to perform bulk and sheet metal forming process.
CO2: Students to perform the machining on raw materials to prepare gear, V-block, etc.,
CO3: Ability to conduct acceptance test for machine tool.

Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial
COURSE OBJECTIVES:
- To gain practical experience in handling 2D drafting and 3D modeling software systems.
- Preparing standard drawing layout for modeled parts or assemblies with BoM.
- To train the students to write CNC Programming to simulate tool path simulation for different components.

CAD LAB
LIST OF EXPERIMENTS
2D DRAFTING
Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing, basic principles of geometric dimensioning & tolerancing.
Bushbearing
Plummerblock
Safety valve
Non-return valve
(Any 2 exercises shall be given)

3D GEOMETRIC MODELING AND ASSEMBLY
Sketcher - Datum planes – Protrusion – Holes - Part modeling – Extrusion – Revolve – Sweep-
Loft – Blend – Fillet- Pattern – Chamfer – Round – Mirror – Section – Assembly – Drafting
Flange coupling
Universal coupling
Knuckle joint
Connecting rod
Stuffing box
Screw jack
(Any 4 exercises shall be given)

CAM LAB
LIST OF EXPERIMENTS
Study of different control systems and NC codes.
Program for Turning, Facing operation.
Program for circular interpolation, Taper turning operation
Program for thread cutting operation
Program using Do-Loop and Sub-routine.
Program for profile milling operation, circular interpolation
Program for Circular, rectangular pocket milling
Program for drilling cycle and Machining
Program for tool compensation and Program offset and Machining
Programming of CNC wire EDM
(Any 6 exercises shall be given)

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
CO1: Apply standard drawing practices using fits and tolerances.
CO2: Model orthogonal views of machine component, assembled the components and create BOM.
CO3: Perform programming on CNC machine using computer assisted and manual part programming.
## Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial

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### MF3691 MECHATRONICS

#### 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

#### UNIT II MICROPROCESSOR AND MICROCONTROLLER

#### UNIT III PROGRAMMABLE PERIPHERAL INTERFACE

#### UNIT IV PROGRAMMABLE LOGIC CONTROLLER
Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

#### UNIT V ACTUATORS AND MECHATRONIC SYSTEM DESIGN

#### TOTAL : 45 PERIODS

### COURSE OUTCOMES:
Upon completion of this course the student will be able
- Select sensors to develop mechatronics systems.
- Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.
- Design appropriate interfacing circuits to connect I/O devices with microprocessor.
- Apply PLC as a controller in mechatronics system.
- Design and develop the apt mechatronics system for an application.
TEXT BOOKS:

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ME3792 COMPUTER INTEGRATED MANUFACTURING

COURSE OBJECTIVES
1. To provide the overview of evolution of automation, CIM and its principles.
2. To learn the various Automation tools, include various material handling system.
3. To train students to apply group technology and FMS.
4. To familiarize the computer aided process planning in manufacturing.
5. To introduce to basics of data transaction, information integration and control of CIM.

UNIT – I INTRODUCTION

UNIT – II AUTOMATED MANUFACTURING SYSTEMS

UNIT – III GROUP TECHNOLOGY AND FMS


UNIT – IV PROCESS PLANNING


UNIT – V PROCESS CONTROL AND DATA ANALYSIS


OUTCOMES:
At the end of the course the students would be able to
1. Discuss the basics of computer aided engineering,
2. Choose appropriate automotive tools and material handling systems.
3. Discuss the overview of group technology, FMS and automation identification methods.
4. Design using computer aided process planning for manufacturing of various components
5. Acquire knowledge in computer process control techniques.

TEXT BOOKS:
2. CIM: Computer Integrated Manufacturing: Computer Steered Industry Book by August-Wilhelm Scheer

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GE3791  HUMAN VALUES AND ETHICS  L T P C  2 0 0 2

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

COURSE OBJECTIVES:

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

UNIT I  DEMOCRATIC VALUES  6
Reading Text: Excerpts from John Stuart Mills’ On Liberty

UNIT II  SECULAR VALUES  6
Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.
Reading Text: Excerpt from Secularism in India: Concept and Practice by Ram Puniyani

UNIT III  SCIENTIFIC VALUES  6
Reading Text: Excerpt from The Scientific Temper by Antony Michaelis  R

UNIT IV  SOCIAL ETHICS  6
Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.
Reading Text: Excerpt from 21 Lessons for the 21st Century by Yuval Noah Harari

UNIT V  SCIENTIFIC ETHICS  6
Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society.

TOTAL: 30 PERIODS
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.

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

GE3752 TOTAL QUALITY MANAGEMENT

 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:**


**MF3681 MECHATRONICS LABORATORY**

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**COURSE OBJECTIVES:**

The main learning objective of this course is to provide hands on training to the students in:

- Measuring of physical quantity such as displacement, force and temperature, and also the operation of signal conditioning circuits.
- Applying a suitable sensor and image processing technique for Mechatronics Systems.
- Designing appropriate circuits to automate and control the Hydraulic, Pneumatic, and Electric actuators.
- Applying PLC, PID and microcontroller as a control unit in the Mechatronics System.
- Developing a model of robot by using simulation software, and also execute real-time control over a Robot by IoT.
LIST OF EXPERIMENTS

2. Experiments on the application of Sensors – LDR, Optocoupler, Ultrasonic, Infrared, Hall effect and MEMS Accelerometer.
4. Modeling and Analysis of basic Hydraulic, Pneumatic, Electro-Pneumatic, Electrical and Electronic Circuits by using simulation software.
5. Actuation of double acting cylinder by using Hydraulic, Pneumatic and Electro-Pneumatic circuits.
6. Automating the cylinder sequence A+B+B-A by using Microcontroller.
7. PLC Automation with Timers and Counters – Cylinder Sequencing – Sorting of Objects on Conveyor Belt.
8. DC Drives – Speed and Direction Control by using Microcontroller.
9. AC Drives – Speed and Direction Control by using Microcontroller.
10. Stepper Motor – Position, Speed and Direction Control.
15. Actuation and control of Robot by using Internet of Things (IoT).

TOTAL : 60 PERIODS

COURSE OUTCOMES:

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

- Measure of physical quantity such as displacement, force and temperature, and also the operation of signal conditioning circuits.
- Apply a suitable sensor and image processing technique for Mechatronics Systems.
- Design appropriate circuits to automate and control the Hydraulic, Pneumatic, and Electric actuators.
- Apply PLC, PID and microcontroller as a control unit in the Mechatronics System.
- Develop a model of robot by using simulation software, and also execute real-time control over a Robot by IoT.

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COURSE OBJECTIVES:
1. To understand the concepts of measurement technology.
2. To learn the various sensors used to measure various physical parameters.
3. To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.
4. To learn about the optical, pressure and temperature sensor.
5. To understand the signal conditioning and DAQ systems.

UNIT I  INTRODUCTION

UNIT II  MOTION, PROXIMITY AND RANGING SENSORS

UNIT III  FORCE, MAGNETIC AND HEADING SENSORS

UNIT IV  OPTICAL, PRESSURE AND TEMPERATURE SENSORS

UNIT V  SIGNAL CONDITIONING AND DAQ SYSTEMS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Recognize with various calibration techniques and signal types for sensors.
CO2: Describe the working principle and characteristics of force, magnetic, heading, pressure and temperature, smart and other sensors and transducers.
CO3: Apply the various sensors and transducers in various applications.
CO4: Select the appropriate sensor for different applications.
CO5: Acquire the signals from different sensors using Data acquisition systems.

TEXT BOOKS:

REFERENCES
Mapping of COs with POs and PSOs

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MR3392 ELECTRICAL DRIVES AND ACTUATORS

COURSE OBJECTIVES:
1. To familiarize a relay and power semiconductor devices
2. To get a knowledge on drive characteristics
3. To obtain the knowledge on DC motors and drives.
4. To obtain the knowledge on AC motors and drives.
5. To obtain the knowledge on Stepper and Servo motor.

UNIT I RELAY AND POWER SEMI-CONDUCTOR DEVICES
Study of Switching Devices – Relay and Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT: SCR, MOSFET and IGBT - Triggering and commutation circuit - Introduction to Driver and snubber circuits

UNIT II DRIVE CHARACTERISTICS

UNIT III DC MOTORS AND DRIVES
DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications

UNIT IV AC MOTORS AND DRIVES

UNIT V STEPPER AND SERVO MOTOR

TOTAL: 45 PERIODS

COURSE OUTCOMES
At the end of the course, the student able to:
CO 1: Recognize the principles and working of relays, drives and motors.
CO 2: Explain the working and characteristics of various drives and motors.
CO 3: Apply the solid state switching circuits to operate various types of Motors and Drivers.
CO 4: Interpret the performance of Motors and Drives.
CO 5: Suggest the Motors and Drivers for given applications.

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TEXT BOOKS:

REFERENCES

MR3492 EMBEDDED SYSTEMS AND PROGRAMMING L T P C 2 0 2 3

COURSE OBJECTIVES:
1. To familiarize the architecture and fundamental units of microcontroller.
2. To know the microcontroller programming methodology and to acquire the interfacing skills and data exchange methods using various communication protocols.
3. To design the interface circuit and programming of I/O devices, sensors and actuators.
4. To understand ARM processor architecture and its functions to meet out the computational and interface needs of growing mechatronic systems.
5. To acquaint the knowledge of real time embedded operating system for advanced system developments.

UNIT I INTRODUCTION TO MICROCONTROLLER

UNIT II PROGRAMMING AND COMMUNICATION
UNIT III  PERIPHERAL INTERFACING
I/O Programming – Interfacing of Memory, Key Board and Displays – Alphanumeric and Graphic, RTC, interfacing of ADC and DAC, Sensors - Relays - Solenoid Valve and Heater - Stepper Motors, DC Motors - PWM Programming – Closed Loop Control Programming of Servomotor – Traffic Light

UNIT IV  ARM PROCESSOR

UNIT V  SINGLE BOARD COMPUTERS AND PROGRAMMING

TOTAL: 30 PERIODS

EMBEDDED SYSTEMS LAB

LIST OF EXPERIMENTS
1. Assembly Language Programming and Simulation of 8051.
2. Alphanumeric and Graphic LCD Interfacing using 8051 Microcontroller.
3. Input switches and keyboard interfacing of 8051.
4. Sensor Interfacing with ADC to 8051 and DAC & RTC Interfacing with 8051.
5. Timer, Counter and Interrupt Program Application for 8051.
6. Step Motor (Unipolar & Bipolar Motor) and PWM Servo Motor Control to Interfacing with 8051.
7. UART Serial and Parallel Port Programming of 8051.
8. I²C, SPI and CAN Programming of 8051.
9. Interfacing and Programming of Bluetooth and Wi-Fi with 8051.
15. IOT application using SBC.

(any 7 experiments)  TOTAL:30 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO 1: Know the various functional units of microcontroller, processors and system-on-chip based on the features and specifications.
CO 2: Recognize the role of each functional units in microcontroller, processors and system- on-chip based on the features and specifications.
CO 3: Interface the sensors, actuators and other I/O’s with microcontroller, processors and system on chip based interfacing.
CO4: Design the circuit and write the programming microcontroller, processors and system on chip.
CO 5: Develop the applications using Embedded system.

TEXT BOOKS:

REFERENCES:
Mapping of COs with POs and PSOs

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MR3691          ROBOTICS  
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COURSE OBJECTIVES:
1. To learn about basics of robots and their classifications
2. To understand the robot kinematics in various planar mechanisms
3. To learn about the concepts in robot dynamics
4. To understand the concepts in trajectory planning and programming
5. To know about the various applications of robots

UNIT – I BASICS OF ROBOTICS  

UNIT – II ROBOT KINMEATICS  
Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- D-H, forward & inverse kinematics of 2DOF and 3 DOF planar and spatial mechanisms

UNIT – III ROBOT DYNAMICS  
Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation

UNIT – IV TRAJECTORY, PATH PLANNING AND PROGRAMMING  
Trajectory Planning- Joint space and Cartesian space technique, Introduction to robot control, Robot programming and Languages- Introduction to ROS

UNIT – V ROBOT AND ROBOT APPLICATIONS  

COURSE OUTCOMES
Upon completion of this course, the students can able to
CO1: State the basic concepts and terminologies of robots
CO2: Know the Procedures for Forward and Inverse Kinematics, Dynamics for Various Robots
CO3: Derive the Forward and Inverse Kinematics, Dynamics for Various Robots
CO4: Apply the various programming techniques in industrial applications
CO5: Analyze the use of various types of robots in different applications

TOTAL: 45 PERIODS
Mapping of COs with POs and PSOs

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**TEXT BOOKS:**

**REFERENCES:**

**CMR338 SMART MOBILITY AND INTELLIGENT VEHICLES**

**COURSE OBJECTIVES:**
The objectives of the course are:
1. To introduce students to the various technologies and systems used to implement smart mobility and intelligent vehicles.
2. To learn Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Sensor Technology and Systems and other sensors for automobile vision system.
3. To learn Basic Control System Theory applied to Autonomous Automobiles.
4. To produce overall impact of automating like various driving functions, connecting the automobile to sources of information that assist with a task.
5. To allow the automobile to make autonomous intelligent decisions concerning future actions of the vehicle that potentially impact the safety of the occupants through connected car & autonomous vehicle technology.

**UNIT – I INTRODUCTION TO AUTOMATED, CONNECTED, AND INTELLIGENT VEHICLES**

**UNIT – II SENSOR TECHNOLOGY FOR SMART MOBILITY**
**UNIT – III  CONNECTED AUTONOMOUS VEHICLE**

Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy

**UNIT – IV  VEHICLE WIRELESS TECHNOLOGY & NETWORKING**


**UNIT – V  CONNECTED CAR & AUTONOMOUS VEHICLE TECHNOLOGY**


**TOTAL: 45 PERIODS**

**COURSE OUTCOMES**

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

CO1: Recognize the concept of cyber-physical control systems and their application to collision avoidance and autonomous vehicles  
CO2: Select the concept of remote sensing and the types of sensor technology needed to implement remote sensing  
CO3: Familiar with the concept of fully autonomous vehicles  
CO4: Apply the basic concepts of wireless communications and wireless data networks  
CO 5: Analyze the concept of the connected vehicle and its role in automated vehicles

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**TEXT BOOKS:**

1. “Intelligent Transportation Systems and Connected and Automated Vehicles”, 2016, Transportation Research Board

**REFERENCE:**

COURSE OBJECTIVES
1. To learn various immersive technologies of VR, AR and MR.
2. To learn software related to immersive technologies.
3. To learn the concepts of developing AR applications.
4. To learn the concepts of developing VR and unreal engine.
5. To study the haptic perception and extended reality.

UNIT – I INTRODUCTION TO IMMERSIVE TECHNOLOGIES 9
Introduction on Virtual reality – Augmented reality – Mixed reality – Extended reality – VR Devices – AR Devices – Applications

UNIT – II SOFTWARE TOOLS 9
Intro to Unity – Unity editor workspace – Intro to C# and visual studio - Programming in Unity – Intro to Unreal Engine – UE4 Editor workspace – Intro to Blueprint programming – Programming in Ue4

UNIT – III BUILDING AR APPLICATION WITH UNITY 9
AR SDKs for unity and unreal engine – Working with SDKs for unity – Developing AR application in unity - Building AR application

UNIT – IV BUILDING VR APPLICATION WITH UNREAL ENGINE 9
VR SDKs for unity and unreal engine – Developing VR application in Ue4 – Building VR application

UNIT – V HAPTIC PERCEPTION AND EXTENDED REALITY 9
Extended Reality - Introduction to Haptics – Devices and possibilities – Custom Device development – Device Integration

OUTCOMES: At the end of the course the students would be able to
- Apply detailed knowledge about immersive technology
- Gaining the knowledge of different types of Tools and Devices
- Acquiring the knowledge about Unity and Unreal Engine
- Explain the developing application in immersive technologies
- Discuss about haptics in immersive technologies

TOTAL – 45 PERIODS

TEXT BOOKS:
1. Immersive Multimodal Interactive Presence, by Angelika Peer (Editor), Christos D. Giachritsis (Editor), Springer; 2012th edition (13 April 2014), ISBN-10 : 1447162137

REFERENCES:
1. Practical Augmented Reality, by Steve Aukstakalnis, Addison-Wesley Professional; 1st edition (8 September 2016)
CRA332 DRONE TECHNOLOGIES L T P C
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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
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

UNIT II DRONE DESIGN, FABRICATION AND PROGRAMMING
Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT III DRONE FLYING AND OPERATION
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
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
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
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## TEXT BOOKS


## REFERENCES


## COURSE OBJECTIVES:

- Knowledge to evaluate and select the most desirable projects.
- Ability to plan and implement the projects.
- Ability to control the projects.
- Knowledge to close the projects.
- Knowledge about software projects.

## UNIT I  INTRODUCTION TO PROJECT MANAGEMENT AND PROJECT SELECTION  9

## UNIT II  PROJECT RISK MANAGEMENT  9

## UNIT III  PROJECT PLANNING AND IMPLEMENTATION  9
Work break down structure- Estimate work packages – Identify task relationship – project schedule

## UNIT IV  PROJECT MONITORING AND CONTROL  9
Resource aggregations - Resource levelling - limited resource allocation – project monitoring and control.

## UNIT V  PROJECT CLOSURE AND SPECIAL TOPICS  9
Process project audit – post project audit – normal project closure – premature closure – perpetual project - project closure process. Project management for modern information system – critical success factors for IT project - software project selection and initiation - project management discipline – project overall planning.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
CO1: Evaluate and select the most desirable projects.
CO2: Apply appropriate approaches to plan a new project.
CO3: Apply appropriate methodologies to develop a project schedule.
CO4: Identify important risks facing a new project.
CO5: Understanding the project management skills in IT industries.

CO’s- PO’s & PSO’s MAPPING

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TEXT BOOK:

REFERENCES:

CIE332 PRODUCT DESIGN AND VALUE ENGINEERING

COURSE OBJECTIVES:
• Relate product development integrated with value engineering.
• Summarize the development of new products through conceptualization, design and development phases.
• Relate various aspects of product development with industrial design and manufacturing.
• Describe the value of a product using tools and techniques.
• Design products which are suitable for the needs of the society.

UNIT I VALUE ENGINEERING BASICS
Origin of Value Engineering, Meaning of value, Definition of Value Engineering and Value analysis, Difference between Value analysis and Value Engineering, Types of Value, function - Basic and Secondary functions, concept of cost and worth, creativity in Value Engineering.

UNIT II VALUE ENGINEERING JOB PLAN AND PROCESS
Seven phases of job plan, FAST Diagram as Value Engineering Tool, Behavioural and organizational aspects of Value Engineering, Ten principles of Value analysis, Benefits of Value Engineering.

UNIT III IDENTIFYING CUSTOMER NEEDS and PRODUCT SPECIFICATIONS

UNIT IV CONCEPT GENERATION, SELECTION AND PRODUCT ARCHITECTURE
UNIT V  INDUSTRIAL DESIGN, PROTOTYPING AND ECONOMICS OF PRODUCT DEVELOPMENT

Need for industrial design – Impact of industrial design – Industrial design process – Management of industrial design process – Assessing the quality of industrial design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: The Students should be able to understand the basic concept of product development.
CO2: Design and develop new products in a systematic manner considering the concept of value engineering.
CO3: Able to understand customer requirements.
CO4: Able to understand product architecture.
CO5: Able to do prototyping.

CO’s- PO’s & PSO’s MAPPING

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TEXT BOOKS:

REFERENCES:

CIE333  FACILITY DESIGN

COURSE OBJECTIVES:
- Explain the basic principles in facilities planning and plant location.
- Interpret the basic principles in facility layout design decisions through proper analysis.
- Illustrate and explain various modern trends while designing a layout.
- Develop knowledge in line balancing concepts to implement improved system.
- Summarize basic principles in designing, measuring and analyzing material flow to improve the efficiency of the system.

UNIT I           PLANT LOCATION

Introduction, Factors affecting location decisions, Qualitative models, Quantitative models, Break-Even analysis model, Brown & Gibbs model, Single facility location models, Gravity location models, Mini-Sum model, Mini-Max model, Multi facility location models, Covering model, Warehouse location model.

UNIT II         FACILITIES LAYOUT DESIGN

Need for layout study, COURSE OBJECTIVES of a good facility layout, Classification of layout, Layout procedure – Nadler’s ideal system approach – Immer’s basic steps – Apple’s layout procedure – Reed’s layout procedure,
Layout planning – Systematic layout planning (SLP) – Information gathering, Flow analysis & Activity analysis, Relationship diagram, Space requirement and availability, Designing the layout.

UNIT III COMPUTERIZED LAYOUT PLANNING 9
Designing the process layout – CRAFT, ALDEP, CORELAP – Trends in computerized layout, Group technology models – Production flow analysis (PFA) – Rank order clustering (ROC).

UNIT IV DESIGNING PRODUCT LAYOUT 9

UNIT V MATERIALS HANDLING AND PACKAGING 9
Scope and definitions of material handling – COURSE OBJECTIVES, Principles of material handling, Unit load concept, Material handling system design, Classification of material handling equipments, Equipment selection & specification, JIT impact on facilities design, Packaging.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students should be able to
CO1: apply and evaluate appropriate location models for various facility types.
CO2: effectively design and analyze various facility layouts.
CO3: apply and analyze various computerized techniques while designing a layout.
CO4: effectively implement a strategy to level the workload across all the workstations.
CO5: implement smooth and cost effective system in the material handling process.

CO’s- PO’s & PSO’s MAPPING

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TEXT BOOK:

REFERENCES:
COURSE OBJECTIVES:

- To understand concepts and philosophy of Business Process Re-engineering.
- To learn various BPR and alternate methodologies – TQM, Work Study, ISO standards practiced in the industry.
- To understand and analyze the role of Information Technology and change management in the implementation of BPR.
- To expose practically BPR implementation and best practices through research papers and case discussions.

UNIT I  PROCESS VIEW OF BUSINESS


UNIT II  BPR: METHODOLOGIES AND TECHNIQUES & APPLICATIONS


UNIT III  CRITICAL SUCCESS FACTORS ANALYSIS

Re-engineering Success Factors, Risks associated with BPR, Barriers to BPR, Case: Analysis on “Pillsbury: Customer Driven Reengineering”, Barriers Management, Case: “Walmart China - Supply Chain Transformation”

UNIT IV  BPR Vs OTHER IMPROVEMENT APPROACHES


UNIT V  INFORMATION TECHNOLOGY AND BPR

Role of IT in Reengineering, Criticality of IT in Business Process, BPR Team Characteristics, Threads of BPR in Various Phases, Case: “Otis Elevator: Accelerating Business Transformation with IT”, BPR, SAP and ERP, Elements of ERP, Applications of ERP

COURSE OUTCOMES:

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

CO1. Understand various BPR methodologies and their applications.

CO2. Understand the critical success factors for implementing BPR.


CO5. Analyze and integrate issues and challenges of applying tools/techniques of Information Technology for BPR and learn to apply them in the industry.
TEXT BOOKS:

REFERENCES:
2. Jayanti Natarjan. (2002). Business Process Reengineering. TMH, New Delhi,

CIE335 ENTERPRISE RESOURCE PLANNING L T P C
3 0 0 3

COURSE OBJECTIVES:
- Describe an idea about ERP.
- Grasp the activities of ERP project management cycle.
- Understanding the emerging trends in ERP developments.
- Creating awareness of core and extended modules of ERP.
- Understand the ERP trending concepts.

UNIT I INTRODUCTION
Overview of enterprise systems – Evolution - Risks and benefits - Fundamental technology - Issues to be consider in planning design and implementation of cross functional integrated ERP systems.

UNIT II ERP SOLUTIONS AND FUNCTIONAL MODULES

UNIT III ERP IMPLEMENTATION

UNIT IV POST IMPLEMENTATION
Maintenance of ERP- Organizational and Industrial impact; Success and Failure factors of ERP Implementation.
UNIT V  EMERGING TRENDS ON ERP

COURSE OUTCOMES:
CO1: Knowledge of ERP implementation cycle.
CO2: Awareness of core and extended modules of ERP.
CO3: Able to understand ERP implementation steps.
CO4: Able to understand post implementation procedure.
CO5: Able to understand ERP trending concepts.

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TEXT BOOK:

REFERENCES:

CIE336  COST ESTIMATION AND CONTROL  L T P C
3003

COURSE OBJECTIVES:
- Gaining knowledge in the field of cost estimation.
- Enable the students to estimate the cost of various manufacturing processes.
- Controlling the manufacturing and software cost.
- Designing the cost analysis.
- Applying cost estimation procedures in all types of industries.

UNIT I  ESTIMATION AND COSTING

UNIT II  PRODUCT COST ESTIMATION
Estimation in Forging shop–in welding shop –in Foundry Shop –in Machining Shop etc.,

UNIT III  SOFTWARE COST ESTIMATION

UNIT IV  COSTING METHODS
Job costing –Operating costing – Process costing.

UNIT V  COST ANALYSIS FOR PLANNING AND CONTROL
Marginal costing –Standard costing and Variance Analysis–Budgetary control

TOTAL:45 PERIODS
COURSE OUTCOMES:
CO1: To estimate the manufacturing cost and computation of software cost.
CO2: Able to estimate product cost.
CO3: To control the manufacturing and software cost.
CO4: To enable both the costing and estimating procedures for all type of industry.
CO5: Able to perform cost analysis.

CO’s- PO’s & PSO’s MAPPING

| CO’s | PO’s 1 | PO’s 2 | PO’s 3 | PO’s 4 | PO’s 5 | PO’s 6 | PO’s 7 | PO’s 8 | PO’s 9 | PO’s 10 | PO’s 11 | PO’s 12 | PSO’s 1 | PSO’s 2 | PSO’s 3 |
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TEXTBOOK:

REFERENCES:

CIE337 SUPPLY CHAIN RISK MANAGEMENT

COURSE OBJECTIVES:
- To understand risk management definition & principles in the context of commercial management.
- To understand Risk identification and assessment – techniques and tools & Development and justification of risk-driven management decisions.
- To understand supply chain risk management, vulnerability and develop risk response strategies
- Developing an understanding of basic principles of Risk management processes, procedures & Risk analysis techniques.
- To understand how implementation of supply chain risk management strategies can be effective by industry based real world case studies and scenarios illustrating macro and micro-level risks, and approaches to their management.

UNIT I INTRODUCTION TO RISK MANAGEMENT
Concept of risk, definition of risk management, levels of risk management within organization, Relationship of risk to possible losses and gains, Concept of Risk and Uncertainty & the Sources, Concept of Risk in terms of Uncertainty, Probability Effect & Outcome, risk and uncertainty: basic concepts, Risk and uncertainty, origin of risk, Typical risk Parameter, Steps in Defining and Measuring Risk, uncertainties, types of uncertainty

UNIT II SOURCES OF RISK

UNIT III SUPPLY CHAIN RISK MANAGEMENT - I
UNIT IV SUPPLY CHAIN RISK MANAGEMENT - II

UNIT V SUPPLY CHAIN RISK MANAGEMENT ENABLERS

COURSE OUTCOMES:
CO1. To understand the concept of risk, uncertainty & risk parameters in the context of commercial management.
CO2. To develop a capacity to critically review the principles and applications of risk and vulnerability management in the context of commercial environments.
CO3. Analyze risk assessment and mitigation strategies in specific situations.
CO4. To apply SCOR model for supply chain risk management.
CO5. Describe supply chain risk management strategies to implement and monitor appropriate management techniques relevant to specific situations.

CO’s- PO’s & PSO’s MAPPING

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TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

CIE338 LOGISTICS MANAGEMENT
COURSE OBJECTIVES:
- Impart the basic knowledge on the concepts on logistics and distribution.
- Inculcate knowledge in Logistics Process, Planning and Materials Management.
- Teach the principles and activities in warehousing and storage.
- Provide knowledge on modes of transportation and international transport.
- Inculcate knowledge on performance monitoring, outsourcing and ICT application in logistics and distribution.
UNIT I  INTRODUCTION
Definition and Scope of Logistics – Functions &COURSE OBJECTIVES – Customer Value Chain –
ServicePhasesandattributes–Valueaddedlogisticsservices–RoleoflogisticsinCompetitivestrategy–
CustomerService

UNIT II  DISTRIBUTIONCHANNELSAND OUTSOURCINGLOGISTICS
Distribution channel structure- channel members, channel strategy, role of logistics and support in distribution
channels. Logistics requirements of channel members. Logistics outsourcing — catalysts, benefits, value
proposition. Third and fourth party logistics. Selection of service provider.

UNIT III  TRANSPORTATIONAND PACKAGING
Transportation System — Evolution, Infrastructure and Networks. Freight Management — Vehicle Routing
– Containerization. Modal Characteristics, Inter-modal Operators and Transport Economies. Packaging-

UNIT IV  PERFORMANCE MEASUREMENTAND COSTS
Performance Measurement - Need, System, Levels and Dimensions. Internaland External Performance
Measurement. Logistics Audit. Total Logistics Cost – Concept, Accounting Methods. Cost–Identification,
Time Frame and Formatting.

UNIT V  CURRENT TRENDS
Logistics Resource Management eLRM. Automatic Identification Technologies. Reverse Logistics — Scope,
design and as a competitive tool. Global Logistics — Operational and Strategic Issues, ocean and air
transportation. Strategic logistics planning. Green Logistics

COURSE OUTCOMES:
CO1: Understand the concepts of logistics and distribution
CO2: Effectively gain knowledge in logistics planning
CO3: Apply and analyze various principles and concepts in warehousing and storage
CO4: Effectively design and analyze a system of logistics for freight transport
CO5: Understand the basic concepts in outsourcing, benchmarking and safety in

distribution

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TEXT BOOKS:
1. Bowersox DonaldJ, LogisticsManagement—The Integrated Supply Chain Process, Tata
McGraw Hill, 2010
2. Sople Vinod V, Logistics Management—The Supply Chain Imperative, Pearson Education,3rd

REFERENCES:
2007.
COURSE OBJECTIVES:

- To introduce the concept of composites and its advantages.
- To enlighten the students about the different types of fibers and matrix materials
- To analyze different polymer matrix composites processing methods and their applications
- To expose the students to the various metal matrix composite processing methods
- To analyze the various processing techniques of ceramic matrix composites.

UNIT – I COMPOSITES


UNIT – II FIBRES AND MATRIX MATERIALS


UNIT – III POLYMER MATRIX COMPOSITES

Open mould process, bag moulding, Hand layup and spray up techniques filament winding, compression and transfer moulding, BMC and SMC– pultrusion – centrifugal casting – injection moulding – structure, properties and application of PMC’s – Carbon Matrix Composites – Interfaces– Properties – recycling of PMC.

UNIT – IV METAL MATRIX COMPOSITES


UNIT – V CERAMIC MATRIX COMPOSITES


COURSE OUTCOMES

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

CO1: Acquire Knowledge about various composites and their properties.
CO2: Acquire Knowledge about various types of fibers and matrix materials.
CO3: Explore the various polymer matrix composite processing methods.
CO4: Analyze the various processing methods of metal matrix composites.
CO5: Analyze the various processing techniques of ceramic matrix composites.
Mapping of COs with POs and PSOs

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TEXT BOOKS:

REFERENCES:

PR3002 SMART MATERIALS FOR MANUFACTURING
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COURSE OBJECTIVES:
Basic concepts, types and industrial application of shape memory alloys.
- To emphasize the importance of cutting fluids and its effect in the manufacturing process.
- To understand the efficiency of electrochemical energy systems for industrial application.
- To familiarize the stages, measurement and control of wear.
- To know about battery technology and disseminate the student about clean and green alternate energy sources.

UNIT I SHAPE MEMORY MATERIALS
Shape Memory Alloys – Introduction, one way memory effect, two-way memory effect – Types (copper-aluminium-nickel, and nickel-titanium (Ni-Ti) alloys), manufacturing methods, properties, crystal structures, applications and limitations. Shape memory polymers.

UNIT II NANO FLUIDS
Cutting Fluids – definition, types - oil, water, emulsion fluid as coolant and lubricant, selection parameters for cutting fluids, functions of cutting fluid- shear – strength reduction mechanism, applications, Smart Fluids – introduction, applications - Magnetorheological fluids (MR Fluids), preparation of demineralized water (ion exchange method and permanganate method).
**UNIT III ELECTROCHEMICAL ENERGY SYSTEMS**


**UNIT IV SMART MATERIALS**


**UNIT V BATTERY TECHNOLOGY AND ENERGY SOURCES**


**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

- CO1: Explain the shape memory materials and their manufacturing.
- CO2: Able to list the types and applications of nano fluids in the various industrial applications.
- CO3: Knowledgeable about the efficiency of electrochemical energy systems.
- CO4: Recollect latest developed functional and structural materials.
- CO5: Compare the various energy storage systems.

**Mapping of COs with POs and PSOs**

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**TEXT BOOKS:**

2. REFERENCES:
COURSE OBJECTIVES:

- To introduce the changes in properties of materials with dimension reduction and materials for MEMS.
- To provide overview of micro fabrication processes applicable for MEMS.
- To introduce students on the working principle of typical micro-sensors, micro-actuators and MEMS devices and the role of packaging.
- To apply knowledge on strength of materials, thermal and design engineering in design of MEMS devices.
- To familiarize the properties and method of synthesis of nanomaterial and progress of MEMS to nano system.

UNIT I  EFFECT OF MINIATURISATION AND MATERIALS FOR MEMS


UNIT II  MICRO-FABRICATION PROCESSES


UNIT III  MICROSYSTEM–WORKING PRINCIPLE AND PACKAGING


UNIT IV  MICROSYSTEMS DESIGN


UNIT V  NANOTECHNOLOGY

Classification of nano structures – effect of the nanometer length scale effects of nano scale dimensions on various properties structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – Fabrication methods – Top-down processes – bottom-up processes – nano positioning systems.

COURSE OUTCOMES:

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

CO1: Understand the changes in properties of materials with reduction of dimensions by Scaling laws and choice of materials for MEMS.

CO2: Overview of principles of micro fabrication techniques applicable for MEMS.

CO3: Familiarize on typical MEMS sensors, actuators and devices as well as packaging.

CO4: Apply knowledge on strength of materials, design and thermal engineering for development of MEMS.

CO5: Understand on properties and method of synthesis of nanomaterials and their role in nano systems.

TOTAL: 45 PERIODS
## Mapping of COs with POs and PSOs

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## TEXT BOOKS

## REFERENCES

## COURSE OBJECTIVES:
- To educate on mechanism of machining in micro and nano level based on molecular dynamics.
- To introduce to various methods of micro fabrication based on material addition.
- To introduce to various methods of micromachining with aid of high-rate energy input.
- To introduce to micromachining processes based on abrasive flow and enhanced rheology.
- To introduce the concepts of hybrid machining for high material removal and surface finish.

## UNIT I 
**INTRODUCTION**
Introduction to micromachining process – Classification of micromachining and nanomachining processes – Molecular dynamics (MD), principle of molecular dynamics simulation potential energy function – Boundary condition – MD simulation procedure.

## UNIT II 
**MICROFABRICATION METHODS**
Methods of microfabrication – Electro deposition, Chemical vapour deposition, physical vapour deposition – Electro Chemical spark deposition – LIGA (Lithographie, Galvanoformung, Abformung) process - Stereolithography- Micro Moulding

## UNIT III 
**MECHANICAL MICROMACHINING**
Ultrasonic machining – Abrasive jet machining – Abrasive water jet machining, water jet machining – Beam energy micromachining – Electron beam machining, Electro discharge machining, Ion beam machining, Focused ion beam machining.

## UNIT IV 
**MICROMACHINING AND NANO FUNCTIONING WITH ABRASIVE FLOW**
UNIT V HYBRID MICRO MACHINING

Surface Integrity of Machined Surface-Chemical Mechanical polishing – Electro chemical spark micro machining – Electro discharge grinding – Electrolytic in process dressing – Laser and Ultrasonic aided Machining – High/Low temperature aided Machining - Application.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
CO1: Understand on the molecular dynamic mechanism in micro-nano machining.
CO2: Familiarize on various methods of microfabrication based on material addition.
CO3: Get the Overview of various methods of micromachining with aid of high-rate energy input.
CO4: Acquire Knowledge on micromachining processes based on rheology of abrasive medium.
CO5: Realize hybrid machining for better material removal and surface finish.

Mapping of COs with POs and PSOs

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TEXT BOOKS:

REFERENCES:

CME339 ADDITIVE MANUFACTURING L T P C

2 0 2 3

COURSE OBJECTIVES:
- To introduce the development of Additive Manufacturing (AM), various business opportunities and applications
- To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.
- To be acquainted with vat polymerization and direct energy deposition processes
- To be familiar with powder bed fusion and material extrusion processes
- To gain knowledge on applications of binder jetting, material jetting and sheet lamination processes

UNIT I INTRODUCTION
UNIT II  DESIGN FOR ADDITIVE MANUFACTURING (DfAM)  6

UNIT III  VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION  6

UNIT IV  POWDER BED FUSION AND MATERIAL EXTRUSION  6

UNIT V  OTHER ADDITIVE MANUFACTURING PROCESSES  6

ADDITIONAL MANUFACTURING LABORATORY
Experiments
1. Modelling and converting CAD models into STL file.
3. Design and fabrication of parts by varying part orientation and support structures.
4. Fabrication of parts with material extrusion AM process.
5. Fabrication of parts with vat polymerization AM process.
6. Design and fabrication of topology optimized parts.

Equipment required - lab
1. Extrusion based AM machine
2. Resin based AM machine
3. Mechanical design software
4. Open-source AM software for STL editing, manipulation and slicing.

TOTAL: 30 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 of transforming a concept into the final product in AM technology.
CO3: Elaborate the vat polymerization and direct energy deposition processes and its applications.
CO4: Acquire knowledge on process and applications of powder bed fusion and material extrusion.
CO5: Evaluate the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.

TEXT BOOKS:
REFERENCES:

PR3005 MATERIAL TESTING AND CHARACTERIZATION

COURSE OBJECTIVES:
- To provide understanding of techniques of microstructure and crystal structure evaluation of materials.
- To introduce tools for analysis of microstructure and surface topography of materials.
- To understand the techniques of chemical and thermal analysis of materials.
- To gain knowledge in various static mechanical testing methods.
- To gain knowledge in various dynamic mechanical testing methods.

UNIT I MICRO AND CRYSTAL STRUCTURE ANALYSIS

UNIT II ELECTRON MICROSCOOPY

UNIT III CHEMICAL AND THERMAL ANALYSIS

UNIT IV MECHANICAL TESTING – STATIC TESTS

UNIT V MECHANICAL TESTING – DYNAMIC TESTS

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
CO1: Understand the characterize of engineering materials through structure.
CO2: Know the fundamental principle of Top-notch characterization tools.
CO3: Ability to understand the chemical and thermal analysis for materials characterization.
CO4: Choose appropriate mechanical static testing methods.
CO5: Choose appropriate mechanical dynamic testing methods.

Mapping of COs with POs and PSOs:

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

TEXTBOOKS:

REFERENCES:

CME397 SURFACE ENGINEERING L T P C 3 0 0 3

COURSE OBJECTIVES
1. To study the fundamentals of surface features and different types of friction associated with metals and non-metals
2. To study the different types of wear mechanism and its standard measurement.
3. To study the different types of corrosion and its preventive measures.
4. To study the different types of surface properties and surface modification techniques.
5. To study the various types of materials used in the friction and wear applications.

UNIT 1 SURFACES AND FRICTION
UNIT II WEAR 9
Laws of Wear - Types of Wear mechanism – wear debris analysis - Theoretical wear models - Wear of metals and nonmetals – International standards in friction and wear measurements

UNIT III CORROSION 9

UNIT IV SURFACE TREATMENTS 9

UNIT V ENGINEERING MATERIALS 9

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to
1. Describe the fundamentals of surface features and different types of friction associated with metals and non-metals
2. Analyze the different types of wear mechanism and its standard measurement.
3. Analyze the different types of corrosion and its preventive measures
4. Analyze the different types of surface properties and surface modification techniques
5. Analyze the various types of materials used in the friction and wear applications.

TEXT BOOKS:

REFERENCES:
CMF331  DESIGN OF JIGS AND FIXTURES  L T P C
3 0 0 3

COURSE OBJECTIVES:
At the end of this course the student should be able to understand
- Understand the applications of specific jigs and fixtures
- Identify the types of locators and clamps used in jigs and fixtures.
- Apply the basic principles of work holding and clamping systems.
- Evaluate human factors involved in design of jigs and fixtures
- Understand the material and manufacturing process for jigs and fixtures

UNIT I  BASICS OF JIGS AND FIXTURES 9

UNIT II  PRINCIPLES OF LOCATION 9

UNIT III  PRINCIPLES OF CLAMPING 9

UNIT IV  JIGS AND BUSHINGS AND DRILL JIGS 9

UNIT V  PRINCIPLE OF FIXTURE DESIGN 9

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon the completion of this course the students will be able to
- Categorize and justify the requirements of Jigs and Fixtures for Manufacturing, Testing and Assembly
- Describe and implement various indexing mechanics in manufacturing.
- Analyze problems related to Jigs and fixtures in Manufacturing, Testing and Assembly.
- Select suitable material and manufacturing process
- Design and drafting various Jigs and Fixtures using appropriate software package.

TEXT BOOKS:
REFERENCES:
2. ASTME Fundamentals of Tool Design Prentice Hall of India.

CMF332 DESIGN OF PRESS TOOLS LT P C 3 0 0 3

COURSE OBJECTIVES:
At the end of this course the student should be able to
- Understand sheet metal processes for different press tool operations and estimate percentage of utilization and economy factor.
- Identify the elements and working mechanisms of various press tools.
- Design of press tools for automotive components.
- Analyse the tools for Bending, Forming and Drawing operations.
- Understand the die material and manufacturing process

UNIT I PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 9 Hours

UNIT II DESIGN OF CUTTING DIES 9 Hours
Design and preparation of manufacturing drawing for simple blanking, piercing, compound and progressive dies for industrials components.

UNIT III INTRODUCTION TO BENDING AND DRAWING DIES 9 Hours
UNIT IV  DESIGN OF BENDING AND DRAWING DIES  9 Hours
Design and development of bending, forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.

UNIT V  MATERIALS AND HEAT TREATMENT  9 Hours

COURSE OUTCOMES:
Upon the completion of this course the students will be able to
- Explain the necessity of press tool for Manufacturing of Stage, Progressive, Bending and Compound tools
- Analyse the design constraints in the given problem
- Apply the design rule for designing and manufacturing of press tools
- Design and Drafting of press tools for considering real time issues of Manufacturing, Testing and Assembly
- Select suitable die material and manufacturing process

TEXT BOOKS:

REFERENCES:
1. ASTM Fundamentals of Tool Design Prentice Hall of India.

CMF333  DESIGN OF CUTTING TOOLS  L T P C
3 0 0 3

COURSE OBJECTIVES:
At the end of this course the student should be able to understand
- Understand the fundamentals of metal cutting theory and its practice in industries.
- Estimate the operational costs for maximum productivity.
- Analyse cutting forces of various machining operations.
- Design the cutting tools for longer tool life.

UNIT I  INTRODUCTION  9
Mechanism of chip formation, Mechanism ofyielding, concept of shearing strain, Fracture, overview of chip formation, Mechanism of Metal Cutting – Force system during turning- velocity relationships- Force analysis in turning, milling, drilling etc.- force dynamometer

UNIT II  CUTTING TOOL INSERTS  9
Design features of inserts – Indexable Inserts, Chip breakers, ISO and ANSI classification of inserts and tool holders.
UNIT III TURNING AND MILLING TOOLS

Turning Tool: Design of shank cross section, Classification of form tools, Design characteristics, Graphical and analytical method for profile calculation, chip breakers purpose and types. Milling Tool: Nomenclature, Design principles of plain milling cutter, Life and wear.

UNIT IV DRILLING, BORING, REAMER, BROACHING TOOLS

Drilling Tool: Drills with Indexable insert, deep hole drill, carbide tipped drill, core drill, counter bores, and counter sinks, drill design aspects.
Boring Tool: Types of boring tool, Boring heads, Cartridges, Boring tool design aspects.
Reamer Tool: Types of reamers, Geometry of flutes, Reamer design aspects.
Broaching Tool: Elements, types of broach, broach design aspects, broach strength.

UNIT V ECONOMICS OF MACHINING

Elements of machining cost, Tool cost, Cutting speed for minimum cost, Cutting speed for maximum productivity.

COURSE OUTCOMES:

- Upon the completion of this course the students will be able to
- Understand mechanism of chip formation, measurement of cutting forces
- Analyse the different types of machining operations
- Design cutting tools based on analytical and graphical method for industrial requirements
- Apply engineering knowledge for development of cutting tools for various operations

TOTAL: 45 PERIODS

TEXT BOOKS:


REFERENCES:

5. T A Sadasivan, D Sarathy, Cutting tools for productive machining, Wldia (India) Limited.

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COURSE OBJECTIVES:
At the end of this course the student should be able to understand
• To learn the design concepts for various mould elements.
• To learn the basic design aspects related to Injection Mould and Blow Mould
• To learn the basic design aspects related to Extrusion Dies.
• To learn the basic design aspects related to rotational moulds
• To learn the basic design aspects related to thermoforming dies

UNIT I INJECTION MOULD DESIGN 9 Hours

UNIT II DESIGN OF FEED SYSTEMS 9 Hours

UNIT III DESIGN OF EJECTION SYSTEMS 9 Hours
Requirements – Elements of Ejection system - Ejector grid, Ejector plate assembly, Ejection techniques – Ejection from fixed half - Sprue Pullers- Ejection Force Calculation - Ejection Assembly Actuation

UNIT IV DESIGN OF MOULD TEMPERATURE CONTROL SYSTEM 9 Hours

UNIT V DESIGN OF OTHER MOULDS & DIES 9 Hours

COURSE OUTCOMES:
Upon the completion of this course the students will be able to
• Apply the basics of Plastics mould design.
• Decide moulds for different processing techniques.
• Apply design aspects related to related to Injection Mould and Blow Mould
• Apply design aspects related to Extrusion and thermoforming Dies.
• Apply design aspects related to rotational moulds

TOTAL : 45 PERIODS
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CMF335 DESIGN OF TOOLING FOR DIE CASTING LT P C 3 0 0 3

COURSE OBJECTIVES:
At the end of this course the student should be able to:
- Understand the different types of alloys and its properties.
- Identify the type of casting process, machine and feed system for the components.
- Demonstrate the elements and working principle of different dies.
- Design the Die casting tool for metallic components.

UNIT I INTRODUCTION 9 Hours

UNIT II DIE CASTING MACHINES 9 Hours
History of die casting machines, Hot chamber machine, cold chamber machine, Horizontal machine, Vertical machine, Die locking, Toggle locking, Hydraulic locking, Injection systems, knock out pins and plates, ejection unit, loading of metal into hot chamber.
UNIT III  DIE CONSTRUCTION 9 Hours
Cores, Cavities, pillars and bushes, ejectors, bolster plates, Shot weight, Clamping force, Injection pressure, Shut height and day light, parting surface, relief and venting.
Feed System: Gates, Runners, Taper tangent runner system, Precession layout, Spreader, shot sleeve, shot weight, PQ2 Diagram and calculations etc.
Cooling System: Core cooling, Cavity cooling, cooling of shot sleeve, cooling of spreader, baffles, cooling calculations.

UNIT IV  TYPES OF DIES 9 Hours
Single cavity dies, Multi cavity dies, combination dies, unit dies, trimming and finishing of components, Inspection of components, safety, SPC & visual control techniques - Construction, Actuation of side cores, defects and remedies.

UNIT V  DESIGN OF DIE 9 Hours
Design of Cold chamber, Hot chamber, Single cavity, Multi cavity die-casting dies, and Dies with side cores and splits.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon the completion of this course the students will be able to
- Explain casting processes for different components and materials
- Analyse the casting process for design of feed system, ejection, cooling and parting surfaces.
- Design of Dies for the casting of components
- Solve industrial problems related to casting of metallic components

TEXT BOOKS:

REFERENCES:

CMF336  DESIGN OF TOOLING FOR THERMOSETS  L T P C
3 0 0 3

COURSE OBJECTIVES:
At the end of this course the student should be able to
- Understand basic characteristics of Thermoset Molding Materials
- Understand the basic process of thermoset materials
- Understand the basics of Plastics mould design.
- Acquire knowledge about various moulds for different processing techniques.
- Understand the properties and applications of different thermoset plastic materials and apply this knowledge in analysing the appropriate parameters for processing them.
UNIT I  INTRODUCTION  9 Hours

UNIT II  DESIGN OF COMPRESSION MOULDS  9 Hours

UNIT III  DESIGN OF TRANSFER MOULDS  9 Hours
Introduction -Types –Design of Pot and Plunger - Calculations of Projected area, Transfer Pressure, clamping force - Design of Pressure pad and Feed system - Advantages, Disadvantages and Applications of Transfer mould

UNIT IV  MOULD FOR LIQUID COMPOSITES  9 Hours
Introduction liquid composite moulding – Types: Resign Transfer Molding (RTM) – Vacuum-assisted Resign Transfer Molding (VARTM) – Vacuum Infusion Process (VIP) - Resin Transfer Tooling Light (RTML) – Compressed Resin Transfer Molding (CRTM) - Reaction Injection Moulding (RIM)-Tool Design consideration-Applications.

UNIT V  MOULD FOR SMC / BMC / DMC  9 Hours
Introduction to Sheet Moulding Compound (SMC), Bulk Moulding Compound (BMC), Dough Moulding Compound (DMC) – Tooling requirement – Tooling Materials - Design of mould elements- Assembly- applications-case studies.
Mould for Foams: Expanded Polypropylene (EPP) and Expanded Polystyrene (EPS)

TOTAL : 45 PERIODS

OUTCOMES:
Upon the completion of this course the students will be able to
- List the basic characteristics of Thermoset Molding Materials
- Apply the basic process of thermoset materials
- Preform the basics of Plastics mould design.
- Design moulds for various thermoset processing.
- Identify the properties and applications of different thermoset plastic materials and apply this knowledge in analysing the appropriate parameters for processing them.

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:
At the end of this course the student should be able to

- Impart the basics of gauges and perform measurement tasks accurately.
- Learn the right measurement practices features and geometries.
- Familiarized with the different types of gauges and its application
- Familiarized with the gauge materials and its properties
- Gain knowledge on design of gauges

UNIT I
INTRODUCTION
9 Hours
Types of gauges - Design requirements- gauge tolerance and wear allowance- Workshop gauges - Inspection gauges - Reference, or master or control gauges - Points to be remembered for Gauge Design - IS specifications for gauges Design – GD&T for Gauges- Application of Gauges.

UNIT II
MATERIALS FOR GAUGES
9 Hours

UNIT III
LIMIT GAUGES
9 Hours
Taylor’s principle of limit gauging - Application of limit gauges - gauge makers tolerance - allowance for gauge wear - material for limit gauge- Disposition of gauge tolerance and wear allowance- three basic types of limit gauges: plug gauge -snap gauge -ring gauge - Solid Gauges - Renewable end gauges - Single-ended gauges - Double-ended Gauge- Progressive Guage - manufacturing process- advantages and disadvantages- applications-IS specifications for gauges Design of plug and Snap gauges.

UNIT IV
INDICATING GAUGES
9 Hours
Introduction to pressure gauges, dimensions gauges, levels gauges – types – components-materials- Design considerations- manufacturing process- advantages and disadvantages-applications- IS specifications for indicating gauges.
UNIT V MISCELLANEOUS GAUGES

Combined Limit Gauge- Position Gauge- Contour Gauges- Taper Gauge- Thread Gauge- Form Gauges - Screw Pitch Gauge - Radius and Fillet Gauges - Feeler Gauge - WIRE Gauge - Pin Gauge - Design consideration- manufacturing process- advantages and disadvantages- applications - IS specifications.

TOTAL : 45 PERIODS

OUTCOMES:
At the end of this course, the student shall be able to:
- Recognize the basics of gauges and perform measurement tasks accurately.
- Identify the right measurement practices features and geometries.
- Recognize with the different types of gauges based on its application
- Recognize the gauge materials and its properties
- Ability to design different type of gauges

TEXT BOOKS:

REFERENCES:

COURSE OBJECTIVES:
- To expose the students to the basics of environmental sustainability and impact assessment.
- To incorporate knowledge about the environmental based improvements towards lean manufacturing systems.
- To analyze various machineries with intent to conserve energy
- To analyze hazardous and solid wastes with intent to point out areas of adverse environmental impact and how this impact could be minimized or prevented.
- To impart the knowledge about the need, procedure and benefits of Green-Co rating.

UNIT I ENVIRONMENTAL SUSTAINABILITY AND IMPACT ASSESSMENT

Environmental impact assessment objectives – Legislative development – European community directive – Hungarian directive. Strategic environmental assessment and sustainability appraisal. Regional spatial planning and environmental policy.
UNIT II LEAN MANUFACTURING AND GREEN ENERGY SYSTEM


UNIT III ENERGY SAVING MACHINERY AND COMPONENTS


UNIT IV HAZARDOUS AND SOLID WASTE MANAGEMENT


UNIT V GREEN CO-RATING


TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Understand the concepts of environmental sustainability and environmental impact assessment.

CO2: Apply suitable schemes towards design of green manufacturing requirements.

CO3: Analyze manufacturing processes towards conservation of energy.

CO4: Analyze manufacturing processes towards minimization or prevention of hazardous and solid wastes.

CO5: Acquire Knowledge about green co-rating and its benefits.

Mapping of COs with POs and PSOs

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TEXT BOOKS:


REFERENCES:

CMF339 UNCONVENTIONAL MACHINING PROCESSES

COURSE OBJECTIVES:

- Understand the need and importance of non-traditional machining methods and process selection.
- Gain the knowledge to remove material by thermal evaporation, mechanical energy process.
- Apply the knowledge to remove material by chemical and electro chemical methods.
- Analyze various material removal applications by unconventional machining process.

UNIT I INTRODUCTION

Need for non-traditional machining methods, classifications of modern machining processes, considerations in process selection, materials application, Ultrasonic machining: Elements of the process, mechanics of metal removal, process parameters, economic considerations, application and limitations, recent developments.

UNIT II ABRASIVE JET MACHINING

Abrasive jet machining, water jet machining and abrasive water jet machining: basic principles, equipment's process variables, mechanics of metal removal, MRR, applications and limitations; Electro chemical processes: Fundamentals of electro chemical machining, electro chemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, tool design, surface finish and accuracy, economic aspect of ECM, simple problem for estimation of metal removal rate.

UNIT III THERMAL METAL REMOVAL PROCESSES

General principle and applications of Electric discharge machining, electric discharge grinding, electric discharge wire cutting processes, power circuits in EDM, mechanism of metal removal in EDM, process parameters. Selection of tool electrodes and dielectric fluids, surface finish and accuracy.

UNIT IV ELECTRON BEAM MACHINING

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non thermal processes, general principle and applications of laser beam machining, thermal features, cutting speed and accuracy of cut.

UNIT V PLASMA MACHINING

Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries; Chemical machining principle, maskants, etchants, applications.

TOTAL : 45 PERIODS
OUTCOMES:
Upon the completion of this course the students will be able to
- Compare non-traditional machining, classification, material applications in material removal process
- Summarize the principle and processes of abrasive jet machining.
- Understand the principles, processes and applications of thermal metal removal processes.
- Identify the principles, processes and applications of EBM.
- Understand the principles, processes and applications of Plasma Machining.

TEXT BOOKS:

REFERENCES:

CMF338 NON DESTRUCTIVE TESTING AND EVALUATION LT P C 3 0 0 3

COURSE OBJECTIVES:
- To acquaint the students with the overview of NDT
- To elaborate the concept and procedure for liquid and magnetic penetrant testing and evaluate through practical study
- To introduce the concept and procedure for radiograph testing methods and evaluate through practical study
- To brief the concepts and procedures for Ultrasonic testing methods and their applications
- To impart knowledge in other methods of NDT and electrical method with case study
UNIT I  INTRODUCTION  9 Hours
NDT Versus Mechanical testing - Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT- Visual inspection – Unaided and aided.

UNIT II  SURFACE NDE METHODS  9 Hours

UNIT III  THERMOGRAPHY AND EDDY CURRENT TESTING (ET)  9 Hours

UNIT IV  ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE)  9 Hours

UNIT V  RADIOGRAPHY (RT)  9 Hours
Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

TOTAL : 45 PERIODS

OUTCOMES:
Upon the completion of this course the students will be able to
- Discuss the basics of NDT and its industrial standards
- Acquire knowledge on the concept and procedure for liquid and magnetic penetrant testing.
- Interpret the given mechanical components to inspect using radiograph testing methods techniques
- Apply ultrasonic techniques based on materials and its application.
- Describe the applications of electrical and other NDT methods.

TEXT BOOKS:

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PR3006 PRODUCTION OF AUTOMOTIVE COMPONENTS

COURSE OBJECTIVES:
- To impart knowledge in various manufacturing methods in developing automotive components
- To study the concepts of automobile engineering.
- To impart the knowledge in various parts of automotive engine.
- To understand the concepts of fuel and transmission system.
- To learn the recent developments in automobile industries.

UNIT I ENGINE
Working principle of two strokes, four stroke and Wankel engines – wet and dry liners – Piston and Piston rings – types – classification. Production of Cylinder block, Cylinder head, liners, oil pan, piston and piston rings and testing.

UNIT II ENGINE PARTS
Working principle of crank shaft – Cam shaft – valve operating mechanisms – carburetors – sparkplug Production of Connecting rod, Crankshaft, push rod and rocker arm, valves, tappets, carburetors and spark plugs.

UNIT III FUEL AND TRANSMISSION SYSTEM
UNIT IV  CHASSIS AND SUSPENSION SYSTEM
Working principle of – Suspension system – leaf spring and shock absorbers – wheel housing –
design concepts of chassis (aerodynamics and cross worthiness) - Production of Brake shoes,
leaf spring, wheel disc, wheel rim –usage of non-metallic materials for chassis components.

UNIT V  RECENT ADVANCES
Application of sensors and actuators – Emission control system – catalytic converter –
Hydroforming of exhaust manifold and lamp housing – stretch forming of Auto body panels – MMC
liners– thermal barrier coating of Engine head and valves – Selection of materials for Auto
components.

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Acquire knowledge of production of various automotive components.
CO2: Learn the working principles of engines.
CO3: Get knowledge about various engine components.
CO4: Learn working of Fuel and Transmission System and its types.
CO5: Acquire knowledge of recent development in automobile industries.

Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS:
1. B.P. Bhardwaj, “The Complete Book on Production of Automobile Components & Allied
3. Hiroshi yamagata, “The Science and Technology of materials in Automotive Engines”,

REFERENCES:
   3rd edition, 2001
3. Serope Kalpakjian and Steven R. Schmid, "Manufacturing Processes for Engineering
   2008.
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 Dennavit and Hartenberg transformation.

UNIT III  ROBOT DRIVE SYSTEMS AND END EFFECTORS

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

UNIT V  RECENT ADVANCES
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.

COURSE OUTCOMES:
Upon successful completion of the course, students should 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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1 = Slight, 2 = Moderate, 3 = Substantial

TEXT BOOKS:

REFERENCES:

PR3008 MACHINE VISION L T P C
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COURSE OBJECTIVES:
- To understand the principles and tasks of machine vision.
- To know the importance of image acquisition systems and conversion processes.
- To use the image processing techniques for decision making.
- To understand the fundamental of classifiers.
- To apply the concept of the machine vision system in Manufacturing and measurement.

UNIT I INTRODUCTION TO MACHINE VISION
Machine Vision use of machine vision – tasks for a vision system – relation to other fields – place of vision in CIM.

UNIT II IMAGE ACQUISITION AND CONVERSION

UNIT III IMAGE PROCESSING DECISION MAKING
Processing of binary images – thresholding, geometrical properties, topological properties – processing of gray scale images statistical operations, spatial operations, segmentation edge detection, morphological operations – image analysis – factors extraction – decision making.

UNIT IV PATTERN RECOGNITION

UNIT V MACHINE VISION APPLICATIONS
Applications in user industries automotive, semiconductor, electronic manufacturing, printing industries etc. – generic applications founding manufacturing metrology, inspection assembly verification – application analysis and implementation.

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand the Machine vision principle.
CO2: Understand the image acquisition and conversion principle.
CO3 Understand the image processing procedures for decision making
CO4: Use machine vision techniques for pattern recognizing.
CO5: Apply machine vision concept in manufacturing industries in process implementation and assembly.

Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial

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REFERENCES:
1. Richard O.Duda, Peter E. Hurt, Pattern Classification and Scene Analysis, Johnweily Publisher, 2000.

PR3009 INSTRUMENTATION AND CONTROL

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COURSE OBJECTIVES:
- To understand the principle of measurement systems and standards
- To understand the principle of measuring displacement, velocity, acceleration, vibration, force, stress and strain
- To understand the principle of data display and printers
- To build mathematical model for control system.
- To familiarize with bode plots.

UNIT I INTRODUCTION
Static and dynamic characteristics of measurement systems, standards and calibration, error and uncertainty analysis, statistical analysis of data, and curve fitting.

UNIT II MECHANICAL MEASUREMENTS AND INDUSTRIAL INSTRUMENTATION
Measurement of displacement, velocity (linear and rotational), acceleration, shock, vibration, force torque power, strain, stress, pressure temperature
UNIT III DATA DISPLAY AND RECORDING DEVICES
Data display-CRO, LED, LCD, magnetic tape recorders, x-y recorders, UV recorders, Oscilloscope recorders, digital printers and data loggers.

UNIT IV CONTROL
Introduction to control systems, mathematical model of physical systems in transfer function and state space forms, response of dynamic systems, concept of pole and zero of a system, realization of transfer functions.

UNIT V STABILITY ANALYSIS
Stability criteria bode plots, routh and Nyquist criteria.

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand the dynamic characteristics of measurement system.
CO2: Understand the mechanical measurements and industrial instrumentation.
CO3: Understand the working principle of data display and recording devices.
CO4: Understand the working principle of control system.
CO5: Perform Stability Analysis.

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Mapping of Co with POs and PSOs

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TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:
- To provide overview of in the fields of corrosion and its control
- To create awareness on types, properties and applications of abrasives and Refractories.
- To introduce to various metallic coatings processes
- To educate on various types of chemical conversion and organic coatings
- To introduce to various surface characterization tools.

UNIT – I CORROSION AND ITS CONTROL

UNIT – II ABRASIVES AND REFRACTORIES
Abrasives: definition, classification or types, grinding wheel, abrasive paper and cloth. Refractories: definition, characteristics, classification, properties – refractoriness and RUL, dimensional stability, thermal spalling, thermal expansion, porosity; Manufacture of refractories – general method; acidic refractories – fire clay, silica; basic refractories – magnesite, dolomite; neutral refractories – silicon carbide, zircon.

UNIT – III METALLIC COATINGS
Definition – methods of metallic coating, hot dipping - galvanizing, tinning, metal cladding, electroplating, electroless plating. Various other metallic coatings – displacement plating-Kanigen process – metal spraying or metallised coating – cementation or diffusion coatings.

UNIT – IV CHEMICAL CONVERSION AND ORGANIC COATINGS
Chemical Conversion coatings- Types- phosphate, chromate, chemical oxide and anodized (Aluminum) coatings -Organic coatings- paint, vehicle or drying oil, thinners, driers- Formulation of paints, failure of paint film- Varnishes, Enamels, Lacquers, EPI coating, Emulsion Paints-types, advantages and disadvantages – Special paint.

UNIT – V SURFACE CHARACTERIZATION

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: To review the various corrosion and methods to combat corrosion.
CO2: To compare the properties and typical applications of abrasives and refractories.
CO3: To discuss on the various metallic coatings processes.
CO4: To choose a type of chemical conversion and organic coating for typical applications.
CO5: To state the various surface characterization tools and their capability.

Mapping of COs with POs and PSOs

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**TEXT BOOKS:**

**REFERENCES:**

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**PR3011 PROCESSING OF COMPOSITES**

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**COURSE OBJECTIVES:**
- To introduce the concept of composites.
- To enlighten the students about the different types of fibres and matrix materials
- To analyze different polymer matrix composites processing methods and their applications
- To expose the students to the various metal matrix composite processing methods
- To analyze the various processing techniques of ceramic matrix composites.

**UNIT – I COMPOSITES**
Definition and fundamentals of composites—need for composites – enhancement of properties - Reinforcement, classification, general characteristics, rule of mixture – Theory of composites – Mechanical behavior – Stress strain relationships. Applications of various types of composites.

**UNIT – II FIBRES AND MATRIX MATERIALS**
Fibres – Types, Fabrication, Structure, properties and applications – Glass, Boron, carbon, polyethylene, Kevlar, Aramid, Alumina, SiC, Si3N4, B4C, ceramic and metallic fibers whiskers.

**UNIT – III POLYMER MATRIX COMPOSITES**
Open mould process, bag moulding, Hand layup and spray up technique’s filament winding, compression and transfer moulding, BMC and SMC—pultrusion – centrifugal casting – injection moulding – structure, properties and application of PMC’s – Carbon Matrix Composites – Interfaces.

**UNIT – IV METAL MATRIX COMPOSITES**

**UNIT – V CERAMIC MATRIX COMPOSITES**
COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
CO1: acquire Knowledge about the basics of composites and its types.
CO2: acquire Knowledge about various types of fibres and matrix materials.
CO3: explore the various polymer matrix composite processing methods.
CO4: analyze the various processing methods of metal matrix composites.
CO5: analyze the various processing techniques of ceramic matrix composites.

Mapping of COs with POs and PSOs

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TEXT BOOKS:

REFERENCES:

PR3012 COMPUTER AIDED PRODUCT DESIGN L T P C 3 0 0 3

COURSE OBJECTIVES:
- To introduce the general design process and software tools being used in the academics and Industries.
- To introduce the computer graphics and concepts related to the design.
- To introduce the concepts on geometric modelling and applications of CAD.
- To give information about product design and process tools.
- To exhibit the knowledge in product data management and product life cycle.
UNIT – I  INTRODUCTION TO COMPUTER AIDED DESIGN  
Introduction to Engineering Design – Various phases of systematic design – sequential engineering and concurrent engineering – Computer hardware and Peripherals – software packages for design and drafting.

UNIT – II  COMPUTER GRAPHICS FUNDAMENTALS  

UNIT – III  GEOMETRIC MODELING  

UNIT – IV  PRODUCT DESIGN CONCEPTS  

UNIT – V  PRODUCT DATA MANAGEMENT  

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Understand the basic design process and features of modern design tools.
CO2: Get exposure in fundamentals of computer graphics and its concepts.
CO3: Acquire knowledge on geometric modelling and usage of CAD software packages.
CO4: Develop in-depth knowledge on product design and process tools.
CO5: Gain knowledge on data handling and product life cycle management.

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TEXT BOOKS:

REFERENCES:
CPR332

FINITE ELEMENT ANALYSIS

L T P C
3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:

1. Developing mathematical models for Boundary Value Problems and their numerical solution.
2. Applying concepts of Finite Element Analysis to solve one dimensional problem.
3. Determining field variables for two dimensional scalar variable problems.
4. Determining field variables for two dimensional vector variable problems.
5. Applying the need for Isoparametric transformation and the use of numerical integration.

UNIT I

INTRODUCTION


UNIT II

ONE-DIMENSIONAL PROBLEMS


UNIT III

TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS


UNIT IV

TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS


UNIT V

ISOPARAMETRIC FORMULATION AND ADVANCED TOPICS


TOTAL : 45 PERIODS

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

1. Develop mathematical models for Boundary Value Problems and their numerical solution
2. Apply concepts of Finite Element Analysis to solve one dimensional problems
3. Determine field variables for two dimensional scalar variable problems
4. Determine field variables for two dimensional vector variable problems
5. Apply the need for Isoparametric transformation and the use of numerical integration

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MF3491 CNC MACHINING TECHNOLOGY LT P C 3 0 0 3

COURSE OBJECTIVES:
- To introduce the concepts and applications of CAD
- To introduce the various concepts and techniques used for Product design and to develop product design skills.
- To introduce the evolution, types and principles of CNC machine tools
- To familiarize the students with constructional features of CNC machine tools
- To gain knowledge on manual part program and generation of CNC part program using CAM packages

UNIT I FUNDAMENTALS OF COMPUTER GRAPHICS
Product cycle- Design process- sequential and concurrent engineering- Computer aided design — CAD system architecture- Computer graphics — co-ordinate systems- 2D and 3D transformations homogeneous coordinates - Line drawing -Clipping- viewing transformation

UNIT II GEOMETRIC MODELING

UNIT III CNC MACHINES

UNIT IV CNC PROGRAMMING

UNIT V FUNDAMENTALS OF CAM
Brief introduction to CAM – Manufacturing Planning, Manufacturing control- Concurrent Engineering-CIM concepts – Computerized elements of CIM system –Types of production - Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course the student will be able
- Apply concept of CAD systems for 3D modeling and visual realism.
- Recognize the evolution, types and principle of CNC machine tools
- Acquire knowledge on constructional features of CNC machine tools
- Identify drives and axis measuring system used in CNC machine tools
- Demonstrate competency in manual part program and generation of CNC part program using CAM packages
- Elaborate various tooling and work holding devices used in CNC machine tools

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PR3013 QUALITY CONTROL AND RELIABILITY ENGINEERING  L  T  P  C
3  0  0  3
COURSE OBJECTIVES:

- To impart the knowledge of the quality control, control charts and application and construction of various quality control charts and the selection.
- To impart the knowledge sampling plan types, characteristics and design procedure
- To study the significance of design of experiments and its application.
- To train the students in the field of reliability and its estimation.
- To introduce various distributions and its mathematical functions used in failure data analysis

UNIT – I  STATISTICAL PROCESS CONTROL


UNIT – II  ACCEPTANCE SAMPLING

Lot by lot sampling types – probability of acceptance in single, double, multiple sampling plans – OC curves – Producer’s risk and consumer’s risk. AQL, LTPD, AOQ, AOQL, Concepts Design of sampling plan – single, double, multiple- standard sampling plans for AQL and LTPD – Use of standard sampling plans – Sequential sampling plan.

UNIT – III  EXPERIMENTAL DESIGN AND TAGUCHI METHOD


UNIT – IV  RELIABILITY AND ITS PREDICTION


UNIT – V  FAILURE DATA ANALYSIS

Real time distribution, exponential, normal, log normal, gamma and Weibull – reliability data requirements – Graphical evaluation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:
CO1: Able to create and interpret different statistical process control charts.
CO2: Capacity to generate and compare various sampling plans.
CO3: Able to apply design of experiments tool.
CO4: Generate reliability testing plans and Evaluate reliability of a component or system.
CO5: Select suitable distribution for reliability data analysis and integrate reliability concepts in new product design and development.

Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS:

REFERENCES:

COURSE OBJECTIVES:
- To introduce the students to the fundamentals of machine design, material selection and to solve the basic design problems.
- To introduce the design of bolts & joints and selection of keys.
- To introduce the design of shafts, coupling & brakes.
- To give information about design of gears and belt drives.
- To provides knowledge on various springs and bearings.

UNIT – I INTRODUCTION

UNIT – II DETACHABLE AND PERMANENT JOINTS
Design of Bolts under Static Load, Design of Bolt with Tightening/Initial Stress, Design of Bolts subjected to Fatigue – Keys -Types, Selection of Square and Flat Keys-Design of Riveted Joints and Welded Joints.

UNIT – III SHAFTS AND COUPLING
Design of Shaft –For Static and Varying Loads, For Strength and Rigidity-Design of Coupling-Types, Flange, Muff and Flexible Rubber Bushed Coupling.

UNIT – IV GEARS AND BELT DRIVES
Design of Spur and Helical Gear Drives-Design of Belt Drives-Flat and V Belts.

UNIT – V SPRINGS AND BEARINGS

TOTAL: 45 PERIODS

Note:(Use of PSG Design Data Book is permitted in the University examination)

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
- CO1: To formulate and analyze stresses and strains in machine elements subjected to various loads
- CO2: To analyze and design structural joints such as Riveted joints, welded joints, Bolts.
- CO3: To analyze and design the components for power transmission like shaft and couplings.
- CO4: To analyze and design different types of gears and belts for engineering applications.
- CO5: To analyze and design mechanical springs and bearings.

Mapping of COs with POs and PSOs
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TEXT BOOKS:

REFERENCES:

MANDATORY COURSES I

MX3081   INTRODUCTION TO WOMEN AND GENDER STUDIES   L T P C
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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.
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:
1.2 *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?
REVIEW

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.
Development – Standard operation Procedure for disaster response – Financial planning for disaster Management

UNIT V  DISASTER MANAGEMENT: CASE STUDIES  
Discussion on selected case studies to analyse the potential impacts and actions in the context 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:

REFERENCES

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

CO’s – PO’s & PSO’s MAPPING

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COURSE OBJECTIVES:

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

UNIT I HEALTH AND ITS IMPORTANCE 2+4

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


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

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

UNIT II DIET 4+6

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


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

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

Common cooking mistakes
Different cooking methods, merits and demerits of each method
UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 4+4

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.

Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadwritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocasm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal

Prevention of illness with our traditional system of medicine
Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

UNIT IV MENTAL WELLNESS 3+4

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


Sleep - Sleep and its importance for mental wellness - Sleep and digestion.

Immunity - Types and importance - Ways to develop immunity

UNIT V YOGA 2+12

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

TOTAL: 45 PERIODS

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

REFERENCES:
1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D.Roberts
   The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
2. Simple lifestyle modifications to maintain health
https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.

3. Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html
7. BMI https://www.hsph.harvard.edu/nutritionsource/healthy-weight/
   https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations
8. Yoga https://www.healthifyme.com/blog/types-of-yoga/
   https://yogamedicine.com/guide-types-yoga-styles/
   Ayurveda: https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda
10. CAM: https://www.hindawi.com/journals/ecam/2013/376327/
11. Preventive herbs: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/

COURSE OUTCOMES:
After completing the course, the students will be able to:
- Learn the importance of different components of health
- Gain confidence to lead a healthy life
- Learn new techniques to prevent lifestyle health disorders
- Understand the importance of diet and workouts in maintaining health

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<tr>
<th>MX3086</th>
<th>HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA</th>
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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)

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 Kumaraappa)

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

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, Kumaraappa)

Essential elements of Indian civilization. (3 lectures)
(Refs: Pt Sundarlal, R C Mazumdar, Dharampal)

Technology as driver of society, Role of education in shaping of society. Future directions. (4 lectures) (Refs: Nandkishore Acharya, David Dixon, Levis Mumford)
Conclusion (2 lectures)

Total lectures: 39

Preferred Textbooks: See Reference Books

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

GRADING:

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<td>Term paper</td>
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TOTAL : 45 PERIODS

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

MX3088 STATE, NATION BUILDING AND POLITICS IN INDIA

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

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

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

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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<td>CO5</td>
<td>Obtain knowledge of Risk Assessment Techniques.</td>
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Industrial safety 3    3    3    2    1    3    2    2    3    2    1     3     3     3     3     3     3
OPEN ELECTIVE I AND II

OCS351 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS L T P C 2 0 2 3

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

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH 6

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

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

UNIT IV SUPERVISED LEARNING 6

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

TOTAL : 30 PERIODS

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

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

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

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

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

TOTAL: 60 PERIODS

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

REFERENCES

OCS352 IOT CONCEPTS AND APPLICATIONS L T P C
2 0 2 3

OBJECTIVES:
- To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IoT
- To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
- To introduce the technologies behind Internet of Things(IoT).
- To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform.
- To apply the concept of Internet of Things in real world scenario.

UNIT I INTRODUCTION TO INTERNET OF THINGS

UNIT II COMPONENTS IN INTERNET OF THINGS
Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee,Wifi, GPS, GSM Modules)

UNIT III PROTOCOLS AND TECHNOLOGIES BEHIND IOT
UNIT IV OPEN PLATFORMS AND PROGRAMMING


UNIT V IOT APPLICATIONS

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

PRACTICAL EXERCISES: 30 PERIODS
1. Introduction to Arduino platform and programming
2. Interfacing Arduino to Zigbee module
3. Interfacing Arduino to GSM module
4. Interfacing Arduino to Bluetooth Module
5. Introduction to Raspberry PI platform and python programming
6. Interfacing sensors to Raspberry PI
7. Communicate between Arduino and Raspberry PI using any wireless medium
8. Setup a cloud platform to log the data
9. Log Data using Raspberry PI and upload to the cloud platform
10. Design an IOT based system

OUTCOMES:
CO 1: Explain the concept of IoT.
CO 2: Understand the communication models and various protocols for IoT.
CO 3: Design portable IoT using Arduino/Raspberry Pi/open platform
CO 4: Apply data analytics and use cloud offerings related to IoT.
CO 5: Analyze applications of IoT in real time scenario.

TOTAL: 60 PERIODS

TEXTBOOKS

REFERENCES
1. Perry Lea, “Internet of things for architects”, Packt, 2018

OCS353 DATA SCIENCE FUNDAMENTALS L T P C 2 0 2 3

COURSE OBJECTIVES:
● Familiarize students with the data science process.
● Understand the data manipulation functions in Numpy and Pandas.
● Explore different types of machine learning approaches.
● Understand and practice visualization techniques using tools.
● Learn to handle large volumes of data with case studies.
UNIT I INTRODUCTION
Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data

UNIT II DATA MANIPULATION

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

UNIT IV DATA VISUALIZATION

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

PRACTICAL EXERCISES:

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

Note: Example data sets like: UCI, Iris, Pima Indians Diabetes etc.
COURSE OUTCOMES:
At the end of this course, the students will be able to:

CO1: Gain knowledge on data science process.
CO2: Perform data manipulation functions using Numpy and Pandas.
CO3: Understand different types of machine learning approaches.
CO4: Perform data visualization using tools.
CO5: Handle large volumes of data in practical scenarios.

TOTAL: 60 PERIODS

TEXT BOOKS

REFERENCES

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

UNIT I        INTRODUCTION  7

UNIT II       VR MODELING  6

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

UNIT IV     APPLICATIONS  6
UNIT V  AUGMENTED REALITY

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

30 PERIODS

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

TOTAL:60 PERIODS

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

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

OPEN ELECTIVE III

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

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

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

TOTAL: 45 PERIODS

LEARNING OUTCOMES:
At the end of the course, learners will be able
• Expand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with the emphasis required
• Identify errors with precision and write with clarity and coherence
• Understand the importance of task fulfilment and the usage of task-appropriate vocabulary
• Communicate effectively in group discussions, presentations and interviews
• Write topic based essays with precision and accuracy
CO-PO & PSO MAPPING

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

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

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:

Websites
http://civilservicesmentor.com/, http://www.educationobserver.com
http://www.cambridgeenglish.org/in/

OMG352 NGOS AND SUSTAINABLE DEVELOPMENT

COURSE OBJECTIVES

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

UNIT I ENVIRONMENTAL CONCERNS

Introduction to sustainable development goals, Global responsibility of environmental concern, Importance of environmental preservation, Environmental threats, Pollution and its types, Effects of Pollution, Pollution control, Treatment of wastes
UNIT II ROLE OF NGOS 9
Role of NGO’s in national development, NGO’s and participatory management, Challenges and limitations of NGO’s, Community Development programmes, Role of NGO’s in Community Development programmes, Participation of NGO’s in environment management, Corporate Social responsibility, NGO’s and corporate social responsibility

UNIT III SUSTAINABLE DEVELOPMENT 9
Issues and Challenges of Sustainable Development, Bioenergy, Sustainable Livelihoods and Rural Poor in Sustainable Development, Protecting ecosystem services for sustainable development, Non-renewable sources of energy and its effect, Renewable sources of energy for sustainability, Nuclear resources and Legal Regulation of Hazardous Substances, Sustainable Development: Programme and Policies, Sustainability assessment and Indicators

UNIT IV NGO’S FOR SUSTAINABILITY 9
Civil Society Initiatives in Environment Management, Civil Society Initiatives for Sustainable Development, Global Initiatives in Protecting Global Environment, World Summit on Sustainable Development (Johannesburg Summit 2002), Ecological economics, Environmental sustainability, Social inclusion, Health for all, education for all, Food security and Water security, NGOs and Sustainable Development strategies

UNIT V LEGAL FRAMEWORKS 9
Need for a Legal framework and its enforcement, Legal measures to control pollution, Environmental Legislations in India, Mechanism to implement Environmental Laws in India, Legal Protection of Forests Act 1927, Legal Protection of Wild Life, Role of NGO’s in implementing environmental laws, Challenges in the implementation of environmental legislation

TOTAL 45 : PERIODS

OUTCOMES
Upon completion of this course, the student will:
CO1 Have a thorough grounding on the issues and challenges being faced in attaining sustainable development
CO2 Have a knowledge on the role of NGOs towards sustainable development
CO 3 Present strategies for NGOs in attaining sustainable development
CO 4 recognize the importance of providing energy, food security and health equity to all members of the society without damaging the environment
CO 5 understand the environmental legislations

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

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

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

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

REFERENCES:
4. Saima Saeed: Screening the Public Sphere: Media and Democracy in India, 2013

CME365 RENEWABLE ENERGY TECHNOLOGIES

COURSE OBJECTIVES
1. To know the Indian and global energy scenario
2. To learn the various solar energy technologies and its applications.
3. To educate the various wind energy technologies.
4. To explore the various bio-energy technologies.
5. To study the ocean and geothermal technologies.

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

UNIT – II SOLAR ENERGY

UNIT – III WIND ENERGY

UNIT – IV BIO-ENERGY
UNIT – V  OCEAN AND GEOTHERMAL ENERGY

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students would be able to
- Discuss the Indian and global energy scenario.
- Describe the various solar energy technologies and its applications.
- Explain the various wind energy technologies.
- Explore the various bio-energy technologies.
- Discuss the ocean and geothermal technologies.

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

OME354 APPLIED DESIGN THINKING

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

UNIT I  DESIGN THINKING PRINCIPLES
Exploring Human-centered Design - Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy-building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] - Case studies
UNIT II ENDUSER-CENTRIC INNOVATION
Importance of customer-centric innovation - Problem Validation and Customer Discovery - Understanding problem significance and problem incidence - Customer Validation. Target user, User persona & user stories. Activity: Customer development process - Customer interviews and field visit

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

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

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

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

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

REFERENCES
1. https://www.ideou.com/pages/design-thinking#process
4. https://blog.forgefor ward.in/evaluating-product-innovations-e8178e58b86e
5. https://blog.forgefor ward.in/user-guide-for-product-innovation-rubric-8571811b253dd
6. https://blog.forgefor ward.in/startup-failure-is-like-true-lie-7812cde9b85
COURSE OBJECTIVES:

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

UNIT I

INTRODUCTION & GEOMETRIC FORM 9 Hours

UNIT II

MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION 9 Hours

UNIT III

DATA PROCESSING 9 Hours

UNIT IV

3D SCANNING AND MODELLING 9 Hours

UNIT V

INDUSTRIAL APPLICATIONS 9 Hours

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

REFERENCES:

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

COURSE OBJECTIVES:
The objective of this course is to prepare the students to know about the general aspects of Electric and Hybrid Vehicles (EHV), including architectures, modelling, sizing, and sub system design and hybrid vehicle control.

UNIT I DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES
9

UNIT II ENERGY SOURCES
9

UNIT III MOTORS AND DRIVES
9
Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT IV POWER CONVERTERS AND CONTROLLERS
9
Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes

UNIT V HYBRID AND ELECTRIC VEHICLES
9
Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

TOTAL: 45 PERIODS
**COURSE OUTCOMES:**
At the end of this course, the student will be able to
1. Understand the operation and architecture of electric and hybrid vehicles
2. Identify various energy source options like battery and fuel cell
3. Select suitable electric motor for applications in hybrid and electric vehicles.
4. Explain the role of power electronics in hybrid and electric vehicles.
5. Analyze the energy and design requirement for hybrid and electric vehicles.

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**OBJECTIVES:**
- Use the standard atmosphere tables and equations.
- Find lift and drag coefficient data from NACA plots.
- Apply the concept of static stability to flight vehicles.
- Describe the concepts of stress, strain, Young’s modulus, Poisson’s ratio, yield strength.
- Demonstrate a basic knowledge of dynamics relevant to orbital mechanics.

**UNIT I**
**STANDARD ATMOSPHERE**
History of aviation – standard atmosphere - pressure, temperature and density altitude.

**UNIT II**
**AERODYNAMICS**
Aerodynamic forces – Lift generation Viscosity and its implications - Shear stress in a velocity profile - Lagrangian and Eulerian flow field - Concept of a streamline – Aircraft terminology and geometry - Aircraft types - Lift and drag coefficients using NACA data.

**UNIT III**
**PERFORMANCE AND PROPULSION**
Viscous and pressure drag - flow separation - aerodynamic drag - thrust calculations -thrust/power available and thrust/power required.

**UNIT IV**
**AIRCRAFT STABILITY AND STRUCTURAL THEORY**
UNIT V
SPACE APPLICATIONS

History of space research - spacecraft trajectories and basic orbital manoeuvres - six orbital elements - Kepler’s laws of orbits - Newton's law of gravitation.

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCE:

OIM351 INDUSTRIAL MANAGEMENT

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

UNIT I INTRODUCTION

UNIT II FUNCTIONS OF MANAGEMENT

UNIT III ORGANIZATIONAL BEHAVIOUR
UNIT IV  GROUPDYNAMICS

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

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OIE354 QUALITY ENGINEERING

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

UNIT I  INTRODUCTION

UNIT II  CONTROLCHARTS
Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X, R and S charts, attribute control charts - p, np, c and u- Construction and application.
UNIT III  SPECIAL CONTROL PROCEDURES  9
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  9
Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNIT V  ACCEPTANCE SAMPLING  9
The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS2500 standards.

TOTAL: 45 PERIODS

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

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OSF351  FIRE SAFETY ENGINEERING  L T P C
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COURSE OBJECTIVES
1: To enable the students to acquire knowledge of Fire and Safety Studies
2: To learn about the effect of fire on materials used for construction, the method of test for non-combustibility & fire resistance
3: To learn about fire area, fire stopped areas and different types of fire-resistant doors
4: To learn about the method of fire protection of structural members and their repair due to fire damage.
5: To develop safety professionals for both technical and management through systematic and quality-based study programmes

UNIT I  INHERENT SAFETY CONCEPTS  9
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 household materials.
UNIT II  PLANT LOCATIONS
Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; Fire resistance test on structural elements-standard heating condition, Indian standard test method, performance criteria.

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

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

UNIT V WORKING AT HEIGHTS

TOTAL : 45 PERIODS

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

TEXT BOOKS

REFERENCES:
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:

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

UNIT I INTRODUCTION TO NDT & VISUAL TESTING

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

UNIT II LIQUID PENETRANT & MAGNETIC PARTICLE TESTING

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

UNIT III EDDY CURRENT TESTING & THERMOGRAPHY

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

UNIT IV ULTRASONIC TESTING & AET

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

TOTAL: 45 PERIODS

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

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OMR351  
MECHATRONICS
L T P C
3 0 0 3

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

UNIT – II  8085 MICROPROCESSOR

UNIT – III  PROGRAMMABLE PERIPHERAL INTERFACE

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

UNIT – V  ACTUATORS AND MECHATRONICS SYSTEM DESIGN

TOTAL: 45 PERIODS

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

Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS:
REFERENCES:

ORA351 FOUNDATION OF ROBOTICS

COURSE OBJECTIVES:
1. To study the kinematics, drive systems and programming of robots.
2. To study the basics of robot laws and transmission systems.
3. To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
4. To familiarize students with the various Programming and Machine Vision application in robots.
5. To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

UNIT – I FUNDAMENTALS OF ROBOT

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

UNIT – III ROBOT DRIVE SYSTEMS AND END EFFECTORS
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-Effecter 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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1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS:

REFERENCES:

OAE352  FUNDAMENTALS OF AERONAUTICAL ENGINEERING

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

OAE352  FUNDAMENTALS OF AERONAUTICAL ENGINEERING  L T P C

3 0 0 3
UNIT I       HISTORY OF FLIGHT  8
Balloon flight-ornithopter-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

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

UNIT III     BASICS OF AERODYNAMICS  9

UNIT IV      BASICS OF AIRCRAFT STRUCTURES  9

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

TOTAL : 45 PERIODS

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

TEXT BOOKS

REFERENCE

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

OBJECTIVES:
• To introduce the concepts of remote sensing processes and its components.
• To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation
UNIT I  
REMOTE SENSING AND ELECTROMAGNETIC RADIATION  

UNIT II  
EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL  

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

UNIT IV  
SENSING TECHNIQUES  

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

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

TOTAL:45 PERIODS

TEXTBOOKS:

REFERENCES:
CO-PO MAPPING

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<td>Design/Development of Solutions</td>
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<td>PO10</td>
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OAI351 URBAN AGRICULTURE

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

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

UNIT II VERTICAL FARMING

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

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

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

TOTAL: 45 PERIODS
COURSE OUTCOMES

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

TEXT BOOKS:

REFERENCES:

CO-PO MAPPING

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<th>PO/PSO</th>
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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

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

TEXT BOOKS:
REFERENCES:

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

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</tbody>
</table>

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

OEE352 ELECTRIC VEHICLE TECHNOLOGY

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

UNIT I ROTATING POWER CONVERTERS

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

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

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

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

|     | CO1 | CO2 | CO3 | CO4 | CO5 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PO16 | PO17 | PO18 | PO19 | PO20 | PO21 | PO22 | PO23 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|     | 3   | 2   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   |

REFERENCES:

OEI353 INTRODUCTION TO PLC PROGRAMMING

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

UNIT I INTRODUCTION TO PLC

Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers/DSP, PLC/DDC- PLC Construction: What is a PLC, PLC Memories, PLC I/O, , PLC Special I/O, PLC Types.
UNIT II  
**PLC INSTRUCTIONS**
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

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
3. https://www.etf.ues.rs.ba/~slubura/Procesni%20racunari/Programmable%20Logic%20Contr
ollers%20Programming%20Methods.pdf
OCH351 NANO TECHNOLOGY

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

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

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

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

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

TOTAL : 45 PERIODS

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

COURSE ARTICULATION MATRIX
<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO 1</th>
<th>PO 2</th>
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<td>CO5</td>
<td>develop a deeper knowledge in the application of nanomaterials in different fields</td>
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OBJECTIVE:
- The course emphasis on the molecular safe assembly and materials for polymer electronics

UNIT I  INTRODUCTION

UNIT II  MOLECULAR SELF ASSEMBLY

UNIT III  BIO-INSPIRED MATERIALS

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

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

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

TEXT BOOK:

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

UNIT II  TRADITIONAL METHODS OF FOOD PROCESSING  9

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

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1 To understand the historical and traditional perspective of foods and food habits
CO2 To understand the wide diversity and common features of traditional Indian foods and meal patterns.

TEXT BOOKS:

OFD353  INTRODUCTION TO FOOD PROCESSING  L T P C 3 0 0 3

OBJECTIVE:
• The course aims to introduce the students to the area of Food Processing. This is necessary for effective understanding of a detailed study of food processing and technology subjects. This course will enable students to appreciate the importance of food processing with respect to the producer, manufacturer and consumer.

UNIT I  PROCESSING OF FOOD AND ITS IMPORTANCE  9
Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.
UNIT II  METHODS OF FOOD HANDLING AND STORAGE  
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  
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  
Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment.

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

TOTAL: 45 PERIODS

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

TEXT BOOKS/REFERENCES:

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

UNIT II  FLAME PROOF & WATERPROOF  9
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  9

UNIT IV  MECHANICAL FINISHES  9

UNIT V  STIFFENING AND SOFTENING  9
Concept of stiffening and softening of textile materials. Mechanism in the weight reduction of PET. Concept of Micro encapsulation techniques in finishing process, Nano finish, Plasma Treatment and Bio finishing.

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

TOTAL: 45 PERIODS
OTT352        INDUSTRIAL ENGINEERING FOR GARMENT INDUSTRY        L T P C
                   3 0 0 3

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
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
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
Definition, Objectives, Procedure, Process charts and symbols. Various charts – Charts
indicating process sequence: Outline process chart, flow process chart (man type, material type
and equipment type); Charts using time scale – multiple activity chart. Diagrams indicating
movement – flow diagram, string diagram, cycle graph, chrono cycle graph, travel chart
MOTION STUDY: Principle of motion economy, Two handed process chart, micro motion analysis
– therbligs, SIMO chart.

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

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

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
1. Microencapsulation in finishing, Review of progress of Colouration, SDC, 2001 62
OUTCOMES:
Upon the completion of the course the student shall be able to understand
CO1: Fundamental concepts of industrial Engineering and productivity
CO2: Method study
CO3: Motion analysis
CO4: Work measurement and SAM
CO5: Ergonomics and its application to garment industry

TEXTBOOKS:

REFERENCES

Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
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<td>Overall CO</td>
<td>1.2 2 3</td>
<td>3 2 1 1.2</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES:
To enable the students to learn about the basics of fibre forming, yarn production, fabric formation, coloration of fabrics and garment manufacturing

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

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

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

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

UNIT V  BASICS OF KNITTING AND NONWOVEN

TOTAL : 45 PERIODS

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

TEXTBOOKS
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<td>Regenerated and synthetic fibres</td>
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<tr>
<td>CO3.</td>
<td>Yarn spinning</td>
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<td>CO4.</td>
<td>Weaving</td>
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<tr>
<td>CO5.</td>
<td>Knitting and nonwoven</td>
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</table>

REFERENCES:

COURSE ARTICULATION MATRIX:

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE:
The course is aimed to
Gain knowledge about petroleum refining process and production of petrochemical products.

UNIT I ORIGIN, FORMATION AND REFINING OF CRUDE OIL

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

UNIT III REFORMING AND HYDROTREATING

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

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

TOTAL: 45 PERIODS

OUTCOMES:
On the completion of the course students are expected to
CO1: Understand the classification, composition and testing methods of crude petroleum and its products. Learn the mechanism of refining process.
CO2: Understand the insights of primary treatment processes to produce the precursors.
CO3: Study the secondary treatment processes cracking, vis-breaking and coking to produce more petroleum products.
CO4: Appreciate the need of treatment techniques for the removal of sulphur and other impurities from petroleum products.
CO5: Understand the societal impact of petrochemicals and learn their manufacturing processes.
CO6: Learn the importance of optimization of process parameters for the high yield of petroleum products.

TEXT BOOKS:
REFERENCES:

CPE334 ENERGY CONSERVATION AND MANAGEMENT  L T P C
3 0 0 3

OBJECTIVES:
At the end of the course, the student is expected to
- understand and analyse the energy data of industries
- 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

OUTCOMES:
Upon completion of this course, the students can able to analyze the energy data of industries.
CO1: Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.
CO2: Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.
CO3: Skills on combustion thermodynamics and kinetics.
CO4: Apply calculation and design tube still heaters.
CO5: Studied different heat treatment furnace.
CO6: Practical and theoretical knowledge burner design.
TEXT BOOKS:

REFERENCES:

OPT351 BASICS OF PLASTICS PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES
- Understand the fundamentals of plastics processing, such as the relationships between material structural properties and required processing parameters, and so on
- To gain practical knowledge on the polymer selection and its processing
- Understanding the major plastic material processing techniques (Extrusion, Injection molding, Compression and Transfer molding, Blow molding, Thermoforming and casting)
- To understand suitable additives for plastics compounding
- To Propose troubleshooting mechanisms for defects found in plastics products manufactured by various processing techniques

UNIT I INTRODUCTION TO PLASTICS PROCESSING 9

UNIT II EXTRUSION 9

UNIT III INJECTION MOLDING 9
Injection molding – Principles and processing outline, machinery, accessories and functions, specifications, process variables, mould cycle. Types of clamping: hydraulic and toggle mechanisms. Start-up and shut down procedures-Cylinder nozzles- Press capacity projected area -Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables. Basic mould types. Reciprocating vs. plunger type injection moulding. Thermoplastic vs. thermosetting injection moulding. Injection moulding vs. other plastic processing techniques. State-of-the-art injection moulding techniques - Introduction to trouble shooting
UNIT IV  COMPRESSION AND TRANSFER MOLDING

Compression moulding – Basic principles of compression and transfer moulding-Meaning of terms-Bulk factor and flow properties, moulding materials, process variables and process cycle, Inter relation between flow properties-Curing time-Mould temperature and Pressure requirements. Preforms and preheating- Techniques of preheating. Machines used-Types of compression mould- positive, semi-positive and flash. Common moulding faults and their correction- Finishing of mouldings. Transfer moulding: working principle, equipment, Press capacity-Integral moulds and auxiliary ram moulds, moulding cycle, moulding tolerances, pot transfer, plunger transfer and screw transfer moulding techniques, advantages over compression moulding

UNIT V  BLOW MOLDING, THERMOFORMING AND CASTING


TOTAL: 45 PERIODS

COURSE OUTCOMES

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

REFERENCES:


OEC351  SIGNALS AND SYSTEMS

COURSE OBJECTIVES:

- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and system in the Fourier and Laplace domain
- To analyze discrete time signals and system in the Fourier and Z transform domain
UNIT I  CLASSIFICATION OF SIGNALS AND SYSTEMS  

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

UNIT III  LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS  

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

UNIT V  LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS  

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

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
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 AMP AND DC/DC CONVERTORS
 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.

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CBM348 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT  L T P C

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

214
UNIT III  DESIGN AND TESTING

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

UNIT V  BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY

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

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

REFERENCES:

TOTAL: 45 PERIODS
CBM333 ASSISTIVE TECHNOLOGY

OBJECTIVES:
The student should be made to:
- To know the hardware requirement various assistive devices
- To understand the prosthetic and orthotic devices
- To know the developments in assistive technology

UNIT I CARDIAC ASSIST DEVICES
Cardiac functions and parameters, principle of External counter pulsation techniques, intra aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, cardiac pacemaker.

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

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

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

UNIT V RECENT TRENDS
Transcutaneous electrical nerve stimulator, bio-feedback, assistive devices in drug delivery

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

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OMA352 OPERATIONS RESEARCH

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

UNIT IV DYNAMIC PROGRAMMING PROBLEMS

UNIT V NON-LINEAR PROGRAMMING PROBLEMS

TOTAL:45 PERIODS

OUTCOMES:
At the end of the course, students will be able to
- Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.
- Analyze the concept of developing, formulating, modeling and solving transportation and assignment problems.
- Solve the integer programming problems using various methods.
- Conceptualize the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming.
- Determine the optimum solution for non-linear programming problems.

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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

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

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

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS :

REFERENCES:
COURSE OBJECTIVES:

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

UNIT I MATRICES AND SYSTEM OF LINEAR EQUATIONS 9

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

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

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

UNIT V EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION 9

TOTAL : 45 PERIODS

COURSE OUTCOMES:
After the completion of the course the student will be able to
1. Test the consistency and solve system of linear equations.
2. Find the basis and dimension of vector space.
3. Obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
4. Find orthonormal basis of inner product space and find least square approximation.
5. Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.
TEXT BOOKS

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OBT352 BASICS OF MICROBIAL TECHNOLOGY L T P C 3 0 0 3

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

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

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

UNIT III PATHOGENIC MICROBES 9
Infectious Disease – Awareness, Causative agent, Prevention and control - Cholera, Dengu, Malaria, Diarrhea, Tuberculosis, Typhoid, Covid, HIV.
UNIT IV  BENEFICIAL MICROBES  9
Applications of microbes – Clinical microbiology, agricultural microbiology, Food Microbiology, Environmental Microbiology, Animal Microbiology, Marine Microbiology.

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to
1. Microbes and their types
2. Cultivation of microbes
3. Pathogens and control measures for safety
4. Microbes in different industry for economy.

TEXT BOOKS

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

OBJECTIVES:
• The objective is to offer basic concepts of biochemistry to students with diverse background in life sciences including but not limited to the structure and function of various biomolecules and their metabolism.

UNIT I  CARBOHYDRATES  9
Introduction to carbohydrate, classification, properties of monosaccharide, structural aspects of monosaccharides. Introduction to disaccharide (lactose, maltose, sucrose) and polysaccharide (Heparin, starch, and glycogen) biological function of carbohydrate.

UNIT II  LIPID AND FATTY ACIDS  9
Introduction to lipid, occurrence, properties, classification of lipid. Importance of phospholipids, sphingolipid and glycerolipid. Biological function of lipid. Fatty acid, Introduction, Nomenclature and classification of fatty acid Essential and non essential fatty acids.
UNIT III  AMINO ACIDS AND PROTEIN.

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

UNIT V  VITAMINS AND HORMONES

OUTCOMES:
- Students will learn about various kinds of biomolecules and their physiological role.
- Students will gain knowledge about various metabolic disorders and will help them to know the importance of various biomolecules in terms of disease correlation.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

OBT354  FUNDAMENTALS OF CELL AND MOLECULAR BIOLOGY

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

UNIT I  INTRODUCTION TO CELL
Cell, cell wall and Extracellular Matrix (ECM), composition, cellular dimensions, Evolution, Organisation, differentiation of prokaryotic and Eukaryotic cells, Virus, bacteria, cyanobacteria, mycoplasma and prions.
UNIT II  CELL ORGANELLES  
Molecular organisation, biogenesis and function Mitochondria, endoplasmic reticulum, golgi apparatus, plastids, chloroplast, leucoplast, centrosome, lysosome, ribosome, peroxisome, Nucleus and nucleolus. Endo membrane system, concept of compartmentalisation.

UNIT III  BIO-MEMBRANE TRANSPORT  

UNIT IV  CELL CYCLE  
Cell cycle- Cell division by mitosis and meosis, Comparision of meosis and mitosis, regulation of cell cycle, cell lysis, Cytokinesis, Cell signaling, Cell communication, Cell adhesion and Cell junction, cell cycle checkpoints.

UNIT V  CENTRAL DOGMA  

TOTAL: 45 PERIODS

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

TEXTBOOKS:

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

UNIT I

UNIT II

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

UNIT IV

UNIT V

OUTCOMES
By the end of the course, learners will be able to
- Write effective project reports.
- Use statistical tools with confidence.
- Explain the purpose and intention of the proposed project coherently and with clarity.
- Create writing texts to suit achieve the intended purpose.
- Master the art of writing winning proposals and projects.
### CO-PO & PSO MAPPING

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

### REFERENCES:


### OMA355 ADVANCED NUMERICAL METHODS

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#### UNIT I ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEM


#### UNIT II INTERPOLATION

Central difference: Stirling and Bessel's interpolation formulæ; Piecewise spline interpolation: Piecewise linear, piecewise quadratic and cubic spline; Least square approximation for continuous data (upto 3rd degree).

#### UNIT III NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS


#### UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS

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

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


**TOTAL : 45 PERIODS**
TEXT BOOKS:

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OMA356 RANDOM PROCESSES        LTTPC     3003

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.

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

TEXT BOOKS

REFERENCES
OBJECTIVES:
- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the concept of queueing models and apply in engineering.
- To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.
- To study the system reliability and hazard function for series and parallel systems.
- To implement Markovian Techniques for availability and maintainability which opens up new avenues for research.

UNIT I RANDOM PROCESSES

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

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

UNIT IV SYSTEM RELIABILITY

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

TOTAL: 45 PERIODS

OUTCOMES
Upon successful completion of the course, students should be able to:
- Enable the students to apply the concept of random processes in engineering disciplines.
- Students acquire skills in analyzing various queueing models.
- Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.
- Students can analyze reliability of the systems for various probability distributions.
- Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach.

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OMG354 PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS

OBJECTIVES:
- To know the basic concept and function of Production and Operation Management for entrepreneurship.
- To understand the Production process and planning.
- To understand the Production and Operations Management Control for business owners.

UNIT I INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT
Functions of Production Management - Relationship between production and other functions – Production management and operations management, Characteristics of modern production and operation management, organisation of production function, recent trends in production /operations management - production as an organisational function, decision making in production Operations research

UNIT II PRODUCTION & OPERATION SYSTEMS
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
Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of production process systems – Steps for production process- Production Planning Control Functions – Planning phase-Action phase- Control phase - Aggregate production planning

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS
UNIT V CONTROLLING PRODUCTION & OPERATIONS MANAGEMENT
9

TOTAL 45 : PERIODS

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

REFERENCES

OCE354 BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT 3 0 0 3

OBJECTIVES
- To introduce the interdisciplinary approach of water management.
- To develop knowledge base and capacity building on IWRM.

UNIT I OVERVIEW OF IWRM

UNIT II WATER USE SECTORS: IMPACTS AND SOLUTION
Water users: People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management.

UNIT III WATER ECONOMICS
Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management - PPP experiences through case studies.

UNIT IV RECENT TRENDS IN WATER MANAGEMENT
River basin management - Ecosystem Regeneration – 5 Rs - WASH - Sustainable livelihood - Water management in the context of climate change.
UNIT V IMPLEMENTATION OF IWRM
Barriers to implementing IWRM - Policy and legal framework - Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.

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).

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

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

UNIT I INTRODUCTION
Uni-variate, Bi-variate and Multi-variate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation.

UNIT II PREPARING FOR MULTIVARIATE ANALYSIS
Conceptualization of research model with variables, collection of data — Approaches for dealing with missing data – Testing the assumptions of multivariate analysis.

UNIT III MULTIPLE LINEAR REGRESSION ANALYSIS, FACTOR ANALYSIS
Multiple Linear Regression Analysis – Inferences from the estimated regression function – Validation of the model. - Approaches to factor analysis – interpretation of results.
OUTCOMES:
- Demonstrate a sophisticated understanding of the concepts and methods; know the exact scopes and possible limitations of each method; and show capability of using multivariate techniques to provide constructive guidance in decision making.
- Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.
- Show substantial understanding of the real problems; conduct deep analysis using correct methods; and draw reasonable conclusions with sufficient explanation and elaboration.
- Write an insightful and well-organized report for a real-world case study, including thoughtful and convincing details.
- Make better business decisions by using advanced techniques in data analytics.

REFERENCES:

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

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

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

OUTCOMES:
On completion of this course, the student is expected to be able to
CO1 Explains the contemporary management techniques and the issues in present scenario.
CO2 Apply the basics of lean management principles and their evolution from manufacturing industry to construction industry.
CO3 Develops a better understanding of core concepts of lean construction tools and techniques and their importance in achieving better productivity.
CO4 Apply lean techniques to achieve sustainability in construction projects.
CO5 Apply lean construction techniques in design and modeling.

REFERENCES:

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 9

UNIT II VAT POLYMERIZATION AND MATERIAL EXTRUSION 9

UNIT III POWDER BED FUSION AND BINDER JETTING 9

UNIT IV MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION 9

UNIT V SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY 9
Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course students shall be able to:
CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.
CO2: Acquire knowledge on process vat polymerization and material extrusion processes and its applications.
CO3: Elaborate the process and applications of powder bed fusion and binder jetting.
CO4: Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.
CO5: Acquire knowledge on sheet lamination and direct write technology.

TEXT BOOKS:

REFERENCES:
OME343  NEW PRODUCT DEVELOPMENT  L  T  P  C
3  0  0  3

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

UNIT – I  FUNDAMENTALS OF NPD

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

UNIT – III  ESSENTIALS OF NPD

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

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

TOTAL :45 PERIODS

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

1. Discuss fundamental concepts and customer specific requirements of the New Product development
2. Discuss the Material specification standards, analysis and fabrication, manufacturing process.
3. Develop Feasibility Studies & reporting of New Product development
4. Analyzing the New product qualification and Market Survey on similar products of new product development
5. Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

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

REFERENCES:
1. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark
2. Change by Design
5. Product Design & Value Engineering – Dr. M.A. Bulsara &Dr. H.R. Thakkar

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OME355 INDUSTRIAL DESIGN & RAPID PROTOTYPING TECHNIQUES

OBJECTIVES:
The course aims to

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

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

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

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS
3. Steve Krug, Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability,
   Pearson,3rd edition(2014)

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
- Select suitable precision machine tools and operate
- Apply the macro and micro components for fabrication of micro systems.
- Apply suitable machining process
- Able to work with miniature models of existing machine tools/robots and other instruments.
- Apply metrology for micro system

TEXT BOOKS:
REFERENCES:

OMF354 COST MANAGEMENT OF ENGINEERING PROJECTS LT P C
3 0 0 3

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

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

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

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

UNIT – IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL

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

TOTAL: 45 PERIODS
COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand the costing concepts and their role in decision making.
CO2: Understand the project management concepts and their various aspects in selection.
CO3: Interpret costing concepts with project execution.
CO4: Gain knowledge of costing techniques in service sector and various budgetary control techniques.
CO5: Become familiar with quantitative techniques in cost management.

TEXT BOOKS:

REFERENCES:

AU3002 BATTERIES AND MANAGEMENT SYSTEM L T P C
3 0 0 3

COURSE OBJECTIVES:
The objective of this course is to make the students 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.

UNITIII BATTERY MODELLING
Battery Modelling Methods-Equivalent Circuit Models, Electrochemical Model, Neural Network Model. ECM Comparisons- Rint model, Thevenin model, PNGV model. State space Models- Introduction. Battery Modelling software/simulation frameworks
UNIT IV  BATTERY STATE ESTIMATION  

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

TOTAL =45 PERIODS

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Acquire knowledge of different Li-ion Batteries performance.
2. Design a Battery Pack and make related calculations.
3. Demonstrate a Battery Model or Simulation.
5. Approach different BMS architectures during real world usage.

TEXT BOOKS

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

AU3008  SENSORS AND ACTUATORS  L T P C
3 0 0 3

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

UNIT III VARIABLE AND OTHER SPECIAL SENSORS
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostriective, 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.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. List common types of sensor and actuators used in vehicles.
2. Design measuring equipment's for the measurement of pressure force, temperature and flow.
3. Generate new ideas in designing the sensors and actuators for automotive application
4. Understand the operation of these sensors, actuators and electronic control.
5. Design temperature control actuators for vehicles.

TEXT BOOKS:

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

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

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

UNIT III  ENGINE SYSTEMS, CONTROLS, AND INTEGRATION

UNIT IV  THRUST VECTOR CONTROL
TVC Mechanisms with a Single Nozzle – TVC with Multiple Thrust Chambers or Nozzles – Testing – Integration with Vehicle – SITVC method – other jet control methods - exhaust plume problems in space environment

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

TOTAL: 45 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
- Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.
- Apply knowledge in selecting the appropriate rocket propulsion systems.
- Interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.
- Analyze aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.
- Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.
COURSE OBJECTIVES:
Of this course are
- To introduce fundamental concepts of management and organization to students.
- To impart knowledge to students on various aspects of marketing, quality control and marketing strategies.
- To make students familiarize with the concepts of human resources management.
- To acquaint students with the concepts of project management and cost analysis.
- To make students familiarize with the concepts of planning process and business strategies.

UNIT I  INTRODUCTION TO MANAGEMENT AND ORGANISATION  9

UNIT II  OPERATIONS AND MARKETING MANAGEMENT  9

UNIT III  HUMAN RESOURCES MANAGEMENT  9
Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager:Manpower planning, Recruitment, Selection, TrainingandDevelopment, WageandSalaryAdministration, Promotion, Transfer, PerformanceAppraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating –Capability Maturity Model (CMM)Levels.

UNIT IV  PROJECT MANAGEMENT  9
Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

UNIT V  STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES  9

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of the course, Students will be able to
CO1: Plan an organizational structure for a given context in the organization to carryout 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.

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TEXT BOOKS:

REFERENCES:

OIM353 PRODUCTION PLANNING AND CONTROL L T P C 3 0 0 3

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

UNIT I INTRODUCTION
Objectives and benefits of planning and control-Functions of production control-Types of production job- batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration-Standardization, Simplification & specialization- Break even analysis-Economics of a new design.
UNIT II WORK STUDY
Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING
Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

UNIT IV PRODUCTION SCHEDULING

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

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).

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OIE353 OPERATIONS MANAGEMENT L T P C 3 0 0 3

COURSE OBJECTIVE:
- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm’s competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
- Relate the interdependence of the operations function with the other key functional areas of a firm.
- Teach analytical skills and problem-solving tools to the analysis of the operations problems.
- Apply scheduling and Lean Concepts for improving System Performance.

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

UNIT II FORECASTING, CAPACITY AND FACILITY DESIGN

UNIT III DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS
UNIT IV MATERIALS MANAGEMENT


UNIT V SCHEDULING AND PROJECT MANAGEMENT

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

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

CO3: The students will able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.

CO4: The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.

CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance.

CO’s- PO’s & PSO’s MAPPING

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TEXT BOOKS


REFERENCES

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

UNIT I INTRODUCTION AND SCOPE

UNIT II MONITORING FOR SAFETY, HEALTH & ENVIRONMENT
Occupational Health and Environment Safety Management System, ILO and EPA Standards Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.

UNIT III OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION

UNIT IV OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT

UNIT V INDUSTRIAL HAZARDS

TOTAL: 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
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 BOOKS:

REFERENCES:
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OML352       ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS   L T P C   3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
- Understanding the importance of various materials used in electrical, electronics and magnetic applications
- Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
- Gaining knowledge on the selection of suitable materials for the given application
- Knowing the fundamental concepts in Semiconducting materials
- Getting equipped with the materials used in optical and optoelectronic applications.

UNIT I      DIELECTRIC MATERIALS
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics. Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

UNIT II     MAGNETIC MATERIALS
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis

UNIT III    SEMICONDUCTOR MATERIALS
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, bimetal fusrs, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.
UNIT V  OPTICAL AND OPTOELECTRONIC MATERIALS


TOTAL: 45 PERIODS

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

- Understand various types of dielectric materials, their properties in various conditions.
- Evaluate magnetic materials and their behavior.
- Evaluate semiconductor materials and technologies.
- Select suitable materials for electrical engineering applications.
- Identify right material for optical and optoelectronic applications

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OML353  NANOMATERIALS AND APPLICATIONS

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications
2. Gaining knowledge on dimensionality effects on different properties of nanomaterials

254
3. Getting acquainted with the different processing techniques employed for fabricating nanomaterials
4. Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
5. Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

UNIT I  NANOMATERIALS  
Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.

UNIT II  THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS  
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.

UNIT III  PROCESSING  
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.

UNIT IV  STRUCTURAL CHARACTERISTICS  
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis.

UNIT V  APPLICATIONS  
Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
1. Evaluate nanomaterials and understand the different types of nanomaterials
2. Recognise the effects of dimensionality of materials on the properties
3. Process different nanomaterials and use them in engineering applications
4. Use appropriate techniques for characterising nanomaterials
5. Identify and use different nanomaterials for applications in different engineering fields.

TEXT BOOKS:

REFERENCES:

255
OMR352 HYDRAULICS AND PNEUMATICS  L  T  P  C
3 0 0 3

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 9
Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids -
Properties of fluids and selection – Basics of Hydraulics – Pascal’s Law – Principles of flow - Friction
loss – Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory – Pump
Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection
criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9
Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic
motors - Control Components : Direction Control, Flow control and pressure control valves – Types,
Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs,

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump,
Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control,
Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9
Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control
Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method –
Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and
pneumatic logic circuits

256
UNIT V  TROUBLE SHOOTING AND APPLICATIONS


TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO 1: Analyze the methods in fluid power principles and working of hydraulic pumps
CO 2: Recognize the concepts in hydraulic actuators and control components
CO 3: Obtain the knowledge in basics of hydraulic circuits and systems
CO 4: Know about the basics concept in pneumatic and electro pneumatic systems
CO 5: Apply the concepts to solve the trouble shooting hydraulic and pneumatics

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TEXT BOOKS

REFERENCES:
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.

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1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS:

REFERENCES:

ORA352 CONCEPTS IN MOBILE ROBOTS
L T P C
3 0 0 3

COURSE OBJECTIVES
1. To introduce mobile robotic technology and its types in detail.
2. To learn the kinematics of wheeled and legged robot.
3. To familiarize the intelligence into the mobile robots using various sensors.
4. To acquaint the localization strategies and mapping technique for mobile robot.
5. To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT – I INTRODUCTION TO MOBILE ROBOTICS
UNIT – II KINEMATICS

UNIT – III PERCEPTION

UNIT – IV LOCALIZATION

UNIT – V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Evaluate the appropriate mobile robots for the desired application.
CO2: Create the kinematics for given wheeled and legged robot.
CO3: Analyse the sensors for the intelligence of mobile robotics.
CO4: Create the localization strategies and mapping technique for mobile robot.
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.

TEXT BOOKS

REFERENCES:
COUrSE OBJECTIVES:

1. To impart knowledge on basics of propulsion system and ship dynamic movements
2. To educate them on basic layout and propulsion equipment's
3. To impart basic knowledge on performance of the ship
4. To impart basic knowledge on Ship propeller and its types
5. To impart knowledge on ship rudder and its types

UNIT I    BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS

- law of floatation
- Basics principle of propulsion
- Earlier methods of propulsion
- ship propulsion machinery
- boiler, Marine steam engine, diesel engine, ship power transmission system, ship dynamic structure
- Marine propulsion equipment
- shaft tunnel, Intermediate shaft and bearing, stern tube, stern tube sealing etc.
- degree of freedom, Modern propelling methods
- water jet propulsion, screw propulsion.

UNIT II    SHIPS MOVEMENTS AND SHIP STABILIZATION

- Thrust augmented devices
- Ship hull, modern ship propulsion design, bow thruster
- Advantages, various methods to stabilize the ship
- passive and active stabilizer, fin stabilizer, bilge keel
- stabilizing and securing ship in port
- effect of tides on ship
- effect of river water and sea water sailing vessel,
- Load line and load line of marking draught markings.

UNIT III    SHIPS SPEED AND ITS PERFORMANCE

- Ship propulsion factors, factors affecting ships speed, various velocities of ship
- hull drag, effects of fouling on ships hull, ship wake, relation between powers, Fuel consumption of ship
- cavitations and its effects of cavitation’s, ship turning radius.

UNIT IV    BASICS OF PROPELLER

- 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 propeller. Propeller Material – Propeller balancing
- static and dynamic.

UNIT V    BASICS OF RUDDER

- Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings
- Rudder pintle
- Rudder types
- Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits of various types of rudders,
- Propeller and rudder interaction, Rudder stopper, movement of rudders
- Basic construction of Rudder

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the basics of propulsion system and ship dynamic movements
CO2: Familiarize with various components assisting ship stabilization.
CO3: Demonstrate the performance of the ship.
CO4: Classify the Propeller and its types, Materials etc.
CO5: Categories the Rudder and its types, design criteria of rudder.
TEXT BOOKS:
1. GP. Ghose, “Basic Ship propulsion”, 2015

REFERENCES BOOKS:

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OMV351 MARINE MERCHANT VESSELS LT P C 3 0 0 3

OBJECTIVES:
At the end of the course, students are expected to acquire
1. Knowledge on basics of Hydrostatics
2. Familiarization on types of merchant ships
3. Knowledge on Shipbuilding Materials
4. Knowledge on marine propeller and rudder
5. Awareness on governing bodies in shipping industry

UNIT I  INTRODUCTION TO HYDROSTATICS  9
Archimedes Principle- Laws of floatation– Meta centre – stability of floating and submerged bodies-
Density, relative density - Displacement –Pressure –centre of pressure.

UNIT II  TYPES OF SHIP  10
General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers-
Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gas carriers - Chemical tankers -
Passenger ships

UNIT III  SHIPBUILDING MATERIALS  9
Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel sandwich
panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys, Aluminium alloy
sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced Composites

262
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

OUTCOMES:
Upon completion of this course, students would
1. Acquire Knowledge on floatation of ships
2. Acquire Knowledge on features of various ships
3. Acquire Knowledge of Shipbuilding Materials
4. Acquire Knowledge to identify the different types of marine propeller and rudder
5. Understand the Roles and responsibilities of governing bodies

TEXT BOOKS:
2. Dr.DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006

REFERENCES:
2. MARPOL Consolidated Edition, Bhandakar Publications, 2018

OMV352  ELEMENTS OF MARINE ENGINEERING  L T P C

OBJECTIVES:
At the end of the course, students are expected to
1. Understand the role of Marine machinery systems
2. Be familiar with Marine propulsion machinery system
3. Acquaint with Marine Auxiliary machinery system
4. Have acquired basics of Marine Auxiliary boiler system
5. Be aware of ship propellers and steering system

UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS
Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems
UNIT II    MARINE PROPULSION MACHINERY SYSTEM
Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system

UNIT III    MARINE AUXILIARY MACHINERY SYSTEM
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications

UNIT IV    MARINE BOILER SYSTEM
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories

UNIT V    SHIP PROPELLERS AND STEERING MECHANISM
Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, students should able to,
1. Distinguish the role of various marine machinery systems
2. Relate the components of marine propulsion machinery system
3. Explain the importance of marine auxiliary machinery system
4. Acquire knowledge of marine boiler system
5. Understand the importance of ship propellers and steering system

TEXT BOOKS:

REFERENCES:
1. Alan L.Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006
2. A.S.Tambwekar, “Naval Architecture and Ship Construction”, The Institute of Marine Engineers (India), Mumbai, 2015
CRA332  DRONE TECHNOLOGIES  L  T  P  C
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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
CO4: Create the programs for various drones
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</tbody>
</table>

1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS

REFERENCES

OGI352 GEOGRAPHICAL INFORMATION SYSTEM 3 0 0 3

OBJECTIVES:
To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.

UNIT I FUNDAMENTALS OF GIS

UNIT II SPATIAL DATA MODELS

UNIT III DATA INPUT AND TOPOLOGY
UNIT IV  DATA QUALITY AND STANDARDS
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure

UNIT V  DATA MANAGEMENT AND OUTPUT
Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS- distributed GIS.

TOTAL:45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to
CO1 Have basic idea about the fundamentals of GIS.
CO2 Understand the types of data models.
CO3 Get knowledge about data input and topology
CO4 Gain knowledge on data quality and standards
CO5 Understand data management functions and data output

TEXT BOOKS:

REFERENCES:

CO – PO – PSO MAPPING: GEOGRAPHIC INFORMATION SYSTEM

<table>
<thead>
<tr>
<th>PO</th>
<th>Graduate Attribute</th>
<th>Course Outcome</th>
<th>Average</th>
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<tr>
<td>PO1</td>
<td>Engineering Knowledge</td>
<td>CO1 3</td>
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<td>Problem Analysis</td>
<td>CO2 3</td>
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<tr>
<td>PO3</td>
<td>Design/Development of Solutions</td>
<td>CO3 3</td>
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<td>PO4</td>
<td>Conduct Investigations of Complex Problems</td>
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<td>PO5</td>
<td>Modern Tool Usage</td>
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<tr>
<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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<tr>
<td>PSO1</td>
<td>Knowledge of Geoinformatics discipline</td>
<td>CO1 3</td>
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<tr>
<td>PSO2</td>
<td>Critical analysis of Geoinformatics</td>
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<tr>
<td></td>
<td>Engineering problems and innovations</td>
<td>CO2 3</td>
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</table>

PSO 1 Knowledge of Geoinformatics discipline
PSO 2 Critical analysis of Geoinformatics Engineering problems and innovations

TOTAL:45 PERIODS
OBJECTIVES
- To introduce the importance of Agri-business management, its characteristics and principles
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.

UNIT I ENTREPRENEURIAL ENVIRONMENT IN INDIAN CONTEXT
Entrepreneur Development (ED): Concept of entrepreneur and entrepreneurship assessing overall business environment in Indian economy- Entrepreneurial and managerial characteristics- Entrepreneurship development programmers (EDP)- Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment.

UNIT II AGRIPRNEURSHIP IN GLOBAL ARENA: LEGAL PERSPECTIVE
Importance of agribusiness in Indian economy - International trade-WTO agreements- Provisions related to agreements in agricultural and food commodities - Agreements on Agriculture (AOA)- Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS).

UNIT III ENTREPRENEURSHIP MANAGEMENT: FINANCIAL PERSPECTIVE

UNIT IV ENTREPRENEURIAL OPPORTUNITIES: ECONOMIC GROWTH PERSPECTIVE
Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country- Overview of Indian social, political system and their implications for decision making by individual entrepreneurs- Economic system and its implication for decision making by individual entrepreneurs.

UNIT V ENTREPRENEURIAL PROMOTION MEASURES AND GOVERNMENT SUPPORT
Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis- Government schemes and incentives for promotions of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract framing (CF) and Joint Venture (JV), public-private partnerships (PPP) - overview of agricultural engineering industry, characteristics of Indian farm machinery industry.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
1. Judge about agricultural finance, banking and cooperation
2. Evaluate basic concepts, principles and functions of financial management
3. Improve the skills on basic banking and insurance schemes available to customers
4. Analyze various financial data for efficient farm management
5. Identify the financial institutions

TEXT BOOKS:

REFERENCES:

CO-PO MAPPING

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
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<th>CO4</th>
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<td>Design/ Development of Solutions</td>
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<td>PO4</td>
<td>Conduct Investigations of Complex Problems</td>
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<td>Modern Tool Usage</td>
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<tr>
<td>PO6</td>
<td>The Engineer and Society</td>
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<td>Individual and team work:</td>
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<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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PSO2
To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.  

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PSO3
To inculcate entrepreneurial skills through strong Industry-Institution linkage.  

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OEN352 BIODIVERSITY CONSERVATION L T P C 3 0 0 3

OBJECTIVE:
The identification of different aspects of biological diversity and conservation techniques.

UNIT I INTRODUCTION Concept of Species, Variation; Introduction to Major Plant Groups; Evolutionary relationships between Plant Groups; Nomenclature and History of plant taxonomy; Systems of Classification and their Application; Study of Plant Groups; Study of Identification Characters; Study of important families of Angiosperms; Plant Diversity Application.

UNIT II INTRODUCTION TO ANIMAL DIVERSITY AND TAXONOMY Principles and Rules of Taxonomy; ICZN Rules, Animal Study Techniques; Concepts of Taxon, Categories, Holotype, Paratype, Topotype etc; Classification of Animal kingdom, Invertebrates, Vertebrates, Evolutionary relationships between Animal Groups.

UNIT III MICROBIAL DIVERSITY Microbes and Earth History, Magnitude, Occurrence and Distribution. Concept of Species, Criteria for Classification, Outline Classification of Microorganisms (Bacteria, Viruses and Protozoa); Criteria for Classification and Identification of Fungi; Chemical and Biochemical Methods of Microbial Diversity Analysis

UNIT IV MEGA DIVERSITY Biodiversity Hot-spots, Floristic and Faunal Regions in India and World; IUCN Red List; Factors affecting Diversity, Impact of Exotic Species and Human Disturbance on Diversity, Dispersal, Diversity-Stability Relationship; Socio-economic Issues of Biodiversity; Sustainable Utilization of Bioresources; National Movements and International Convention/Treaties on Biodiversity.

UNIT V CONSERVATIONS OF BIODIVERSITY In-Situ Conservation- National parks, Wildlife sanctuaries, Biosphere reserves; Ex-situ conservation- Gene bank, Cryopreservation, Tissue culture bank; Long term captive breeding, Botanical gardens, Animal Translocation, Zoological Gardens; Concept of Keystone Species, Endangered Species, Threatened Species, Rare Species, Extinct Species

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

OUTCOMES:
Upon successful completion of this course, students will:
CO1: An insight into the structure and function of diversity for ecosystem stability.
CO2: Understand the concept of animal diversity and taxonomy
CO3: Understand socio-economic issues pertaining to biodiversity
CO4: An understanding of biodiversity in community resource management.
CO5: Student can apply fundamental knowledge of biodiversity conservation to solve problems associated with infrastructure development.

CO’s- PO’s & PSO’s MAPPING

<table>
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<tr>
<th>CO’s</th>
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1:low, 2:medium, 3:high, "": no correlation
Note: The average value of this course to be used for program articulation matrix.

OEE353 INTRODUCTION TO CONTROL SYSTEMS L T P C
3 0 0 3

OBJECTIVES
- To impart knowledge on various representations of systems.
- To familiarize time response analysis of LTI systems and steady state error.
- To analyze the frequency responses and stability of the systems.
- To analyze the stability of linear systems in frequency domain and time domain.
- To develop linear models mainly state variable model and transfer function model.

UNIT I MATHEMATICAL MODELS OF PHYSICAL SYSTEMS 9
Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction–Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS & ROOTLOCUS TECHNIQUE 9
UNIT III FREQUENCY RESPONSE ANALYSIS 9
Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV STABILITY CONCEPTS & ANALYSIS 9

UNIT V STATE VARIABLE ANALYSIS 9
Concept of state – State Variable & State Model – State models for linear & continuous time systems—Solution of state & output equation—controllability & observability.

TOTAL: 45 PERIODS

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.
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) 5
1. Market survey of the recent PLCs and comparison of their features.
2. Summarize the PLC standards
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)

COURSE OUTCOMES:
Students able to
CO1 Design a signal conditioning circuits for various application (L3).
CO2 Acquire a detail knowledge on data acquisition system interface and DCS system (L2).
CO3 Understand the basics and Importance of communication buses in applied automation Engineering (L2).
CO4 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block. (L3)

CO5 Able to develop a PLC logic for a specific application on real world problem. (L5)

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1. https://archive.nptel.ac.in/courses/108/105/108105062/
2. https://nptel.ac.in/courses/108105063

CO's- PO's & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO's</th>
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<th>PSO's</th>
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OCH353 ENERGY TECHNOLOGY L T P C
UNIT I INTRODUCTION
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources

UNIT II CONVENTIONAL ENERGY
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.
UNIT III  NON-CONVENTIONAL ENERGY  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, magnetohydrodynamic 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

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
   1981.
## Course articulation matrix

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statements</th>
<th>Program Outcomes</th>
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<tr>
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<td>Statements</td>
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<tr>
<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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<tr>
<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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</tr>
<tr>
<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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<td>OVERALL CO</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE:
- To enable the students to analyze properties of surfaces and correlate them to structure, chemistry, and physics and surface modification technique.

UNIT I  SURFACE STRUCTURE AND EXPERIMENTAL PROBES  9
Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, absobrate structure, Band and Vibrational structure, Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy

UNIT II  ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT SURFACES  9
Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods

UNIT III  LIQUID INTERFACES  9
Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells

UNIT IV  HETEROGENEOUS CATALYSIS  9
Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, 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  9

TOTAL: 45 PERIODS

OUTCOME:
- Upon completion of this course, the students can understand, predict and design surface properties based on surface structure. Students would understand the physics and chemistry behind surface phenomena

TEXT BOOK:

REFERENCE:
OBJECTIVES:
The course aims to
- Acquaint and equip the students with different techniques of measurement of engineering properties.
- Make the students understand the nature of food constituents in the design of processing equipment

UNIT I
Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.

UNIT II
Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foammat dryers

UNIT III
Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger’s, Kick’s and Bond’s equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping)

UNIT IV
Mixing: theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for low- or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids.

UNIT V
Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine, Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids, Membrane separation: General considerations, materials for membrane construction, ultra-filtration, microfiltration, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, pervaporation 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.

TEXT BOOKS:

OFD355 FOOD SAFETY AND QUALITY REGULATIONS L T P C
3 0 0 3

OBJECTIVES:
• To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
• To help become skilled in systems for food safety surveillance
• To be aware of the regulatory and statutory bodies in India and the world
• To ensure processed food meets global standards

UNIT I
Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labeling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection, ISO 22000 – Importance and Implementation

UNIT II
Food quality: Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities.

UNIT III
Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system. Food inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system to monitor food safety, risk communication

UNIT IV
Indian and global regulations: FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)
UNIT V
Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1 Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments
CO2 Awareness on regulatory and statutory bodies in India and the world

REFERENCES:
1. Handbook of food toxicology by S. S. Deshpande, 2002
2. The food safety information handbook by Cynthia A. Robert, 2009
4. Microbiological safety of Food by Hobbs BC, 1973

OPY353 NUTRACEUTICALS L T P C
3 0 0 3

OBJECTIVES:
- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease.

UNIT I INTRODUCTION AND SIGNIFICANCE
Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoochemicals and microbes in food, plants, animals and microbes.

UNIT II PHYTOCHEMICALS AS NUTRACEUTICALS
Phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, lycopene, chitin, carotenoids. Manufacturing practice of selected nutraceuticals such as lycopene, isoflavonoids, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals - stability, analytical and labelling issues.

UNIT III ASSESSMENT OF ANTIOXIDANT ACTIVITY
In vitro and in vivo methods for the assessment of antioxidant activity, Comparison of different in vitro methods to evaluate the antioxidant, antioxidant mechanism, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

UNIT IV ROLE IN HEALTH AND DISEASE
The health benefit of - Soy protein, Spirulina, Tea, Olive oil, plant sterols, Broccoli, omega3 fatty acid and eicosanoids. Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and synbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.
UNIT V  SAFETY ISSUES

Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues International and national.

TOTAL: 45 PERIODS

TEXT BOOKS:
3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006

REFERENCES:
1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007

COURSE OUTCOME - NUTRACEUTICALS

CO 1    Acquire knowledge about the nutraceuticals and functional foods, their classification and benefits.
CO 2    Acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes
CO 3    Attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods.
CO 4    Distinguish the various 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.

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CO – PO MAPPING
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

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

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
2. Dr. N N Mahapatra., “Textile dyeing”, Wood head publishing India, 2018
4. Bleaching & Mercerizing – BTRA Silver Jubilee Monograph series
COURSE ARTICULATION MATRIX:

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

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FT 3201            FIBRE SCIENCE  L T P C  3 0 0 3

COURSE OBJECTIVES

- To enable the students to learn about the types of fibre and its properties

UNIT I  INTRODUCTION TO TEXTILE FIBRES  9
Definition of various forms of textile fibres - staple fibre, filament, bicomponent fibres. Classification of Natural and Man-made fibres, essential and desirable properties of Fibres. Production and cultivation of Natural Fibers: Cotton, Silk, Wool -Physical and chemical structure of the above fibres.

UNIT II  REGENERATED FIBRES  9
Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel, Tencel

UNIT III  SYNTHETIC FIBRES  9
Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass, carbon. Introduction to spin finishes and texturization
UNIT IV  SPECIALITY FIBRES
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.

COURSE OUTCOMES
Upon completion of this course, the student would be able to
• Understand the process sequence of various fibres
• Understand the properties of various fibres

TEXT BOOKS:

REFERENCES:

OTT355  GARMENT MANUFACTURING TECHNOLOGY  L T P C
OBJECTIVE:
• To enable the students to understand the basics of pattern making, cutting and sewing.
• To expose the students to various problems & remedies during garment manufacturing

UNIT I  PATTERN MAKING, MARKER PLANNING, CUTTING
Anthropometry, specification sheet, pattern making – principles, basic pattern set drafting, grading, marker planning, spreading & cutting

UNIT II  TYPES OF SEAMS, STITCHES AND FUNCTIONS OF NEEDLES
Different types of seams and stitches; single needle lock stitch machine – mechanism and accessories; needle – functions, special needles, needlepoint
UNIT III COMPONENTS AND TRIMS USED IN GARMENT
Sewing thread-construction, material, thread size, packages, accessories – labels, linings, interlinings, wadding, lace, braid, elastic, hook and loop fastening, shoulder pads, eyelets and laces, zip fasteners, buttons

UNIT IV GARMENT INSPECTION AND DIMENSIONAL CHANGES
Raw material, in process and final inspection; needle cutting; sewability of fabrics; strength properties of apparel; dimensional changes in apparel due to laundering, dry-cleaning, steaming and pressing.

UNIT V GARMENT PRESSING, PACKING AND CARE LABELING
Garment pressing – categories and equipment, packing; care 285abelling of apparels

OUTCOMES:
Upon completion of the course, the students will be able to Understand
CO1: Pattern making, marker planning, cutting
CO2: Types of seams, stitches and functions of needles
CO3: Components and trims used in garment
CO4: Garment inspection and dimensional changes
CO5: Garment pressing, packing and care 285abelling

TOTAL: 45 PERIODS

TEXT BOOKS:
2. Gerry Cooklin, “Introduction to Clothing Manufacture” Blackwell Science Ltd., 1995. 64

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OBJECTIVES:

- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen’s Compensation and other laws) enacted for the protection of employees health at work settings.
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards.

UNIT I  INTRODUCTION  9
Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.

UNIT II  OCCUPATIONAL HEALTH AND HYGIENE  9

UNIT III  WORKPLACE SAFETY AND SAFETY SYSTEMS  9

UNIT IV  HAZARDS AND RISK MANAGEMENT  9

UNIT V  ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT  9

TOTAL: 45 PERIODS

OUTCOMES:

After completion of this course, the student is expected to be able to:

- Describe, with example, the common work-related diseases and accidents in occupational setting
- Name essential members of the Occupational Health team
- What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee
OBJECTIVES:
- To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.

UNIT I  FLUID MECHANICS CONCEPTS
Fluid definition and classification of fluids, types of fluids, Rheological behaviour of fluids & Newton’s Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems),Basic equations of fluid flow - Continuity equation, Euler’s equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits - Hagen Poiseuille equation (no derivation). Flow through stagnant fluids – theory of Settling and Sedimentation – Equipment (cyclones, thickeners) Conceptual numericals.

UNIT II  FLOW MEASUREMENTS & MECHANICAL OPERATIONS

UNIT III  CONDUCTIVE & CONVECTIVE HEAT TRANSFER
Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).

UNIT IV  BASICS OF MASS TRANSFER

UNIT V  MASS TRANSFER OPERATIONS
Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction).Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method.Drying- drying operations, batch and continuous drying. Conceptual numerical.

COURSE OUTCOMES:
At the end of the course the student will be able to:
- State and describe the nature and properties of the fluids.
- Study the different flow measuring instruments, the principles of various size reductions, conveying equipment’s, sedimentation and mixing tanks.
- Comprehend the laws governing the heat and mass transfer operations to solve the problems.
- Design the heat transfer equipment suitable for specific requirement.
TEXTBOOKS:
1. Unit operations in Chemical Engineering Warren L. McCabe, Julian C. Smith & Peter Harriott
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008

REFERENCE BOOKS
2. Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996

OPT352 PLASTIC MATERIALS FOR ENGINEERS

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
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:

- To study the importance, advantages and classification of plastic materials
- Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics
- To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins
- Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU
- To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

REFERENCES


OPT353  PROPERTIES AND TESTING OF PLASTICS

COURSE OBJECTIVES

- To understand the relevance of standards and specifications as well as the specimen preparation for polymer testing.
- To study the mechanical properties and testing of polymer materials and their structural property relationships.
- To understand the thermal properties of polymers and their testing methods.
- To gain knowledge on the electrical and optical properties of polymers and their testing methods.
- To study about the environmental effects and prevent polymer degradation.

UNIT I INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS


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UNIT II    MECHANICAL PROPERTIES
Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact strength, resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic fatigue, ageing properties, Basic concepts of stress and strain, short term tests: Viscoelastic behavior (simple models: Kelvin model for creep and stress relaxation, Maxwell-Voigt model, strain recovery and dynamic response), Effect of structure and composition on mechanical properties, Behavior of reinforced polymers

UNIT III    THERMAL RHEOLOGICAL PROPERTIES
Thermal properties: Transition temperatures, specific heat, thermal conductivity, co-efficient of thermal expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness temperature, thermal stability and flammability. Product testing: Plastic films, sheeting, pipes, laminates, foams, containers, cables and tubes.

UNIT IV    ELECTRICAL AND OPTICAL PROPERTIES
Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and power factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric co-efficient, dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive index, haze, gloss, clarity, birefringence.

UNIT V    ENVIRONMENTAL AND CHEMICAL RESISTANCE

TOTAL : 45 PERIODS

COURSE OUTCOMES
- Understand the relevance of standards and specifications.
- Summarize the various test methods for evaluating the mechanical properties of the polymers.
- To know the thermal, electrical & optical properties of polymers.
- Identify various techniques used for characterizing polymers.
- Distinguish the processability tests used for thermoplastics, thermosets and elastomers.

REFERENCES:
OBJECTIVES:

- Understand the fundamentals of IC technology components and their characteristics.
- Understand combinational logic circuits and design principles.
- Understand sequential logic circuits and clocking strategies.
- Understand Interconnects and Memory Architecture.
- Understand the design of arithmetic building blocks.

UNIT I  MOS TRANSISTOR PRINCIPLES  9
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  9

UNIT III  SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES  9

UNIT IV  INTERCONNECT, MEMORY ARCHITECTURE  9
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  9
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

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.

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CBM370 WEARABLE DEVICES L T P C
3 0 0 3

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

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS

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

UNIT III WIRELESS HEALTH SYSTEMS

UNIT IV SMART TEXTILE
UNIT V 
APPLICATIONS OF WEARABLE SYSTEMS

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

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

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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UNIT I 
INTRODUCTION TO MEDICAL INFORMATICS

Introduction - Structure of Medical Informatics—Internet and Medicine—Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics — Medical Informatics, Bioinformatics
UNIT II  COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING
Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III  COMPUTERISED PATIENT RECORD
Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT IV  COMPUTER ASSISTED MEDICAL DECISION-MAKING
Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer–assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis inclinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V  RECENT TRENDS IN MEDICAL INFORMATICS
Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
1. Explain the structure and functional capabilities of Hospital Information System.
2. Describe the need of computers in medical imaging and automated clinical laboratory.
3. Articulate the functioning of information storage and retrieval in computerized patient record system.
4. Apply the suitable decision support system for automated clinical diagnosis.
5. Discuss the application of virtual reality and telehealth technology in medical industry.

TEXT BOOKS:

REFERENCES:

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UNIT I BIOLOGICAL TREATMENT PROCESS 9

UNIT II WASTE BIOMASS AND ITS VALUE ADDITION 9
Types of waste biomass – Solid waste management - Nature of biomass feedstock – Biobased economy/process – Value addition of waste biomass – Biotransformation of biomass – Biotransformation of marine processing wastes – Direct extraction of biochemicals from biomass – Plant biomass for industrial application

UNIT III BIOCONVERSION OF WASTES TO ENERGY 9
Perspective of biofuels from wastes - Bioethanol production – Biohydrogen Production – dark and photofermentative process - Biobutanol production – Biogas and Biomethane production - Single stage anaerobic digestion, Two stage anaerobic digestion - Biodiesel production - Enzymatic hydrolysis technologies

UNIT IV CHEMICALS AND ENZYME PRODUCTION FROM WASTES 9
Production of lactic acid, succinic acid, citric acid – Biopolymer synthesis – Production of Amylases - Lignocellulolytic enzymes - Pectinolytic enzymes - Proteases – Lipases

UNIT V BIOCOMPOSTING OF ORGANIC WASTES 9
Overview of composting process - Benefits of composting. Role of microorganisms in composting - Factors affecting the composting process - Waste Materials for Composting, Fundamentals of composting process - Composting technologies, Composting systems – Nonreactor Composting, Reactor composting - Compost Quality

TOTAL: 45 PERIODS

COURSE OUTCOMES
After completion of this course, the students should be able
1. To learn the various methods biological treatment
2. To know the details of waste biomass and its value addition
3. To develop the bioconversion processes to convert wastes to energy
4. To synthesize the chemicals and enzyme from wastes
5. To produce the biocompost from wastes
6. To apply the theoretical knowledge for the development of value added products

TEXT BOOKS

REFERENCE BOOKS
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:

COURSE OBJECTIVES
The aim of this course is to
1. Create higher standard of knowledge on healthcare system and services
2. Prioritize advanced technologies for the diagnosis and treatment of various diseases

UNIT I  PUBLIC HEALTH
UNIT II  CLINICAL DISEASES
Communicable diseases: Chickenpox / Shingles, COVID-19, Tuberculosis, Hepatitis B, Hepatitis C, HIV / AIDS, Influenza, Swine flu. Non Communicable diseases: Diabetes mellitus, atherosclerosis, fatty liver, Obesity, Cancer

UNIT III  VACCINOLOGY
History of Vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems. Instruments related to monitoring of temperature, sterilization, environment.

UNIT IV  OUTPATIENT & IN PATIENT SERVICES
Radiotherapy, Nuclear medicine, surgical units, OT Medical units, G & Obs. units Pediatric, neonatal units, Critical care units, Physical medicine & Rehabilitation, Neurology, Gastroenterology, Endoscopy, Pulmonology, Cardiology.

UNIT V  BASICS OF IMAGING MODALITIES

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCE BOOKS:

VERTICAL 1: FINTECH AND BLOCK CHAIN
CMG331  FINANCIAL MANAGEMENT  LT P C  3 0 0 3

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 MANGEMENT
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

UNIT V WORKING CAPITAL DECISION

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
2. Prasanna Chandra, Financial Management,

CMG332 FUNDAMENTALS OF INVESTMENT

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.

UNITI 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, securitymarket indices, sources of financial information, Concept of return and risk, Impact of Taxes andInflationonreturn.

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UNIT II FIXED INCOME SECURITIES
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk
and credit rating.

UNIT III APPROACHES TO EQUITY ANALYSIS
Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend
capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT IV PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial
Derivatives; Financial Derivatives Markets in India

UNIT V INVESTOR PROTECTION
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal
system, insider trading, investors’ awareness and activism

TOTAL: 45 PERIODS

REFERENCES:
   2019.
2. Chandra, Prasanna. Investment analysis and portfolio management. McGraw-hill education, 5th,
4. Zvi Bodie, Alex Kane, Alan J Marcus, Pitabas Mohanty, Investments, McGraw Hill Education (India),
   11 Edition(SIE), 2019

CMG333 BANKING, FINANCIAL SERVICES AND INSURANCE LT P C
3 0 0 3

OBJECTIVES
- Understand the Banking system in India
- Grasp how banks raise their sources and how they deploy it
- Understand the development in banking technology
- Understand the financial services in India
- Understand the insurance Industry in India

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM 9
Overview of Banking system – Structure – Functions – Banking system in India - Key Regulations in
Indian Banking sector – RBI. Relationship between Banker and Customer - Retail & Wholesale Banking
– types of Accounts - Opening and operation of Accounts.

UNIT II MANAGING BANK FUNDS/ PRODUCTS 9
Liquid Assets - Investment in securities - Advances - Loans. Negotiable Instruments – Cheques, Bills of
Exchange & Promissory Notes. Designing deposit schemes – Asset and Liability Management – NPA’s
– Current issues on NPA’s – M&A’s of banks into securities market

UNIT III DEVELOPMENT IN BANKING TECHNOLOGY 9
Payment system in India – paper based – e payment – electronic banking – plastic money – e-money –
forecasting of cash demand at ATM’s – The Information Technology Act, 2000 in India – RBI’s Financial
Sector Technology vision document – security threats in e-banking & RBI’s Initiative.
UNIT IV  FINANCIAL SERVICES  9

UNIT V  INSURANCE  9

REFERENCES :

CMG334  INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS  LT P C  3 0 0 3

UNIT I  INTRODUCTION TO BLOCKCHAIN  9
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  9

UNIT III  ETHEREUM  9
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  9

UNIT V  EMERGING TRENDS  9

TOTAL: 45 PERIODS
REFERENCE
2. Peter Borovykh, Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018

CMG335 FINTECH PERSONAL FINANCE AND PAYMENTS L T P C 3 0 0 3

UNIT I CURRENCY EXCHANGE AND PAYMENT

UNIT II DIGITAL FINANCE AND ALTERNATIVE FINANCE
A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity,. Introduction to the concept of Initial Coin Offering

UNIT III INSURETECH
InsurTech Introduction , Business model disruption AI/ML in InsurTech IoT and InsurTech ,Risk Modeling ,Fraud Detection Processing claims and Underwriting Innovations in Insurance Services

UNIT IV PEER TO PEER LENDING
P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies , Concept of Crowdfunding Crowd funding Architecture and Technology, P2P and Crowdfunding unicorns and business models , SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations

UNIT V REGULATORY ISSUES

REFERENCES:
5. IIBF, Digital Banking, Taxmann Publication, 2016
OBJECTIVES:
1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I INTRODUCTION
Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY
FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III INSURANCE INDUSTRY

UNIT IV FINTECH AROUND THE GLOBE

UNIT V FUTURE OF FINTECH
How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

REFERENCES
CMG337 FOUNDATIONS OF ENTREPRENEURSHIP

L T P C
3 0 0 3

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 5 EMERGING TRENDS IN ENTREPRENEURSHIP

TOTAL 45 : PERIODS
OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1  Learn the basics of Entrepreneurship
CO 2  Understand the business ownership patterns and environment
CO 3 Understand the Job opportunities in Industries relating to Technopreneurship
CO 4 Learn about applications of tehnopreneurship and successful technopreneurs
CO 5 Acquaint with the recent and emerging trends in entrepreneurship

TEXT BOOKS:

REFERENCES:
7. Basics of Technopreneurship: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelona, UP
8. Journal articles pertaining to Entrepreneurship

CMG338 TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS  L T P C
3 0 0 3

COURSE OBJECTIVES:
- To develop and strengthen the Leadership qualities and motivation of learners.
- To impart the Leadership skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of Team Building in managing Technology oriented businesses.
- To empower the learners to build robust teams for running and leading a business efficiently and effectively.

UNIT I INTRODUCTION TO MANAGING TEAMS 9
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:  
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
CMG340  PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS  

L  T  P  C  
3  0  0  3

COURSE OBJECTIVES:
- To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs.
- To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
- To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.

UNIT I  INTRODUCTION TO MARKETING MANAGEMENT  
9

UNIT II   MARKETING ENVIRONMENT  
9

UNIT III  PRODUCT AND PRICING MANAGEMENT  
9

UNIT IV  PROMOTION AND DISTRIBUTION MANAGEMENT  
9

UNIT V  CONTEMPORARY ISSUES IN MARKETING MANAGEMENT  
9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to:
CO1 Have the awareness of marketing management process
CO2 Understand the marketing environment
CO3 Acquaint about product and pricing strategies
CO4 Knowledge of promotion and distribution in marketing management.
CO5 Comprehend the contemporary marketing scenarios and offer solutions to marketing issues.
REFERENCES:

CMG341 HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS L T P C
3 0 0 3

OBJECTIVES:
- To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
- To create an awareness of the roles, functions and functioning of the human resource department.
- To understand the methods and techniques followed by Human Resource Management practitioners.

UNIT I INTRODUCTION TO HRM

UNIT II HUMAN RESOURCE PLANNING
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

TOTAL : 45 PERIODS

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:

CMG342                      FINANCING NEW BUSINESS VENTURES

COURSE OBJECTIVES:
- To develop the basics of business venture financing.
- To impart the knowledge essential for entrepreneurs for financing new ventures.
- To acquaint the learners with the sources of debt and equity financing.
- To empower the learners towards fund raising for new ventures effectively.

UNIT I          ESSENTIALS OF NEW BUSINESS VENTURE

UNIT II         INTRODUCTION TO VENTURE FINANCING

UNIT III        SOURCES OF DEBT FINANCING

UNIT IV         SOURCES OF EQUITY FINANCING
Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.

UNIT V         METHODS OF FUND RAISING FOR NEW VENTURES

TOTAL: 45 PERIODS
OUTCOMES:
Upon completion of this course, the students should be able to:
CO 1 Learn the basics of starting a new business venture.
CO 2 Understand the basics of venture financing.
CO 3 Understand the sources of debt financing.
CO 4 Understand the sources of equity financing.
CO 5 Acquaint with the methods of fund raising for new business ventures.

REFERENCES:
1) Principles of Corporate Finance by Brealey and Myers et al., 12TH ed, McGraw Hill Education (India) Private Limited, 2018

VERTICAL 3: PUBLIC ADMINISTRATION

CMG343 PRINCIPLES OF PUBLIC ADMINISTRATION L T P C 3 0 0 3

UNIT-I
1. Meaning, Nature and Scope of Public Administration (9)
2. Importance of Public Administration
3. Evolution of Public Administration

UNIT-II
1. New Public Administration (9)
2. New Public Management
3. Public and Private Administration

UNIT-III
1. Relationships with Political Science, History and Sociology (9)
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

REFERENCES:
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.
REFERENCES:
4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi.

CMG345 PUBLIC PERSONNEL ADMINISTRATION

UNIT-I
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

UNIT-II
1. Generalist Vs Specialist
2. Civil Servants' Relationship with Political Executive
3. Integrity in Administration.

UNIT-III
1. Recruitment: Direct Recruitment and Recruitment from Within
2. Training: Kinds of Training
3. Promotion

UNIT-IV
1. All India Services
2. Service Conditions
3. State Public Service Commission

UNIT-V
1. Employer Employee Relations
2. Wage and Salary Administration
3. Allowances and Benefits

REFERENCES:
1. Stahl Gleen O: Public Personnel Administration
4. Dwivedi O.P and Jain R.B: India’s Administrative state.
7. Davar R.S. Personnel Management & Industrial Relations

TOTAL: 45 PERIODS
UNIT I
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. Crozior M : The Bureaucratic phenomenon (Chand)
3. Presthus. R : The Organizational Society (MAC)
5. Keith Davis : Organization Theory (MAC)

TOTAL: 45 PERIODS

UNIT I
Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India

UNIT II
Role & Functions of the District Collector, Relationship between the District Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government

UNIT III
Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992

UNIT IV
Coalition politics in India, Integrity and Vigilance in Indian Administration
UNIT V
Corruption – Ombudsman, Lok Pal & Lok Ayuktha

REFERENCES:
1. S.R. Maheswari : Indian Administration
2. Khera. S.S : Administration in India
3. Ramesh K. Arora : Indian Public Administration
4. T.N. Chaturvedi : State administration in India
5. Basu, D.D : Introduction to the Constitution of India

TOTAL: 45 PERIODS
OBJECTIVE:
- To learn the applications of statistics in business decision making.

UNIT I  INTRODUCTION
Basic definitions and rules for probability, Baye's theorem and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT II  SAMPLING DISTRIBUTION AND ESTIMATION
Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters.

UNIT III  TESTING OF HYPOTHESIS - PARAMETRIC TESTS
Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.

UNIT IV  NON-PARAMETRIC TESTS

UNIT V  CORRELATION AND REGRESSION

OUTCOMES:
- To facilitate objective solutions in business decision making.
- To understand and solve business problems
- To apply statistical techniques to data sets, and correctly interpret the results.
- To develop skill-set that is in demand in both the research and business environments
- To enable the students to apply the statistical techniques in a work setting.

REFERENCES:
OBJECTIVES:
- To know how to derive meaning from huge volume of data and information.
- To understand how knowledge discovering process is used in business decision making.

UNIT I  INTRODUCTION
Data mining, Text mining, Web mining, Data ware house.

UNIT II  DATA MINING PROCESS
Datamining process – KDD, CRISP-DM, SEMMA
Prediction performance measures

UNIT III  PREDICTION TECHNIQUES
Data visualization, Time series – ARIMA, Winter Holts,

UNIT IV  CLASSIFICATION AND CLUSTERING TECHNIQUES
Classification, Association, Clustering.

UNIT V  MACHINE LEARNING AND AI
Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization.

TOTAL: 45 PERIODS

OUTCOMES:
1. Learn to apply various data mining techniques into various areas of different domains.
2. Be able to interact competently on the topic of data mining for business intelligence.
3. Apply various prediction techniques.
4. Learn about supervised and unsupervised learning technique.
5. Develop and implement machine learning algorithms

REFERENCES:
1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kaufmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
7. G. K. Gupta, Introduction to Data mining with Case Studies, Prentice hall of India, 2011
9. Elizabeth Vitt, Michael Luckevich Stacia Misner, Business Intelligence, Microsoft, 2011
OBJECTIVES:
- To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
- To know the different types of HR metrics and understand their respective impact and application.
- To understand the impact and use of HR metrics and their connection with HR analytics.
- To understand common workforce issues and resolving them using people analytics.

UNIT I  INTRODUCTION TO HR ANALYTICS  9
People Analytics - stages of maturity - Human Capital in the Value Chain : impact on business – HR metrics and KPIs.

UNIT II  HR ANALYTICS I: RECRUITMENT  9
Recruitment Metrics : Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio- Quality of hire.

UNIT III  HR ANALYTICS - TRAINING AND DEVELOPMENT  9
Training & Development Metrics : Percentage of employees trained- Internally and externally trained - Training hours and cost per employee - ROI.

UNIT IV  HR ANALYTICS EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION  9
Employee Engagement Metrics :Talent Retention index - Voluntary and involuntary turnover- grades, performance, and service tenure - Internal hired index Career Progression Metrics: Promotion index - Rotation index - Career path index.

UNIT V -  HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT  9
Workforce Diversity and Development Metrics : Employees per manager – Workforce age profiling - Workforce service profiling - Churnover index - Workforce diversity index - Gender mix

TOTAL: 45 PERIODS

OUTCOME:
- The learners will be conversant about HR metrics and ready to apply at work settings.
- The learners will be able to resolve HR issues using people analytics.

REFERENCES:
OBJECTIVE:
To showcase the opportunities that exist today to leverage the power of the web and social media

UNIT I MARKETING ANALYTICS
Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT II COMMUNITY BUILDING AND MANAGEMENT
History and Evolution of Social Media - Understanding Science of Social Media - Goals for using Social Media - Social Media Audience and Influencers - Digital PR - Promoting Social Media Pages - Linking Social Media Accounts - The Viral Impact of Social Media.

UNIT III SOCIAL MEDIA POLICIES AND MEASUREMENTS
Social Media Policies - Etiquette, Privacy - ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV WEB ANALYTICS
Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT V SEARCH ANALYTICS
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

TOTAL: 45 PERIODS

OUTCOME:
- The Learners will understand social media, web and social media analytics and their potential impact.

REFERENCES:
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004

OBJECTIVE:
To treat the subject in depth by emphasizing on the advanced quantitative models and methods in operations and supply chain management and its practical aspects and the latest developments in the field.
UNIT I  INTRODUCTION 9
Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains.

UNIT II  WAREHOUSING DECISIONS 9
P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.

UNIT III  INVENTORY MANAGEMENT 9
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV  TRANSPORTATION NETWORK MODELS 9

UNIT V  MCDM MODELS 9
Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic an Techniques, the analytical network process (ANP), TOPSIS.

TOTAL: 45 PERIODS

OUTCOME:
• To enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.

REFERENCES:

CMG354 FINANCIAL ANALYTICS L T P C 3 0 0 3

OBJECTIVE:
• This course introduces a core set of modern analytical tools that specifically target finance applications.

UNIT I  CORPORATE FINANCE ANALYSIS 9
Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.

UNIT II  FINANCIAL MARKET ANALYSIS 9
Estimation and prediction of risk and return (bond investment and stock investment) –Time series-examining nature of data, Value at risk, ARMA, ARCH and GARCH.
UNIT III PORTFOLIO ANALYSIS
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.

UNIT IV TECHNICAL ANALYSIS

UNIT V CREDIT RISK ANALYSIS
Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.

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

OBJECTIVE:
- To impart knowledge about sustainable Infrastructure development goals, practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.

UNIT I SUSTAINABLE DEVELOPMENT GOALS
UNIT II SUSTAINABLE INFRASTRUCTURE PLANNING

UNIT III SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES

UNIT IV SUSTAINABLE CONSTRUCTION MATERIALS

UNIT V SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS

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.

TOTAL: 45 PERIODS
REFERENCES:
5. New Building Materials and Construction World magazine
7. Munier N, "Introduction to Sustainability”, Springer2005

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

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CES332 SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT

OBJECTIVES:
• To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.

UNIT I AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS
Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

322
UNIT II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT
Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT III WATER MANAGEMENT
Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT IV ENERGY AND WASTE MANAGEMENT
Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS
Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS

OUTCOMES:
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
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CES333 SUSTAINABLE BIOMATERIALS

OBJECTIVES
- To impart knowledge of biomaterials and their properties
- To learn about Fundamentals aspects of Biopolymers and their applications
- To learn about bioceramics and biopolymers
- To introduce the students about metals as biomaterials and their usage as implants
- To make the students understand the significance of bionanomaterials and its applications.

UNIT I INTRODUCTION TO BIOMATERIALS

UNIT II BIO POLYMERS
Molecular structure of polymers -Molecular weight - Types of polymerization techniques–Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials -Polyethylene - Polymethylmethacrylate (PMMA-Polyactic acid (PLA) and polyglycolic acid (PGA) -Polycaprolactone (PCL) - Other biodegradable polymers -Polyurethanes- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT III BIO CERAMICS AND BIOCOMPOSITES
General properties- Bio ceramics -Silicate glass - Alumina (Al2O3) -Zirconia (ZrO2)-Carbon- Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites-Polymer Matrix Compsite(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

324
UNIT V  NANOBIOIMATERIALS

TOTAL : 45 PERIODS

OUTCOMES

- Students will gain familiarity with Biomaterials and they will understand their importance.
- Students will get an overview of different biopolymers and their properties
- Students gain knowledge on some of the important Bioceramics and Biocomposite materials
- Students gain knowledge on metals as biomaterials
- Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

REFERENCES

6. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018

CES334 MATERIALS FOR ENERGY SUSTAINABILITY L T P C
3 0 0 3

OBJECTIVES

- To familiarize the students about the challenges and demands of energy sustainability
- To provide fundamental knowledge about electrochemical devices and the materials used.
- To introduce the students to various types of fuel cell
- To enable students to appreciate novel materials and their usage in photovoltaic application
- To introduce students to the basic principles of various types Supercapacitors and the materials used.

UNIT I SUSTAINABLE ENERGY SOURCES

Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy
UNIT II ELECTROCHEMICAL DEVICES

Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O2 battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO2, LiFePO4, LiMn2O4) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)

UNIT III FUEL CELLS


UNIT IV PHOTOVOLTAICS


UNIT V SUPERCAPACITORS

Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor-Faradaic and non-Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D:3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite- conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitriles, and nitrides.

OUTCOMES

- Students will acquire knowledge about energy sustainability.
- Students understand the principles of different electrochemical devices.
- Students learn about the working of fuel cells and their application.
- Students will learn about various Photovoltaic applications and the materials used.
- The students gain knowledge on different types of supercapacitors and the performance of various materials
REFERENCES
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh

CES335 GREEN TECHNOLOGY

COURSE OBJECTIVE:

- To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.
- To provide green engineering solutions to energy demand, reduced energy footprint.

UNIT I PRINCIPLES OF GREEN CHEMISTRY 9
Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.

UNIT II POLLUTION TYPES 9
Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT III GREEN REAGENTS AND GREEN SYNTHESIS 9
Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions

UNIT IV DESIGNING GREEN PROCESSES 9
Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention

UNIT V GREEN NANOTECHNOLOGY 9
Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

TOTAL: 45 PERIODS
COURSE OUTCOMES:
CO1: To understand the principles of green engineering and technology
CO2: To learn about pollution using hazardous chemicals and solvents
CO3: To modify processes and products to make them green and safe.
CO4: To design processes and products using green technology
CO5: To understand advanced technology in green synthesis

TEXT BOOKS

REFERENCE BOOKS
1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

CES336 ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS L T P C
3 0 0 3

OBJECTIVES:
- To understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.

UNIT I ENVIRONMENTAL MONITORING AND STANDARDS

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.

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.

TEXT BOOKS:
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and solid wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc

REFERENCES
1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.

COURSE ARTICULATION MATRIX

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OTAL: 45 PERIODS

329
COURSE OBJECTIVES:
1. To create awareness on the energy scenario of India with respect to world
2. To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation
3. Familiarisation on the concept of sustainable development and its benefits
4. Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development
5. Acquainting with energy policies and energy planning for sustainable development

UNIT I ENERGY SCENARIO
Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security

UNIT II ENERGY AND ENVIRONMENT
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

UNIT III SUSTAINABLE DEVELOPMENT

UNIT IV RENEWABLE ENERGY TECHNOLOGY

UNIT V ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the world and Indian energy scenario
2. Analyse energy projects, its impact on environment and suggest control strategies
3. Recognise the need of Sustainable development and its impact on human resource development
4. Apply renewable energy technologies for sustainable development
5. Fathom Energy policies and planning for sustainable development.

REFERENCES:
7. https://www.niti.gov.in/verticals/energy

CES338   ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT   L T P C

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

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the prevailing energy scenario
2. Familiarise on energy audits and its relevance
3. Apply the concept of energy audit on thermal utilities
4. Employ relevant techniques for energy improvement in electrical utilities
5. Understand Sustainable development and its impact on human resource development

TOTAL:45 PERIODS
REFERENCES: