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

B.E. AERONAUTICAL ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

<table>
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<th>I.</th>
<th>To employ comprehensive knowledge in Aeronautical Engineering and analytical skills to work towards solving complex problems to excel in the professional career.</th>
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<td>II.</td>
<td>To design, analyze and produce cutting edge engineering solutions by employing modern techniques and adhering to moral values for sustainable development.</td>
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<tr>
<td>III.</td>
<td>To assume global careers and leadership responsibilities through consistent learning with idealistic managerial practices.</td>
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PROGRAM OUTCOMES (POs):

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<tr>
<td>1</td>
<td><strong>Engineering knowledge</strong>: 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><strong>Problem analysis</strong>: 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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<td>3</td>
<td><strong>Design/development of solutions</strong>: 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>
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<td>4</td>
<td><strong>Conduct investigations of complex problems</strong>: 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><strong>Modern tool usage</strong>: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.</td>
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<td>6</td>
<td><strong>The engineer and society</strong>: 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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<td>7</td>
<td><strong>Environment and sustainability</strong>: 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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<td>8</td>
<td><strong>Ethics</strong>: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.</td>
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**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**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.

**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.

**PROGRAM SPECIFIC OUTCOMES (PSOs):**

1. To gather data using modern tools and apply design techniques to develop solutions for challenges in the domain of Aerodynamics, Propulsion, Aircraft Structures and Aircraft Maintenance with professional ethics.

2. To function as engineering solution providers or entrepreneurs, who are able to manage, innovate, communicate, train and lead a team for continuous improvement.

3. Graduate will be able to work as a team member which will be a main requirement in industry or research organisation or in any business enterprise. This will pave the way for successful career for the graduate and also play a role for the success of the organisation in which the graduate is employed.

**PEO’s – PO’s & PSO’s MAPPING:**

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# B. E. AERONAUTICAL ENGINEERING
## REGULATIONS 2021
### CHOICE BASED CREDIT SYSTEM
#### 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
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* NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
### SEMESTER V

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

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

*a 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)

# Elective - Management shall be chosen from the elective Management courses

---

### SEMESTER VIII / VII

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

TOTAL CREDITS: 166
### MANDATORY COURSES I*

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*Mandatory Courses are offered as Non-Credit courses

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*Mandatory Courses are offered as Non-Credit courses

### ELECTIVE – MANAGEMENT COURSES

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<td><strong>Aerospace Structures</strong></td>
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<td>Design of Gas Turbine Engine Components</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: COMPUTATIONAL ENGINEERING

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## VERTICAL 2: AERODYNAMICS AND PROPULSION

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OPEN ELECTIVES
(Student 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)**

<table>
<thead>
<tr>
<th>VERTICAL I</th>
<th>VERTICAL II</th>
<th>VERTICAL III</th>
<th>VERTICAL IV</th>
<th>VERTICAL V</th>
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<td>Creativity and Innovation in Entrepreneurship</td>
<td>Public Personnel Administration</td>
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(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

### VERTICAL 1: FINTECH AND BLOCK CHAIN

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VERTICAL 4: BUSINESS DATA ANALYTICS

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VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

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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 don’ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.
(v) Proficiency Modules

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

(vi) Lectures by Eminent People

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

(vii) Visits to Local Area

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

(viii) Familiarization to Dept./Branch & Innovations

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

(ix) Department Specific Activities

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

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

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

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

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

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

TOTAL : 45 PERIODS
LEARNING OUTCOMES:
At the end of the course, learners will be able
• 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

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

REFERENCE BOOKS:

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

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

UNIT - I  MATRICES  9+3

UNIT - II  DIFFERENTIAL CALCULUS  9+3

UNIT - III  FUNCTIONS OF SEVERAL VARIABLES  9+3

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

UNIT - V  MULTIPLE INTEGRALS  9+3

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.

TOTAL: 60 PERIODS

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

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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 successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I MECHANICS


UNIT II ELECTROMAGNETIC WAVES

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

UNIT III OSCILLATIONS, OPTICS AND LASERS


UNIT IV BASIC QUANTUM MECHANICS

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

UNIT V APPLIED QUANTUM MECHANICS

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

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  9


UNIT II  NANO CHEMISTRY  9

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

UNIT III  PHASE RULE AND COMPOSITES  9

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

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

UNIT IV  FUELS AND COMBUSTION  9

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

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO₂ emission and carbon foot print.

UNIT V  ENERGY SOURCES AND STORAGE DEVICES  9

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

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

- 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:

REFERENCES:

CO-PO & PSO MAPPING

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1-low, 2-medium, 3-high, "-"-no correlation
COURSE OBJECTIVES:
- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

UNIT I  COMPUTATIONAL THINKING AND PROBLEM SOLVING  9

UNIT II  DATA TYPES, EXPRESSIONS, STATEMENTS  9
Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III  CONTROL FLOW, FUNCTIONS, STRINGS  9
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

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

UNIT V  FILES, MODULES, PACKAGES  9
Files and 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/

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

GE3152
HERITAGE OF TAMILS

UNIT I
LANGUAGE AND LITERATURE
3

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

UNIT III
FOLK AND MARTIAL ARTS
3
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyllattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV
THINAI CONCEPT OF TAMILS
3
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V
CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE
3
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. தமிழின் கல்வி மறைவு – மக்களவு பார்வையும் - சுத்து. பிறந்தாஸ் (புதியப்பதிவு: தமிழின் கல்வி மறைவு – மக்களவு பார்வையும் - சுத்து. பிறந்தாஸ்) - திசைவெளியில் மூன்று முன்னையமாக குறிப்பிட்டியது.)
2. கோயில்களின் கல்வி – பல்தோன்று ஒட்டு. கம்புகுரு. (எனினம் பதிப்பியை).
3. தமிழ் – தொழில் திட்டிக்காட்டுப்படுத்தும் கலாசாரா நுட்பம் குறிப்பிட்டிய (தொழில்நுட்பம் தாளும் பதிப்பியை)
4. புராணக்கல் – ஆரம் கூம் குறிப்பிட்டிய (தொழில்நுட்பம் தாளும் பதிப்பியை)
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).
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9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
COURSE OBJECTIVES:

- 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/

COs- PO’s & PSO’s MAPPING

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

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.
CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

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

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

TOTAL : 30 PERIODS

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:

CO-PO & PSO MAPPING

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1-low, 2-medium, 3-high, “-“ no correlation
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 6
Listening for general information-specific details - conversation: Introduction to classmates - Audio/video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies- making polite requests, making polite offers, replying to polite requests and offers - understanding basic instructions( filling out a bank application for example).

UNIT II NARRATION AND SUMMATION 6
Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings- engaging in small talk- describing requirements and abilities.

UNIT III DESCRIPTION OF A PROCESS / PRODUCT 6
Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights - talking about quantities(large & small)-talking about precautions.

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

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

TOTAL: 30 PERIODS

LEARNING OUTCOMES:
At the end of the course, learners will be able
- To listen to and comprehend general as well as complex academic information
- To listen to and understand different points of view in a discussion
- To speak fluently and accurately in formal and informal communicative contexts
- To describe products and processes and explain their uses and purposes clearly and accurately
- To express their opinions effectively in both formal and informal discussions
ASSESSMENT PATTERN
- One online / app based assessment to test listening /speaking
- End Semester **ONLY** listening and speaking will be conducted online.
- Proficiency certification is given on successful completion of listening and speaking internal test and end semester exam.

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- 1-low, 2-medium, 3-high, "-" no correlation
- **Note:** The average value of this course to be used for program articulation matrix.
OBJECTIVES:
- To engage learners in meaningful language activities to improve their reading and writing skills
- To learn various reading strategies and apply in comprehending documents in professional context.
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To demonstrate an understanding of job applications and interviews for internship and placements

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

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

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

UNIT IV  REPORTING OF EVENTS AND RESEARCH  6

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

TOTAL : 30 PERIODS

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

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

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

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- Note: The average value of this course to be used for program articulation matrix.
MA3251  STATISTICS AND NUMERICAL METHODS  

COURSE OBJECTIVES:

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

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

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

UNIT III  SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS  
9+3

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

UNIT V  NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS  
9+3

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- 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:

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COURSE OBJECTIVES:

- To equip the students to have a knowledge on different types of electron theory, basics of quantum mechanics and about energy bands
- To introduce the physics of semiconducting materials and applications of semiconductors in device fabrication
- To make the students to learn the mechanisms of polarization in dielectric materials, and about classification and properties of dielectric materials
- To make the students to learn the origin of magnetism in magnetic materials and their classification; to learn the physics of superconductivity and various properties exhibited by superconductors
- To make the students familiarize with the optical properties of materials.

UNIT I ELECTRICAL PROPERTIES OF MATERIALS


UNIT II SEMICONDUCTOR AND TRANSPORT PHYSICS


UNIT III DIELECTRICS AND FERROELECTRICS

Macroscopic description of the static dielectric constant. The electronic and ionic polarizabilities of molecules - orientational polarization - Measurement of the dielectric constant of a solid. The internal field - Lorentz, Clausius - Mosotti relation. Behaviour of dielectrics in an alternating field, elementary ideas on dipole relaxation, - Piezo, pyro and ferroelectric properties of crystals -classification of ferroelectric crystals - BaTiO₃ and KDP.

UNIT IV MAGNETISM AND SUPERCONDUCTIVITY


UNIT V OPTICAL PROPERTIES OF MATERIALS


TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students should be able to

- Familiarize with theories of electrical and thermal conduction in solids, basic quantum mechanics, and energy bands
- Gain knowledge on semiconducting materials based on energy level diagrams, its types, temperature effect.
- Understand the mechanisms of various types of polarization and about classification and properties of ferroelectric crystals
- Learn the classification of magnetic materials, theory and applications of ferromagnetic materials and superconductors
- Acquire knowledge on light waves, non-linear optical properties of materials and their applications

TEXT BOOKS:

REFERENCES:
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:

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1 – Slight, 2 – Moderate, 3 – Substantial
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  PLANЕ CURVES  6+12
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

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

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

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

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

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.

TOTAL: (L=30; P=60) 90 PERIODS
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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Low (1) : Medium (2) : High (3)
### Text-Cum-Reference Books:

1. Classical Tamil Grammar (Dr.K.Pillay) (TNTB & ESC and RMRL – in print)
2. Classical Tamil - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
GE3252  TAMILS AND TECHNOLOGY  L T P C
1001

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

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

UNIT III  MANUFACTURING TECHNOLOGY  3

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

UNIT V  SCIENTIFIC TAMIL & TAMIL COMPUTING  3

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. தமிழக வரலை – மக்களும் பண்பொடும் – மக.மக. பிள்மள (தவளியீடு: தமிழ்நொடு பொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முமனவர் இலசுந்தரம். (இன்றான் பிரசுரம்).
4. விகடன் பிரசுரம் – முமனவர் இலசுந்தரம். (இந்துநிஜம் கல்விக்கட்டு வட்ட வாதங்களின் துறை முன்மனவர்).
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)
### NCC Credit Course Level 1*

#### 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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### 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

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**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 |
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### SOCIAL SERVICE AND COMMUNITY DEVELOPMENT

| SS 1 | Basics, Rural Development Programmes, NGOs, Contribution of Youth | 3 |
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| SS 6 | New Initiatives | 2 |
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TOTAL : 30 PERIODS

54
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: 15
   a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
   b) Preparing plumbing line sketches.
   c) Laying pipe connection to the suction side of a pump
   d) Laying pipe connection to the delivery side of a pump.
   e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

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

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

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

PART III MECHANICAL ENGINEERING PRACTICES

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

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

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

SHEET METAL WORK:
   a) Making of a square tray

FOUNDRY WORK:
   a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES

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

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

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

TOTAL = 60 PERIODS

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)
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

TOTAL: 60 PERIODS

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. Analyze the behavior of digital devices.
5. Use DSO to measure the various parameters

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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 analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To be able to communicate effectively through formal and informal writing.
- To be able to use appropriate language structures to write emails, reports and essays.
- To give instructions and recommendations that are clear and relevant to the context.

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

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

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

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

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

TOTAL: 60 PERIODS

LEARNING OUTCOMES
At the end of the course, learners will be able
- Speak effectively in group discussions held in a formal/semi formal context.
- Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions.
- Write emails, letters and effective job applications.
- Write critical reports to convey data and information with clarity and precision.
- Give appropriate instructions and recommendations for safe execution of tasks.

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

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COURSE OBJECTIVES:
- To make the student understand the quantitative analysis of machine and processes for transformation of energy and between work and heat.
- To Make the student understand the Laws of thermodynamics would be able to quantify through measurement of related
- To Apply the thermodynamic properties, energies and their interactions in real time problems
- To develop basic concept of air cycle, gas turbine engines and heat transfer.
- To analyse different types of Heat transfer
- To identify the different components of Jet Engines

UNIT I  FUNDAMENTAL CONCEPT AND FIRST LAW 9
Concept of continuum, macroscopic approach, thermodynamic systems – closed, open and isolated. Property, state, path and process, quasi-static process, work, internal energy, enthalpy, specific heat capacities and heat transfer, SFEE, application of SFEE to jet engine components, First law of thermodynamics, relation between pressure, volume and temperature for various processes, Zeroth law of thermodynamics.

UNIT II  SECOND LAW AND ENTROPY 9

UNIT III  AIR STANDARD CYCLES 9
Otto, Diesel, Dual, Ericsson, Atkinson, Stirling and Brayton cycles - Air standard efficiency – Mean effective pressure.

UNIT IV  FUNDAMENTALS OF VAPOUR POWER CYCLES 9
Properties of pure substances – solid, liquid and vapour phases, phase rule, p-v, p-T, T-v, T-s, h-s diagrams, p-v-T surfaces, thermodynamic properties of steam - calculations of work done and heat transfer in non-flow and flow processes - standard Rankine cycle, Reheat and Regeneration cycle. Heat rate, Specific steam consumption, Tonne of refrigeration.

UNIT V  BASICS OF PROPULSION AND HEAT TRANSFER 9
Classification of jet engines - basic jet propulsion arrangement – Engine station number, thrust equation – Specific thrust, SFC, TSFC, specific impulse, actual cycles, isentropic efficiencies of jet engine components, polytropic efficiency, conduction in parallel, radial and composite wall, Basics of convective and radiation heat transfer.

COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
- CO1: Apply the laws of thermodynamics in real time problems.
- CO2: Demonstrate the principal operation of piston engine and jet engines.
- CO3: Demonstrate the efficiency of different air standard cycles.
- CO4: Determine the heat transfer in different conditions of working medium.
- CO5: Solve heat transfer problems in complex systems.
- CO6: Solve problems related to conduction convention and radiation

TOTAL: 45 PERIODS

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COURSE OBJECTIVES:
1. Ability to think, Analyse and solve Engineering Problems expected from the course.
2. Ability to understand stress and strain concepts related to deformable bodies.
3. To enable understanding of the behaviour and response of materials and to allow the student to carry out easy and moderate level structural analysis of basic structural members.
4. To familiarize with the different methods used for beam deflection analysis.
5. To impart knowledge to the students on how structural elements are sized and to enable the student to gain knowledge in how stresses are developed and distributed internally.

UNIT I CONCURRENT AND NON-CONCURRENT 12
Introduction, Concept of FBD, Coplanar Concurrent force system, Moments, Coplanar Non-Concurrent force system and Support Reactions – Application Problems.

UNIT II SHEAR FORCE AND BENDING MOMENT, SECOND AREA MOMENT PROBLEMS 12
Analysis of Simple Truss, Shear Force and Bending Moment Diagrams, C.G. and M.I of Plane areas.

UNIT III AXIAL BAR AND MATERIAL MODULUS 12

UNIT IV BEAM BENDING AND TORSION 12
Axially loaded members, Statically indeterminate structures, Thermal effects, misfits, and Pre-strains. Torsion of circular bar, Transmission of power by circular shafts. Stresses in beams, Pure bending and Nonuniform bending, Design of beams for bending stresses, Shear stresses in beams of rectangular cross section.

UNIT V STRESS TRANSFORMATION, DEFLECTION OF BEAM AND BUCKLING OF COLUMN 12
Plane stress, Principal stresses, Mohr’s circle and Hooke’s law for plane stresses. Spherical and Cylindrical pressure vessels. Deflection of beams, Column buckling.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of the course, Students will be able to
CO1: Clear understanding of mechanical behaviour of materials.
CO2: Knowledge of different structural members and load types.
CO3: Design members under axial loading.
CO4: Design member under torsion loading.
CO5: Calculate beams deflections.

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Low (1) ; Medium (2) ; High (3)
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 it’s variations - Work saved by fitting air vessels - Rotary pumps.

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

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

- To acquire the knowledge on the Historical evaluation of Airplanes
- To learn the different component systems and functions
- To know the concepts of basic properties and principles behind the flight
- To learn the basics of different structures & construction
- To learn the various types of power plants used in aircrafts

UNIT I  HISTORY OF FLIGHT

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

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


UNIT IV  BASICS OF AIRCRAFT STRUCTURES


UNIT V  BASICS OF PROPULSION

Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust Production - Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to
CO1: Illustrate the history of aircraft & developments over the years
CO2: Ability to identify the types & classifications of components and control systems
CO3: Explain the basic concepts of flight & Physical properties of Atmosphere
CO4: Identify the types of fuselage and constructions.
CO5: Distinguish the types of Engines and explain the principles of Rocket

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COURSE OBJECTIVES:
1. To impart knowledge of the hydraulic and pneumatic systems components
2. To Study the types of instruments and its operation including navigational instruments.
3. Acquire the knowledge of essential systems of safe aircraft operation.
4. To learn the concepts of display systems
5. To study the various engine systems in aircraft

UNIT I AIRCRAFT SYSTEMS
Hydraulic systems – Study of typical systems – components – Hydraulic systems controllers
Modes of operation – Pneumatic systems – Working principles – Typical Pneumatic Power system

UNIT II AIRPLANE CONTROL SYSTEMS
Conventional Systems – Power assisted and fully powered flight controls – Power actuated systems
– Engine control systems – Push pull rod system – operating principles – Modern control systems –
Digital fly by wire systems – Auto pilot system.

UNIT III ENGINE SYSTEMS
Piston and Jet Engines- Fuel systems – Components - Multi-engine fuel systems, lubricating
systems – Starting and Ignition systems.

UNIT IV AIRCONDITIONING AND PRESSURIZING SYSTEM
Basic Air Cycle systems – Vapour Cycle Systems, Boot-strap air cycle system – Evaporative vapour
cycle systems – Evaporation air cycle systems – Oxygen systems – Fire extinguishing system and
smoke detection system, Deicing and anti-icing system.

UNIT V AIRCRAFT INSTRUMENTS
Flight Instruments and Navigation Instruments – Accelerometers, Air speed Indicators – Mach
Meters – Altimeters - Gyroscopic Instruments– Principles and operation – Study of various types of
engine instruments – Tachometers – Temperature and Pressure gauges.

TOTAL: 45 PERIODS

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

CO1: Demonstrate the ability to design a various system using pneumatic and hydraulic
components.

CO2: Keep abreast knowledge on various flight control system and its recent advancements.

CO3: Demonstrate the fundamental understanding of the operation of engine auxiliary systems.

CO4: To understand the various cabin comfort system used in aircraft modern display systems.

CO5: Describe the principle behind the operation of various vital parameter displays and its uses
in effective conduct of the flight.

TEXT BOOKS:

REFERENCES:
1. Handbooks of Airframe and Power plant Mechanics, US dept. of Transportation, Federal,
Aviation Administration, the English Book Store, New Delhi, 1995.
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OBJECTIVES:
- To study the mechanical properties of materials when subjected to different types of loading.
- To study how to improve the material properties.
- To understand the nature of materials under microscopic Examination

STRENGTH OF MATERIALS

LIST OF EXPERIMENTS
1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminum rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
10. Tempering- Improvement Mechanical properties Comparison
   (i) Unhardened specimen
   (ii) Quenched Specimen and
   (iii) Quenched and tempered specimen.
11. Microscopic Examination of
   (i) Hardened samples and
   (ii) Hardened and tempered samples

OUTCOMES:
- Analyse the Hardness and Tensile strength of the given material
- Examine the deformation and torsion strength of the given material
- Analyse the compression and shear strength of given materials

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THERMODYNAMICS LABORATORY

OBJECTIVE:
- To study the engine types and its performance
- To understand the importance of heat transfer and its application.
- To understand the fuel properties.

LIST OF EXPERIMENTS
1. Performance test on a 4-stroke engine
2. Valve timing of a 4 – stroke engine and port timing of a 2 stroke engine
3. Determination of effectiveness of a parallel flow heat exchanger
4. Determination of effectiveness of a counter flow heat exchanger
5. Determination of heating value of a fuel
6. Determination of specific heat of solid
7. Determination of thermal conductivity of solid.
8. Determination of thermal resistance of a composite wall.
9. COP test on a vapour compression refrigeration test rig
10. COP test on a vapour compression air-conditioning test rig

TOTAL: 60 PERIODS

OUTCOMES:
- Perform test on diesel/petrol engine
- Determine the properties of the fuels.
- Analyze the heat transfer properties of solid and composite walls

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COURSE OBJECTIVES:
- Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices.
- Also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.,

LIST OF EXPERIMENTS

A. FLOW MEASUREMENT
1. Verification of Bernoulli’s theorem
2. Flow through Orifice/Venturi meter
3. Friction factor for flow through pipes
4. Impact of jet on fixed plate

B. METACENTRE
5. Determination of metacentric height

C. PUMPS
6. Characteristics of Centrifugal pump
7. Characteristics of Gear pump
8. Characteristics of Submersible pump
9. Characteristics of Reciprocating pump

D. TURBINES
10. Characteristics of Pelton wheel turbine
11. Characteristics of Francis turbine

TOTAL : 60 PERIODS

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

CO1 Verify and apply Bernoulli equation for flow measurement like Orifice/Venturi meter.
CO2 Measure friction factor in pipes and compare with Moody diagram and verify momentum conservation law.
CO3 Determine the performance characteristics of Rotodynamic pumps.
CO4 Determine the performance characteristics of positive displacement pumps.
CO5 Determine the performance characteristics of turbines.

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

MS WORD: 10 Hours
Create and format a document
Working with tables
Working with Bullets and Lists
Working with styles, shapes, smart art, charts
Inserting objects, charts and importing objects from other office tools
Creating and Using document templates
Inserting equations, symbols and special characters
Working with Table of contents and References, citations
Insert and review comments
Create bookmarks, hyperlinks, endnotes footnote
Viewing document in different modes
Working with document protection and security
Inspect document for accessibility

MS EXCEL: 10 Hours
Create worksheets, insert and format data
Work with different types of data: text, currency, date, numeric etc.
Split, validate, consolidate, Convert data
Sort and filter data
Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,)
Work with Lookup and reference formulae
Create and Work with different types of charts
Use pivot tables to summarize and analyse data
Perform data analysis using own formulae and functions
Combine data from multiple worksheets using own formulae and built-in functions to generate results
Export data and sheets to other file formats
Working with macros
Protecting data and Securing the workbook

MS POWERPOINT: 10 Hours
Select slide templates, layout and themes
Formatting slide content and using bullets and numbering
Insert and format images, smart art, tables, charts
Using Slide master, notes and handout master
Working with animation and transitions
Organize and Group slides
Import or create and use media objects: audio, video, animation
Perform slideshow recording and Record narration and create presentable videos

TOTAL: 30 PERIODS
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.
MA3452  VECTOR CALCULUS AND COMPLEX FUNCTIONS  L T P C
3 1 0 4

OBJECTIVES:
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.

UNIT I  VECTOR CALCULUS  9+3
Gradient and directional derivative – Divergence and curl – Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral – Area of a curved surface – Volume integral – Green’s, Gauss divergence and Stoke’s theorems – Verification and application in evaluating line, surface and volume integrals.

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

UNIT III  COMPLEX INTEGRATION  9+3

UNIT IV  LAPLACE TRANSFORMS  9+3

UNIT V  ORDINARY DIFFERENTIAL EQUATIONS  9+3

TOTAL: 60 PERIODS

OUTCOMES:
Upon successful completion of the course, students should be able to:
- Evaluate real and complex integrals using the Cauchy integral formula and the residue theorem.
- Appreciate how complex methods can be used to prove some important theoretical results.
- Evaluate line, surface and volume integrals in simple coordinate systems.
- Calculate grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities.
- Use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.
TEXT BOOKS

REFERENCES

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COURSE OBJECTIVES:
- To introduce the concepts of mass, momentum and energy conservation relating to aerodynamics.
- To introduce the Navier Stroke equations and its application
- To make the student understand the concept of vorticity, irrotationality, theory of airfoil and wing sections.
- To introduce the basics of viscous flow.
- To make the student to understand the different boundary layers and Blasius Solution
- To introduce the basics of turbulence flow

UNIT I  INTRODUCTION TO LOW-SPEED FLOW
Euler equation, incompressible Bernoulli’s equation, circulation and vorticity, green’s lemma and Stoke’s theorem, barotropic flow, kelvin’s theorem, streamline, stream function, irrotational flow, potential function, Equipotential lines, elementary flows and their combinations.

UNIT II  TWO-DIMENSIONAL INVISCID INCOMPRESSIBLE FLOW
Ideal Flow over a circular cylinder, D’Alembert’s paradox, magnus effect, Kutta Joukowski’s theorem, starting vortex, Kutta condition, real flow over smooth and rough cylinder.

UNIT III  AIRFOIL THEORY
Cauchy-Riemann relations, complex potential, methodology of conformal transformation, Kutta-Joukowski transformation and its applications, thin airfoil theory and its applications.

UNIT IV  SUBSONIC WING THEORY
Vortex filament, Biot and Savart law, bound vortex and trailing vortex, horse shoe vortex, lifting line theory and its limitations.

UNIT V  INTRODUCTION TO BOUNDARY LAYER THEORY
Boundary layer and boundary layer thickness, displacement thickness, momentum thickness, energy thickness, shape parameter, boundary layer equations for a steady, two-dimensional incompressible flow, boundary layer growth over a flat plate, critical Reynolds number, Blasius solution, basics of turbulent flow.

COURSE OUTCOMES:
On completion of the course, the student is expected to be able to
CO1: Apply the basics physics for low-speed flows.
CO2: Apply the concept of 2D, inviscid incompressible flows in low-speed aerodynamics.
CO3: Solve lift generation problems using aerofoil theories.
CO4: Make use of lifting line theory for solving flow properties.
CO5: Solve the boundary layer equations for a steady, two-dimensional incompressible flow
CO6: Solve the properties of turbulent flow.

TOTAL: 45 PERIODS

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OBJECTIVES:
1. To establish fundamental approach and application of jet engine components.
2. To learn about the analysis of flow phenomenon and estimation of thrust developed by jet engine.
3. To introduce about the application of various equations in Gas Turbine Engines.
4. To learn the concepts of jet engine combustion chambers
5. To acquire knowledge on compressors and turbines

UNIT I  PRINCIPLES OF AIR BREATHING ENGINES  9+6

UNIT II  JET ENGINE INTAKES AND EXHAUST NOZZLES  9+6

UNIT III  JET ENGINE COMBUSTION CHAMBERS  9+6

UNIT IV  JET ENGINE COMPRESSORS  9+6

UNIT V  JET ENGINE TURBINES  9+6

COURSE OUTCOMES:
On completion of the course, the student is expected
CO1: To be able to apply control volume and momentum equation to estimate the forces produced by aircraft propulsion systems
CO2: To be able to describe the principal figures of merit for aircraft engine
CO3: To be able to describe the principal design parameters and constraints that set the performance of gas turbine engines.
CO4: To apply ideal and actual cycle analysis to a gas turbine engine to relate thrust and fuel burn to component performance parameters.
CO5: Understanding the workings of multistage compressor or turbine, and to be able to use velocity triangles and the Euler Turbine Equation to estimate the performance of a compressor or turbine stage.

TEXT BOOK:
REFERENCES:

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83
COURSE OBJECTIVES:
1. To understand the principles in the formation of mechanisms and their kinematics.
2. To learn the basic concepts of toothed gearing and kinematics of gear trains.
3. To study the effect of friction in different machine elements.
4. To analyse the forces and torque acting on simple mechanical systems.
5. To understand the importance of balancing and vibration.

UNIT I KINEMATIC ANALYSIS IN SIMPLE MECHANISMS AND CAMS

UNIT II TOOTHE GEARING AND GEAR TRAINS

UNIT III FRICTION ASPECTS IN MACHINE COMPONENTS

UNIT IV STATIC AND DYNAMIC FORCE ANALYSIS

UNIT V BALANCING OF ROTATING MASSES AND VIBRATION

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Design the linkages and the cam mechanisms for specified output motions.
CO2: Determine the gear parameters of toothed gearing and speeds of gear trains in various applications.
CO3: Evaluate the frictional torque in screw threads, clutches, brakes and belt drives.
CO4: Determine the forces on members of mechanisms during static and dynamic equilibrium conditions.
CO5: Determine the balancing masses on rotating machineries and the natural frequencies of free and forced vibratory systems.

TEXT BOOK

REFERENCES
5. Thomas Bevan, “The Theory of Machines”, Pearson Education Ltd., 2010
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COURSE OBJECTIVES:
- To provide the students an understanding on the linear static analysis of determinate and indeterminate aircraft structural components.
- To provide the students an understanding on energy methods to statically determinate and indeterminate structures.
- To make the students to Create a structure to carry the given load.
- To make the students to Calculate the response of statically indeterminate structures under various loading conditions.
- To provide the design process using different failure theories.

UNIT I  STATICALLY DETERMINATE & INDETERMINATE STRUCTURES  9

UNIT II  ENERGY METHODS  9

UNIT III  COLUMNS  9
Euler’s column curve – inelastic buckling – effect of initial curvature – Southwell plot – columns with eccentricity – use of energy methods – theory of beam columns – beam columns with different end conditions – stresses in beam columns.

UNIT IV  FAILURE THEORIES  9

UNIT V  INDUCED STRESSES  9
Thermal stresses – impact loading – Fatigue – Creep - Stress Relaxation

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, Students can able to
- CO1: Explain the method to analyse the linear static analysis of determinate and indeterminate aircraft structural components
- CO2: Apply the energy methods to determine the reactions of structure.
- CO3: Analyse the column structure with different end condition.
- CO4: Design the component using different theories of failure.
- CO5: Create a structure to carry the given load by considering effect of induced stresses.

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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  6

UNIT II  ENVIRONMENTAL POLLUTION  6

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

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

UNIT V  SUSTAINABILITY PRACTICES  6

TOTAL : 30 PERIODS

OUTCOMES:

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

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

**REFERENCES:**

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**NX3451 (ARMY WING) NCC Credit Course Level - II**

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### LEADERSHIP

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

### DISASTER MANAGEMENT

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### ENVIRONMENTAL AWARENESS & CONSERVATION

| EA 1 | Environmental Awareness and Conservation                                                                            | 3 |

### GENERAL AWARENESS

| GA 1 | General Knowledge                                                                                                  | 4 |

### ARMED FORCES

| AF 1 | Armed Forces, Army, CAPF, Police                                                                                  | 6 |

### ADVENTURE

| AD 1 | Introduction to Adventure Activities                                                                            | 1 |

### BORDER & COASTAL AREAS

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

**TOTAL: 45 PERIODS**
### NCC Credit Course Level 2*

**NX3452 (NAVAL WING) NCC Credit Course Level - II**

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**TOTAL: 45 PERIODS**
PERSONALITY DEVELOPMENT
PD 3 Group Discussion: Change your mindset, Time Management, Social Skills
PD 5 Public Speaking

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

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

ENVIRONMENTAL AWARENESS & CONSERVATION
EA 1 Environmental Awareness and Conservation

GENERAL AWARENESS
GA 1 General Knowledge

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

ADVENTURE
AD 1 Introduction to Adventure Activities

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

- To understand pressure distribution and characteristic over an airfoil and bluff bodies due to airflow.
- To measure the forces and moments acting on the airfoil at different angle of attack using wind tunnel balance set up.
- To visualize the flow pattern over an object by different method.

LIST OF EXPERIMENTS

1. Calibration of a subsonic Wind tunnel.
2. Determination of lift for the given airfoil section.
3. Pressure distribution over a smooth circular cylinder.
4. Pressure distribution over a rough circular cylinder.
5. Pressure distribution over a symmetric aerofoil.
6. Pressure distribution over a cambered aerofoil.
7. Force measurement using wind tunnel balancing set up.
8. Flow over a flat plate at different angles of incidence.
10. Flow visualization studies in low speed flows over airfoil with different angle of incidence.
11. Flow visualization on bluff bodies using water flow channel

TOTAL: 60 PERIODS

OUTCOMES:

- Calculate the aerodynamic forces and moments experienced by airfoils, wings and bluff bodies.
- Evaluate the performance of thin airfoils with the effects of angle of attack and camber by considering thin aerofoil theory.
- Measure flow velocity, lift and drag by use of wind tunnel instrument and to Visualize the flow by water flow and smoke methods.
OBJECTIVES:
- To explore practically components of aircraft piston and gas turbine engines and their working principles.
- To impart practical knowledge of flow phenomenon of subsonic and supersonic jets.
- To determine practically thrust developed by rocket propellants.

LIST OF EXPERIMENTS
1. Study of aircraft piston and its components.
2. Determine the velocity profiles of free jets.
3. Determine velocity profiles of wall jets.
4. Wall pressure measurements of a subsonic diffusers and ramjet ducts.
5. Flame stabilization studies using conical and hemispherical flame holders.
6. Cascade testing of compressor blades.
7. Velocity and pressure measurements high speed jets.
8. Wall Pressure measurements of supersonic nozzle.
9. Wall pressure measurements on supersonic inlet.

TOTAL: 60 PERIODS

OUTCOMES
- Identify components and information of piston and gas turbine engine.
- Analyze the behaviour of flow through ducts and jet engine components to distinguish subsonic and supersonic flow characteristics.
- Visualize flow phenomenon in supersonic flow.

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COURSE OBJECTIVES:
01. To familiarise the student, the generalized theory of pure bending and work out problems in the calculation of bending stress involving different methods.
02. To gain knowledge in the concept of shear flow in thin-walled sections.
03. To carry out shear flow analysis involving different types of sections.
04. To impart theoretical knowledge on the behaviour of thin plates and thin-walled columns.
05. To carry out basic stress analysis procedures involving aircraft structural components.

UNIT I UNSYMMETRICAL BENDING OF BEAMS
Unsymmetrical bending of beams – different methods of analysis (neutral axis method, ‘k’ method, and the principal axis method), stresses and deflections in beams under unsymmetrical bending.

UNIT II SHEAR FLOW IN OPEN SECTIONS
Definition and expression for shear flow due to bending, shear flow in thin-walled Open sections with and without stiffening elements, torsion of thin-walled Open sections, the shear center of symmetric and unsymmetrical open sections, structural idealization.

UNIT III SHEAR FLOW IN CLOSED SECTIONS
Shear flow due to bending and torsion in single-cell and multi-cell structures, the shear center of symmetric and unsymmetrical closed sections, effect of structural idealization, shear flow in a tapered beam, stress analysis of thin-webbed beams using Wagner’s theory.

UNIT IV BUCKLING OF PLATES
Behaviour of a rectangular plate under compression, governing equation for plate buckling, buckling analysis of sheets and stiffened panel under compression, concept of the effective sheet width, buckling due to shear and combined loading, crippling.

UNIT V AIRCRAFT STRESS ANALYSIS
Loading and analysis of aircraft wing, fuselage, and tail unit. Use of V-n diagram for sizing the aircraft wing, fuselage, and tail unit.

COURSE OUTCOMES:
Upon completion of the course, Students will be able to
CO1: Analyse and investigate the normal stress variation on unsymmetrical sections subjected to bending moments.
CO2: Determine the shear flow variation in thin walled open sections with skin effective and ineffective in bending. Also to find out the shear centre of sections.
CO3: Calculate the shear flow variation in single cell and multicell tubes subjected to shear and torque loads.
CO4: Investigate the behaviour of buckling of simply supported plates and also to know the effective width of sheet stringers combination.
CO5: Analyse the shear and bending moment variation of aircraft wing and fuselage and also to know the characteristics of thin webbed beams.

TEXT BOOKS:
REFERENCES:

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COURSE OBJECTIVES:

- To introduce the concepts of compressibility,
- To learn the theory behind the formation of shocks and expansion fans in Supersonic flows.
- To introduce the methodology of measurements in Supersonic flows.
- To get knowledge on high speed flow over airfoils, wings and airplane configuration.
- To learn the concepts of Transonic flow

UNIT I  ONE DIMENSIONAL COMPRESSIBLE FLOW  9
Energy, Momentum, continuity and state equations, velocity of sound, adiabatic steady state flow equations, Flow through convergent-divergent passage, Performance under various back pressures.

UNIT II  NORMAL AND OBLIQUE SHOCKS  9
Prandtl equation and Rankine – Hugonoit relation, Normal shock equations, Pitot static tube, corrections for subsonic and supersonic flows, Oblique shocks and corresponding equations, Hodograph and pressure turning angle, shock polar, flow past wedges and concave corners, strong, weak and detached shocks

UNIT III  EXPANSION WAVES AND METHOD OF CHARACTERISTICS  9

UNIT IV  DIFFERENTIAL EQUATIONS OF MOTION FOR STEADY COMPRESSIBLE FLOWS  9
Small perturbation potential theory, solutions for supersonic flows, Mach waves and Mach angles, Prandtl-Glauert rule - affine transformation relations for subsonic flows, linearized two dimensional supersonic flow theory - Lift, drag, pitching moment and center of pressure of supersonic profiles.

UNIT V  TRANSONIC FLOW OVER WING  9
Lower and upper critical Mach numbers, Lift and drag, divergence, shock induced separation, Characteristics of swept wings, Effects of thickness, camber and aspect ratio of wings, Transonic area rule.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, Students will be able to

- CO1: Calculate the compressible flow through a duct of varying cross section.
- CO2: Use quasi one-dimensional theory to analyse compressible flow problems.
- CO3: Estimate fluid properties in Rayleigh and Fanno type flows.
- CO4: Estimate the properties across normal and oblique shock waves.
- CO5: Understand the knowledge of various techniques and methods for solving differential equations of motion for steady compressible flows.
- CO6: Predict the properties of transonic flows.

TEXT BOOKS:
REFERENCES

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COURSE OBJECTIVES:
- To enable the students understand the behavior of aircraft structural components under different loading conditions.
- To provide the Principle involved in photo elasticity and its applications in stress analysis for composite laminates.
- To obtain the stresses in circular discs and beams using photo elastic techniques

LIST OF EXPERIMENTS
1. Deflection of Beams
2. Verification of superposition theorem
3. Verification of Maxwell’s reciprocal theorem
4. Buckling load estimation of slender eccentric columns
5. Determination of flexural rigidity of composite beams
6. Unsymmetrical Bending of a Cantilever Beam
7. Combined bending and Torsion of a Hollow Circular Tube
8. Material Fringe Constant of a Photo elastic Models
9. Shear Centre of a Channel Section
10. Free Vibration of a Cantilever Beam
11. Forced Vibration of a cantilever Beam
12. Fabrication of a Composite Laminate.
15. Tension field beam
Any 10 experiments can be chosen

TOTAL: 60 PERIODS

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Evaluate the effects of bending in the aircraft structures.
CO2: Explain the shear centre of the aircraft structures.
CO3: Compare the photo-elastic techniques on the aircraft structures.
CO4: Justify the experimental findings in clear oral and concise report.

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OBJECTIVES:
- To make the students familiarize with computational fluid dynamics and structural analysis software tools.
- To learn the concepts involved in designing a product
- To understand the importance of specification parameters while designing

LIST OF EXPERIMENTS
1. Computer aided design of subsonic diffusers.
2. Computer aided design of supersonic diffusers.
3. Computer aided design of a compressor blade.
6. Computer aided design of typical aircraft wing.
7. Computer aided design of typical fuselage structure.
8. Computer aided design of a landing gear.
10. Computer aided design of a re-entry vehicles.
11. Computer aided design of a Missiles.

TOTAL: 60 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
- Compare commercial design software and understand its structure.
- Deduct the aircraft and spacecraft components and solve engineering problems.
- Explain a formal technical report and convey engineering specifications.

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COURSE OBJECTIVE:

- Know about the forces and moments that are acting on an aircraft, the different types of drag, drag polar, ISA, variation of thrust, power, SFC with velocity and altitude.
- Have understanding about performance in level flight, minimum drag and power required, climbing, gliding and turning flight, v-n diagram and load factor.
- Knowledge about degrees of stability, stick fixed and stick free stability, stability criteria, effect of fuselage and CG location, stick forces, aerodynamic balancing.
- Understanding about lateral control, rolling and yawing moments, static directional stability, rudder and aileron control requirements and rudder lock.
- Understanding about dynamic longitudinal stability, stability derivatives, modes and stability criterion, lateral and directional dynamic stability.

UNIT I  CRUISING FLIGHT PERFORMANCE  9+6
Forces and moments acting on a flight vehicle - Equation of motion of a rigid flight vehicle - Different types of drag – estimation of parasite drag co-efficient by proper area method - Drag polar of vehicles from low speed to high speeds - Variation of thrust, power with velocity and altitudes for air breathing engines. Performance of airplane in level flight - Power available and power required curves. Maximum speed in level flight - Conditions for minimum drag and power required.

UNIT II  MANOEUVERING FLIGHT PERFORMANCE  9+6
Range and endurance - Climbing and gliding flight (Maximum rate of climb and steepest angle of climb, minimum rate of sink and shallowest angle of glide) – Takeoff and landing - Turning performance (Turning rate turn radius). Bank angle and load factor – limitations on turn - V-n diagram and load factor.

UNIT III  STATIC LONGITUDINAL STABILITY  9+6
Degree of freedom of rigid bodies in space - Static and dynamic stability - Purpose of controls in airplanes – Inherently stable and marginal stable airplanes – Static, Longitudinal stability - Stick fixed stability - Basic equilibrium equation - Stability criterion - Effects of fuselage and nacelle - Influence of CG location - Power effects - Stick fixed neutral point - Stick free stability-Hinge moment coefficient - Stick free neutral points-Symmetric maneuvers - Stick force gradients - Stick force per ‘g’ - Aerodynamic balancing.

UNIT IV  LATERAL AND DIRECTIONAL STABILITY  9+6
Dihedral effect - Lateral control - Coupling between rolling and yawing moments - Adverse yaw effects - Aileron reversal - Static directional stability - Weather cocking effect - Rudder requirements - One engine inoperative condition - Rudder lock.

UNIT V  DYNAMIC STABILITY  9+6
Introduction to dynamic longitudinal stability: - Modes of stability, effect of freeing the stick - Brief description of lateral and directional, dynamic stability - Spiral, divergence, Dutch roll, auto rotation and spin.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1:  Build an understanding about forces & moments of an aircraft, types of drag, drag polar, and performance in level flight

CO2:  Develop an understanding about basic maneuvering performance (range, endurance, climbing, gliding & turning flight), v-n diagram and load factor.

CO3:  Build knowledge about degrees of stability, stick fixed & stick free stability, stability criteria, effect of fuselage & CG location, stick forces, aerodynamic balancing.

CO4:  Explanation about lateral control, rolling & yawing moments, static directional stability, rudder & aileron control requirements and rudder lock.
CO5: Illustration about dynamic longitudinal stability, stability derivatives, modes & stability criterion, lateral and directional dynamic stability.

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COURSE OBJECTIVES:
- To understand the purpose and scope of aircraft design
- To provide the student to understand the layout of procedure for evaluation of the aircraft design.
- To make the student to understand the importance of fixing of power plant location.
- To make the student to understand the choice of the selection of design parameters.
- Fixing the geometry and to investigate the performance and stability characteristics of airplanes.

UNIT I INTRODUCTION
State of art in airplane design, Purpose and scope of airplane design, Classification of airplanes based on purpose and configuration. Factors affecting configuration, Merits of different plane layouts. Stages in Airplane design. Designing for manufacturability, Maintenance, Operational costs, Interactive designs.

UNIT II PRELIMINARY DESIGN PROCEDURE

UNIT III POWER PLANT SELECTION
Choices available, comparative merits, Location of power plants, Functions dictating the locations.

UNIT IV DESIGN OF WING, FUSELAGE AND EMPHANAGE
Selection of aero foil. Selection of Wing parameters, selection of sweep, Effect of Aspect ratio, Wing Design and Airworthiness requirements, V-n diagram, loads, Structural features. Elements of fuselage design, Loads on fuselage, Fuselage Design. Fuselage and tail sizing. Determination of tail surface areas, Tail design, Structural features, check for nose wheel lift off.

UNIT V DESIGN OF LANDING GEAR AND CONTROL SURFACE

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, Students will be able to
CO1: Explain the preliminary design of an aircraft starting from data collection to satisfy mission specifications.
CO2: Apply the procedure involved in weight estimation, power plant selection, estimation of the performance parameters, stability aspects, design of structural components of the airplane, stability of structural elements, estimation of critical loads etc
CO3: Estimate of geometric and design parameters of an airplane and to initiate the design of a system, component, or process to meet requirements for aircraft systems;
CO4: Design the aircraft to a level of sufficient detail to demonstrate that it satisfies given mission specifications
CO5: Create a Work environment involving the integration of engineering practices in such subjects as aerodynamics, structures, propulsion, and flight mechanics.

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

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

### ARMED FORCES
- **AF 2**  Modes of Entry to Army, CAPF, Police  3

### COMMUNICATION
- **C 1**  Introduction to Communication & Latest Trends  3

### INFANTRY
- **INF 1**  Organisation of Infantry Battalion & its weapons  3

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

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

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

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**TOTAL**  
60 PERIODS
NCC Credit Course Level 3*

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

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TOTAL : 45 PERIODS
COURSE OBJECTIVES:
- To make the student work in groups and effectively improve their team work.
- To understand the Concepts involved in Aerodynamic design, Performance analysis and stability aspects of different types of airplanes
- To carry out the structural design part of the airplane

AERODYNAMIC DESIGN:
1. Comparative studies of different types of airplanes and their specifications and performance details with reference to the design work under taken.
2. Preliminary weight estimation, Selection of design parameters, power plant selection, aerofoil selection, fixing the geometry of Wing, tail, control surfaces Landing gear selection.
3. Preparation of layout drawing, construction of balance and three view diagrams of the airplane under consideration.

STRUCTURAL DESIGN:
1. Preliminary design of an aircraft wing – Shrenck’s curve, structural load distribution, shear force, bending moment and torque diagrams
2. Detailed design of an aircraft wing – Design of spars and stringers, bending stress and shear flow calculations – buckling analysis of wing panels
3. Preliminary design of an aircraft fuselage – load distribution on an aircraft fuselage
4. Detailed design of an aircraft fuselage – design of bulkheads and longerons – bending stress and shear flow calculations – buckling analysis of fuselage panels
5. Design of control surfaces - balancing and maneuvering loads on the tail plane and aileron, rudder loads
6. Design of wing-root attachment
7. Landing gear design
8. Preparation of a detailed design report with CAD drawings

TOTAL: 60 PERIODS

COURSE OUTCOME:
Upon completion of the Aircraft Design Project students will able to
CO1: Evaluate the weight estimation, drag estimation and selection of design parameters of the aircraft
CO2: Estimate the performance of the aircraft design.
CO3: Design the aircraft wings, fuselage, loading gears etc., in structural point of view.

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COURSE OBJECTIVES:

Of this course are
01. To make students learn the steps involved in CG determination.
02. To introduce the methods of calibrating various flight instruments.
03. To impart practical knowledge to students on determining various performance parameters.
04. To find the neutral points and maneuver points in an aircraft.
05. To impart practical knowledge to students about different modes of stability such as Dutch roll, phugoid motion etc.

- The experiments will be conducted by the students during the flight training programme at IIT- Kanpur or similar place and evaluation is also done by the faculty of IIT-Kanpur. Otherwise the experiments can also be done using Flight simulator.

LIST OF EXPERIMENTS

1. C.G. determination
2. Calibration of ASI and Altimeter
3. Calibration of special instruments
4. Cruise and climb performance
5. Determination of stick fixed & stick free neutral points
6. Determination of stick fixed & stick free maneuver points
7. Verification of Lateral-directional equations of motion for a steady state side slip maneuver
8. Verification of Lateral-directional equations of motion for a steady state coordinated turn
9. Flight determination of drag polar of a glider
10. Demonstration of stall, Phugoid motion and Dutch roll

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of this course, Students will be able to

CO1: Acquire flying experience on a trainer aircraft.
CO2: Determine the C.G position of an airplane.
CO3: Calculate the performance parameters such as rate of climb, climb angle etc.
CO4: Compute the stability parameters such as stick fixed neutral point, stick free neutral point and control parameters such as stick fixed manoeuvre point, stick free manoeuvre point.
CO5: Get practical experience of Dutch roll and phugoid motion.

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COURSE OBJECTIVES:
- To learn the Types of low speed Wind tunnels and non-dimensional numbers with its applications.
- To learn the Types of high speed Wind tunnels and with its calibration methods.
- To understand the Special Wind tunnels and with its calibration methods with its design methods.
- To describe flow visualization techniques and data acquisition methods.
- To understand the functions of various instruments associated with wind tunnel

UNIT I LOW SPEED WIND TUNNELS
Classification –non-dimensional numbers-types of similarities - Layout of open circuit and closed circuit subsonic wind tunnels – design parameters-energy ratio - HP calculations - Calibration methods.

UNIT II HIGH SPEED WIND TUNNELS
Blow down, in draft and induction tunnel layouts and their design features -Transonic, and supersonic tunnels- peculiar features of these tunnels and operational difficulties - sample design calculations and calibration methods.

UNIT III SPECIAL WIND TUNNEL TECHNIQUES
Types of Special Wind Tunnels – Hypersonic, Gun and Shock Tunnels – Design features and calibration methods- Intake tests – store carriage and separation tests - wind tunnel model design for these tests

UNIT IV WIND TUNNEL INSTRUMENTATION

UNIT V FLOW VISUALIZATION and NON-INTRUSIVE FLOW DIAGNOSTICS
Smoke and Tuft grid techniques – Dye injection special techniques – Oil flow visualization and PSP techniques - Optical methods of flow visualization – PIV and Laser Doppler techniques – Image processing and data deduction

COURSE OUTCOMES:
At the end of the course, students will be able to
- CO1: Explain the uses of various types of tunnels and its losses
- CO2: Experiment with calibration of different types of high speed tunnels
- CO3: Make use of various special tunnels and its applications
- CO4: Make use of various measurement techniques of instruments of wind tunnel
- CO5: Can use various techniques for aerodynamic data generation

TOTAL: 45 PERIODS

TEXT BOOKS:
1. NAL-UNI Lecture Series 12:“ Experimental Aerodynamics”, NAL SP 98 01 April 1998

REFERENCES:
1. Bradshaw "Experimental Fluid Mechanics".
2. Lecture course on Advanced Flow diagnostic techniques 17-19 September 2008 NAL, Bangalore
5. Short term course on Flow visualization techniques, NAL , 2009
GE3791 HUMAN VALUES AND ETHICS

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

COURSE OBJECTIVES:

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

UNIT I

DEMOCRATIC VALUES
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 Michaels 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.
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
OBJECTIVES:

- To introduce the knowledge of the maintenance and repair procedures followed for overhaul of aero engines.
- To acquire knowledge in preparation of glass epoxy of composite laminates and its specimens.
- To learn about Welding and sheet metal repair.

LIST OF EXPERIMENTS

1. Dismantling of an aircraft piston engine.
2. Assembling of an aircraft piston engine.
3. Study of Camshaft operation, firing order and magneto, valve timing.
4. Study of lubrication and cooling system.
5. Study of auxiliary systems, pumps and carburetor.
6. Aircraft wood gluing—single & double scarf joints.
10. Sheet metal - Riveted Patch Repair.
11. Dye penetrant test - NDT.
12. Tube bending and flaring.

TOTAL: 30 PERIODS

OUTCOMES:

- Take part in Dismantling and reassembling of an aircraft piston engine.
- Inspect the Welding repair in various components of aircraft frames.
- Take part in preparation of glass epoxy of composite laminates and its specimens.

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AE3712  AIRCRAFT SYSTEMS LABORATORY  L T P C  0 0 2 1

OBJECTIVES:

- To train the students “ON HAND” experience in maintenance of various air frame systems in aircraft.
- To train students in rectification of common snags.
- To train students on maintenance of control systems.

LIST OF EXPERIMENTS

1. Aircraft “Jacking Up” procedure.
3. Control System “Rigging check” procedure.
4. Aircraft “Symmetry Check” procedure.
6. “Pressure Test” To assess hydraulic External/Internal Leakage
7. “Functional Test” to adjust operating pressure
8. “Pressure Test” procedure on fuel system components
9. “Brake Torque Load Test” on wheel brake units
10. Maintenance and rectification of snags in hydraulic and fuel systems.
11. Aircraft weighing procedure
12. Study of combinational control surfaces

TOTAL: 30 PERIODS

OUTCOMES:

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<td>Take part in inspections of aircraft components and systems.</td>
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<td>Examine various control surfaces of aircraft and their functions.</td>
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AE3781  COMPUTATIONAL ANALYSIS LABORATORY

OBJECTIVES:
To familiarize with
- The stress distribution
- Meshing of various geometries
- Variation of mechanical properties on different load conditions,
- Flow analysis, and
- Thermal analysis.

LIST OF EXPERIMENTS:
1. Grid independence study and convergence test using any simple case like cylinder
2. Simulation of flow over an aero foil
3. Simulation of flow over backward facing step.
4. Simulation of Karman vortex trail (vortex shedding) using circular cylinder.
5. External flow simulation of subsonic and supersonic aerofoils.
6. Internal flow simulation of subsonic, sonic and supersonic flow through a CD nozzle.
7. Structural analysis of bar and beam
8. Structural analysis of truss.
10. Structural analysis of fuselage structure.
11. Analysis of composite laminate structures.

TOTAL: 30 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
- Develop and effectively employ solid modelling and simulation tools.
- Choose right specification and create a simple trade diagram.
- Choose appropriate structural models.
- Make use of tools to analyse stress distribution over complex structural components.
- Construct 3d designs and conduct flow analysis

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AE3811 PROJECT WORK / INTERNSHIP

COURSE OBJECTIVES:
- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.
- The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor.
- The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required
at the end of the semester.

- The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

COURSE OUTCOME:
CO1: On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

CAE331  NUMERICAL METHODS IN FLUID DYNAMICS  L  T  P  C  
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COURSE OBJECTIVES
- To make students understand the complexity of general fluid dynamic equations in partial differential form in the mathematical nature of the equations.
- To make students understand the complexity of general fluid dynamic equations under different flow conditions
- To impart knowledge to students on the basic aspects of finite differences and finite volume methods
- To impart knowledge to students on the basic aspects of finite element methods
To expose the students on obtaining solutions for a set of a large number of algebraic equations using the panel methods as examples and to train them to obtain numerical solutions for steady supersonic flows

UNIT-I MATHMATICAL NATURE OF FLUID DYNAMIC EQUATIONS
Governing equations of fluid dynamics and modelling of fluid flow – Eulerian and Lagrangian approaches – Mathematical nature of fluid dynamic equations – Classification of partial differential equations – General behavior of different classes of fluid dynamic equations – Practical examples of fluid dynamic problems governed by different classes of partial differential equations – ill posed and well posed problems

UNIT-II BOUNDARY CONDITIONS AND CHOICE OF NUMERICAL SCHEMES
Importance of boundary conditions in obtaining the numerical solution of fluid dynamic equations - Types of boundary conditions - Boundary conditions for momentum equations for viscous and inviscid flows – Boundary conditions for energy equation for different flow conditions – Practical examples – Symmetry and cyclic boundary conditions – Stability of numerical solution and the choice of numerical schemes for different classes of fluid dynamic equations

UNIT-III INTRODUCTION TO FDM, FVM AND FEM
Introduction to finite difference, finite volume and finite element methods and their areas of application - A brief description of implementing methodologies for finite difference method, finite volume method and finite element method – Illustration of the methods using simple one dimensional fluid dynamic problems – Advantages and limitations of these methods

UNIT-IV PANEL METHODS
A brief description of source, sink and vortex flows – Application of panel methods – Methodology involved in implementing panel methods – Source panel method and its implementation - Solution methods for solving a set of large number of algebraic equations and their applications for panel methods – Solution example of flow over a circular cylinder – Vortex panel method and its implementation – Vortex lattice method

UNIT-V NUMERICAL METHODS FOR STEADY SUPERSONIC FLOWS

COURSE OUTCOMES:

CO1: will be able to understand the importance of numerical methods in finding solutions to complex engineering flow problems
CO2: will be able to develop interest in lifelong learning on numerical methods and apply the knowledge for the solution of aerospace related fluid dynamic problems
CO3: will acquire basic knowledge to learn modern engineering tools such as CFD software tools to solve and analyse the flow fields over the airplanes
CO4: will be able to apply skills to develop algorithms for the solutions of inviscid supersonic flow problems pertaining to aerospace field
CO5: will be able to create new computational techniques in computational methods such as FVM using the imparted knowledge
TEXT BOOKS:

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COURSE OBJECTIVES:
Of this course are
• To impart knowledge to students in the fundamental principles of various numerical methods which are useful to obtain numerical solutions to heat transfer problems.
• To make the students learn numerical methods to obtain solution to 1-D, 2-D and 3-D conductive heat transfer problems.
• To introduce both implicit and explicit methods for numerical solution of transient heat conduction problems to students.
• To make the students familiarize with the numerical treatment of convective heat transfer problems to compute velocity and temperature profiles in boundary problems.
• To acquaint students with the use of finite volume method in radiative heat transfer problems.

UNIT I  INTRODUCTION

UNIT II  CONDUCTIVE HEAT TRANSFER

UNIT III  TRANSIENT HEAT CONDUCTION

UNIT IV  CONVECTIVE HEAT TRANSFER

UNIT V  RADIATIVE HEAT TRANSFER

COURSE OUTCOMES:

Upon completion of this course, Students will be able to
CO1: Acquire knowledge on the basic concepts on the applications of numerical methods for the heat transfer problem solutions.

CO2: Appreciate the role of boundary conditions in defining the complexities and the methodology for numerical solutions of heat transfer problems.

CO3: Use both implicit and explicit schemes for transient heat conduction problems.

CO4: Compute the temperature profiles in thermal boundary layer.

CO5: Apply finite volume methods for radiative heat transfer problems and the role of Monte Carlo methods in radiative heat transfer.

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COURSE OBJECTIVES:
Of this course are
1. To give exposure to various methods of solution, in particular the finite element method.
2. To expose the student to a wide variety of problems involving discrete and continuum elements.
3. To impart knowledge in the basic theory of finite element formulation.
4. To allow the student to learn and understanding how element characteristic matrices are generated.
5. To impart knowledge in assembly of finite element equations, and solve for the unknowns.

UNIT I INTRODUCTION
Review of various approximate methods – variational approach and weighted residual approach; application to structural mechanic’s problems. finite difference methods - governing equation and convergence criteria of finite element method.

UNIT II DISCRETE ELEMENTS
Bar elements, uniform section, mechanical and thermal loading, varying section, 2D and 3D truss element. Beam element - problems for various loadings and boundary conditions – 2D and 3D Frame elements - longitudinal and lateral vibration. Use of local and natural coordinates.

UNIT III CONTINUUM ELEMENTS
Plane stress, plane strain and axisymmetric problems. Derivation of element matrices for constant and linear strain triangular elements and axisymmetric element.

UNIT IV ISOPARAMETRIC ELEMENTS
Definitions, Shape function for 4, 8 and 9 nodal quadrilateral elements, stiffness matrix and consistent load vector, evaluation of element matrices using numerical integration.

UNIT V FIELD PROBLEM AND METHODS OF SOLUTIONS
Heat transfer problems, steady state fin problems, derivation of element matrices for two dimensional problems, torsion problems. bandwidth- elimination method and method of factorization for solving simultaneous algebraic equations – Features of software packages, sources of error.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, Students will be able to
CO1: Have overall understanding of various approximate methods used for solving structural mechanics problems. Be able to understand the formulation of governing equation for the finite element method, convergence criteria and advantage over other approximate methods.
CO2: Have the capability to solve 1-D problems related to static analysis of structural members.
CO3: Formulate the elemental matrices for 2-D problems.
CO4: Get an exposure to isoperimetric element formulations and importance of numerical integration.
CO5: Solve Eigen value problems and scalar field problems.

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COURSE OBJECTIVES:
- Understand the basic flow equations, characteristics of mathematical models for a given flow.
- Know the importance and significance of panel methods
- Familiarize with Finite Volume techniques in Computational fluid analysis.
- To learn the concepts of time dependent methods
- To acquire the knowledge in both structures and unstructured grid generation.

UNIT I  FUNDAMENTAL CONCEPTS  9

UNIT II  GRID GENERATION  9

UNIT III  PANEL METHODS  9
Elements of two and three-dimensional panels, panel singularities – Application of panel methods to incompressible, compressible, subsonic and supersonic flows – Numerical solution of flow over a cylinder using 2D panel methods using both vertex and source panel methods for lifting and non-lifting cases respectively.

UNIT IV  TIME DEPENDENT METHODS  9

UNIT V  FINITE VOLUME TECHNIQUES  9

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
- CO1: Explain and calculate the governing equations for fluid flow.
- CO2: Explain how grids are generated and conduct a grid-convergence assessment.
- CO3: Describe the issues about two-phase flow modelling.
- CO4: Apply the concept of discretization, upwind differencing and implicit, explicit solutions.
- CO5: Apply finite difference and finite volume methods to fluid flow problems.

TOTAL = 45 PERIODS

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COURSE OBJECTIVES:
To familiarize with
- Concepts of modelling of 2D and 3D geometrical elements.
- Concepts of computer graphics.
- CAD Packages and its features.
- Indian standards on drawing practices and standard components
- the effects of real-world conditions on a part or assembly

UNIT I INTRODUCTION

UNIT II GRAPHIC CONCEPTS (2D and 3D)

UNIT III SOFTWARE PACKAGES AND RECENT TECHNOLOGY
All about popular commercial solid modelling packages — their salient features- technical comparison- modules and Tools available- brief outline of Data exchange standards. Brief outline of feature technology - classification of features- design by features- applications of features- its advantages- and limitations

UNIT IV FEM FUNDAMENTALS
Introduction to finite element method - principle- Steps involved in FEA - nodes- element and their types- shape function-constraints, forces and nodal displacements-stiffness matrix- solution techniques. Analysis of spring element. Simple problems involving stepped bars subjected to axial loading and simple structural members for triangular element

UNIT V ANALYSIS
Stages of FEA in a CAD environment - Pre-processor- solver and postprocessor. Pre-processing - FEA modelling - geometry generation- node generation- element generation- boundary constraints-load constraints- - mesh generation and refining. Solving - performing the actual analysis. Post processing - Types of 0/P available- interpretation of results. Demonstration of the above using any one popular commercial package. Other types of analysis: Brief outline of kinematical analysis-manufacturability analysis and simulation.

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
- CO1: Plan and read engineering drawings.
- CO2: Identify engineering objects and components from drawings.
- CO3: Utilize solid models created in computer.
- CO4: Compare the relation between 2D drafting and 3D models.
- CO5: Choose the graphical models for further engineering applications.

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COURSE OBJECTIVES

- To make students understand the need for grid generation for numerical solutions
- To give them exposure to both structured and unstructured grid generation methods
- To impart knowledge on the areas of application and on the implementation methods for structured and unstructured grid generation techniques
- To expose the students on the benefits of adaptive meshing and its methodology
- To impart training to students on the control of grid quality

UNIT-I  BASIC ASPECTS IN GRID GENERATION  9
Methodology of grid generation- classification of grid generation techniques – Structured, Unstructured and Hybrid grids and their characteristic features – Areas of application – Geometry related issues for grid generation – Grid or mesh topology – Conformal Mapping-Domain decomposition with multiblocking

UNIT-II  STRUCTURED GRID GENERATION  9

UNIT-III  UNSTRUCTURED GRID GENERATION  9
Use of triangular, quadrilateral and tetrahedral grids/meshes – Concept of dual mesh – Connectivity Information and data structure in unstructured grid generation – Hierarchy in unstructured grid Generation – Composite grid schemes in unstructured grid generation – Moving front technique- Delaunay base method – Octree approach

UNIT-IV  ADAPTIVE MESHING  9
Description of adaptive mesh refinement – Adaption control – Strategies for mesh adapation-Solution gradient based adaption – Discretization error and Recovery based adaption r adaption, h adaption and p adaption methods – Elementary concepts in dynamic meshing and mesh motion – Role of adaptive meshing in solution accuracy and convergence

UNIT-V  GRID QUALITY AND QUALITY CONTROL  9

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Will be able to acquire knowledge on the basic principles of grid generation and be able to apply preliminary grid selection tasks in aerospace applications
CO2: Will be able to understand the multi-block grid generation procedures and be able to evaluate multi-block grid designs of computational domain in aerospace related problems
CO3: Will be able to evaluate structured and unstructured grid designs and be able to take decisions on selection of suitable grid blocks for the computational domains in aerospace applications.
CO4: Will be able to apply adaptive meshing methods for better management of computer resources and cost effective solutions in aerospace engineering
CO5: Will be able to apply skills in ensuring the good quality of grid that is essential to get reasonably accurate numerical solutions for complex aerospace engineering problems

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COURSE OBJECTIVE:

- To learn the basic measurement technique in Fluid mechanics.
- To provide extensive treatment of the operating principles and limitations of pressure and temperature measurements.
- To cover both operating and application procedures of hot wire anemometer.
- To describe flow visualization techniques and to highlight in depth discussion of analog methods.
- To understand the importance of special flows and error analysis.

UNIT I  BASIC MEASUREMENTS IN FLUID MECHANICS

UNIT II  WIND TUNNEL MEASUREMENTS

UNIT III  FLOW VISUALIZATION AND ANALOGUE METHODS

UNIT IV  PRESSURE, VELOCITY AND TEMPERATURE MEASUREMENTS
Pitot- static tube characteristics - Velocity measurements - Hot-wire anemometry – Constant current and Constant temperature Hot-Wire anemometer – Pressure measurement techniques - Pressure transducers – Temperature measurements.

UNIT V  SPECIAL FLOWS AND UNCERTAINTY ANALYSIS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students can able to
  CO1: Explain the knowledge on measurement techniques in aerodynamic flow.
  CO2: Analysis the Lift and drag measurements through various techniques in wind tunnel
  CO3: Apply the flow visualization technique to study flow pattern of aerodynamic model.
  CO4: Illustrate the Specific instruments for flow parameter measurement like pressure, velocity
  CO5: Apply the Wind tunnel boundary corrections and Scale effects

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COURSE OBJECTIVES:
1. To get insight into the basic aspects of compressible flow.
2. To arrive at the shock wave and expansion wave relations.
3. To get exposure on potential equation for 2-dimensional compressible flow.
4. To get knowledge on high speed flow over airfoils, wings and airplane configuration.
5. To gain basic knowledge on low and high speed wind tunnels.

UNIT I  FUNDAMENTAL ASPECTS OF COMPRESSIBLE FLOW  
Compressibility, Continuity, Momentum and energy equation for steady one dimensional flow-compressible Bernoulli’s equation-Calorically perfect gas, Mach Number, Speed of sound, Area – Mach number – Velocity relation, Mach cone, Mach angle, One dimensional Isentropic flow through variable area duct, Static and Stagnation properties, Critical conditions, Characteristic Mach number, Area-Mach number relation, Maximum discharge velocity.

UNIT II  SHOCK AND EXPANSION WAVES  

UNIT III  TWO DIMENSIONAL COMPRESSIBLE FLOW  
Potential equation for 2-dimensional compressible flow, Linearization of potential equation, perturbation potential, Linearized Pressure Coefficient, Linearized subsonic flow, Prandtl-Glauert rule, Linearized supersonic flow, Method of characteristics.

UNIT IV  HIGH SPEED FLOW OVER AIRFOILS, WINGS AND AIRPLANE CONFIGURATION  
Critical Mach number, Drag divergence Mach number, Shock Stall, Supercritical Airfoil Sections, Transonic area rule, Swept wing, Airfoils for supersonic flows, Lift, drag, Pitching moment and Centre of pressure for supersonic profiles, Shock expansion theory, wave drag, supersonic wings, Design considerations for supersonic aircrafts.

UNIT V  CHARACTERIZATION OF HIGH SPEED FLOWS  

COURSE OUTCOMES:
CO1: Analyze the effect of compressibility at high-speeds and to make intelligent design decisions based on this understanding.
CO2: Analyse about shock waves and expansion waves.
CO3: Calculate 2D compressible flows.
CO4: Estimate the high speed flow over airfoils and wings.

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OBJECTIVES:

- To learn the concepts of Non-aeronautical usages of aerodynamics
- To introduce the topic of wind energy collectors
- To impart concepts of analysing vibrations during flow
- To learn the concepts of Atmospheric boundary layer
- To introduce the basics of Flow induced vibrations.

UNIT I  ATMOSPHERE
Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows.

UNIT II  WIND ENERGY COLLECTORS
Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.

UNIT III  VEHICLE AERODYNAMICS
Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and Hovercraft.

UNIT IV  BUILDING AERODYNAMICS
Pressure distribution on low rise buildings, wind forces on buildings. Environmental winds in city blocks, Special problems of tall buildings, building codes, Building ventilation and architectural aerodynamics.

UNIT V  FLOW INDUCED VIBRATIONS
Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to
CO1: Use of aerodynamics for non- aerodynamics such as vehicle, building.
CO2: Solve the problems and able to analyze vibrations during flow
CO3: Identify the Atmospheric boundary layer and applications of wind energy collectors.
CO4: Analyse the aerodynamics of road vehicles and problems of flow induced vibrations.
CO5: Analyse the aerodynamics of buildings and problems of flow induced vibrations.

TEXT BOOKS:

REFERENCES:
CAE340  ROCKET PROPULSION  L  T  P  C  3  0  0  3

COURSE OBJECTIVES

- To make students understand the basic operating principle of rocket propulsion.
- To make students understand the parameter required to estimate the performance of rockets.
- To impart knowledge to students on different types of rocket propulsion systems.
- To learn the concepts of rocket propulsion applications areas and disadvantages.
- To expose the students on the methods of multi-staging of rocket vehicles and on the technologies for rocket control using aerodynamic and jet control means.

UNIT- I:  INTERNAL BALLISTICS OF ROCKETS


UNIT-II:  SOLID ROCKET PROPULSION

- Selection criteria of solid propellants – Types of solid propellants – Propellant ingredients – Solid propellant regression rate and factors influencing the regression rate – Solid propellant grain configurations – Progressive, regressive and neutral burning of grains – Basics of solid propellant combustion and combustion instability – Erosive burning – Pressure and regression rate relationship.

UNIT-III:  LIQUID ROCKET PROPULSION

- Types of liquid propellant combinations – Gas pressure and turbopump fed pressurization systems for liquid propellant rockets – Liquid rocket injectors and water testing – Liquid rocket cooling methods – Basic aspects of thrust chamber design – Thrust control – Advantages of liquid rockets over solid rockets – Combustion instability – Cryogenic rocket engines – Propellant slosh.

UNIT-IV:  HYBRID ROCKET PROPULSION

- Standard and reverse hybrid systems – Combustion mechanism in hybrid rockets – Limitations and applications of hybrid rockets – Solid grain configurations in hybrid rockets – Solid grain regression rate behavior along the grain length – Local regression rate estimation – Material combinations for hybrid rocket propellants – Estimation of hybrid rocket performance – Performance comparison with solid and liquid rocket systems.

UNIT-V:  STAGING AND STEERING OF ROCKETS


COURSE OUTCOMES:

Upon completion of the course students

CO1: will explain the basic principles and develop interest to join aerospace industry as a scientist/engineer.

CO2: will be able to develop skills and apply them for conceptual designs of rocket propulsion systems as a design team member.

CO3: will be able to evaluate the performance parameters of rocket propulsion systems and can suggest alternate designs if needed.

CO4: will be able to describe the advanced technology concepts like cryogenic rocket technology and be able to create preliminary designs of solid-cryogenic multi-stage configurations.

CO5: will be able to adapt himself/herself to aerospace industry by the acquired knowledge and apply skills in the preliminary design of rocket subsystems.
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COURSE OBJECTIVES:
This course will enable students
1. To impart knowledge on the basic concepts of space propulsion.
2. To learn about the physics of ionized gases.
3. To get familiarize with the types of nuclear rockets and the basic concepts of nuclear propulsion systems.
4. To study about the radioisotope propulsion.
5. To realise the importance of advanced space propulsion concepts.

UNIT I  INTRODUCTION TO SPACE PROPULSION SYSTEMS  9
Historical outline, Scramjet Propulsion-Scramjet Inlets; Scramjet Performance, Chemical rocket Propulsion-Tripropellants; Metalized Propellants; Free Radical Propulsion, Electric Propulsion, Micro propulsion - Micro Propulsion Requirements, MEMS and MEMS- Hybrid Propulsion Systems.

UNIT II  BASIC CONCEPTS OF IONIZED GASES  9

UNIT III  NUCLEAR ROCKET PROPULSION  9

UNIT IV  RADIOISOTOPE PROPULSION  9

UNIT V  ADVANCED SPACE PROPULSION CONCEPTS  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, students will be able to
CO1: Have knowledge on the basics and classification of space propulsion.
CO2: Comprehend the physics of ionized gases, their theories and particle collisions.
CO3: Demonstrate the working, types and performance of nuclear rockets with their design considerations.
CO4: Learn the basics of radioisotope propulsion with their performance studies.
CO5: Have knowledge on advanced methods of space propulsion systems with new thrust generation mechanisms.
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COURSE OBJECTIVES:
1. To learn basics of hypersonic flow, shock wave, boundary layer interaction and aerodynamic heating.
2. To extend the surface inclination methods for hypersonic inviscid flows.
3. To explain the approximate methods for inviscid hypersonic flows.
4. To familiarize them with the aerodynamical aspects of hypersonic vehicles and the general hypersonic flow theory.
5. To understand the viscous interactions in hypersonic viscous flow.

UNIT I  BASICS OF HYPERSONIC AERODYNAMICS
Thin shock layers – entropy layers – low density and high-density flows – hypersonic flight paths – hypersonic flight similarity parameters – shock wave and expansion wave relations of inviscid hypersonic flows.

UNIT II  SURFACE INCLINATION METHODS FOR HYPERSONIC INVISCID FLOWS
Local surface inclination methods – modified Newtonian Law – Newtonian theory – tangent wedge or tangent cone and shock expansion methods – Calculation of surface flow properties.

UNIT III  APPROXIMATE METHODS FOR INVISCID HYPERSONIC FLOWS

UNIT IV  VISCOUS HYPERSONIC FLOW THEORY
Navier-Stokes equations – boundary layer equations for hypersonic flow – hypersonic boundary layer – hypersonic boundary layer theory and non-similar hypersonic boundary layers – hypersonic aerodynamic heating and entropy layers effects on aerodynamic heating – heat flux estimation.

UNIT V  VISCOUS INTERACTIONS IN HYPERSONIC FLOWS
Strong and weak viscous interactions – hypersonic shockwaves and boundary layer interactions – Estimation of hypersonic boundary layer transition – Role of similarity parameter for laminar viscous interactions in hypersonic viscous flow.

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Explain shock wave and expansion wave relations of inviscid hypersonic flows
CO2: Explain the solution methods for hypersonic inviscid flows
CO3: Analyze the hypersonic boundary layers
CO4: Explain the viscous interaction in hypersonic flows
CO5: Analyze chemical and temperature effects in hypersonic flow.

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COURSE OBJECTIVES:
Of this course are

01. To learn about mathematical and principles of facture mechanics
02. To impart the knowledge about the fundamental source of failure of mechanical components.
03. To make students understand the fatigue design curve approaches and limitations
04. To make the students learn the characterization of variables in cyclic loads.
05. To expand student’s knowledge on testing of the material for the fatigue failure

UNIT I   FATIGUE OF STRUCTURES

UNIT II  STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR
Low cycle and high cycle fatigue - Coffin - Manson’s relation - Transition life - cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques - Cumulative damage - Miner’s theory - Other theories.

UNIT III PHYSICAL ASPECTS OF FATIGUE
Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations - fatigue fracture surfaces.

UNIT IV FRACTURE MECHANICS
Strength of cracked bodies - Potential energy and surface energy - Griffith’s theory - Irwin - Orwin extension of Griffith’s theory to ductile materials - stress analysis of “cracked bodies - Effect of thickness on fracture toughness” - stress intensity factors for typical geometries.

UNIT V   FATIGUE DESIGN AND TESTING
Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures.

COURSE OUTCOMES:
Students will be able to
CO1: Apply the mathematical knowledge to define fatigue behaviours of the materials
CO2: Identify the causes for the fatigue failure of the materials.
CO3: Ability to analyse the fracture due to fatigue
CO4: Select the testing method for the fatigue failure prediction of the materials.
CO5: Solve the causes of the crack initiation & its growth.
CO6: Select the materials with ability to with damage tolerant structures

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COURSE OBJECTIVES:
Of this course are
- Be able to understand the various experimental techniques involved for measuring displacements, stresses, strains in structural components.
- To familiarize with the different types of strain gages used.
- Be able to use photo elasticity techniques and methods for stress analysis.
- Be able to familiarize with the different NDT techniques.

UNIT I  BASICS OF MECHANICAL MEASUREMENTS  9

UNIT II  ELECTRICAL-RESISTANCE STRAIN GAUGES  9

UNIT III  STRAIN-GAUGE CIRCUITS & INSTRUMENTATION  9

UNIT IV  PHOTOELASTIC METHODS OF STRESS ANALYSIS  9

UNIT V  NON-DESTRUCTIVE TESTING  9

COURSE OUTCOMES:
Upon completion of this course, Students will be able to
- CO1: Analyse the performance of measuring instrumentation.
- CO2: Impart knowledge on different methods of strain measurement.
- CO3: Design different strain gauge circuits.
- CO4: Use photo elasticity for stress analysis.
- CO5: Exposure the different types of non-destructive testing methods.

TOTAL: 45 PERIODS
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OBJECTIVES:

- To provide the students an understanding on classification and applications of composite materials and its micromechanical study
- To provide the students an understanding on Macromechanics and engineering constants required to relate stress and strain
- To make the students to learn about laminate coding and its governing equations.
- To make the students to familiar with various methods of composite fabrication

UNIT I  MICROMECHANICS  10

UNIT II  MACROMECHANICS  10

UNIT III LAMINATED PLATE THEORY  10
Governing differential equation for a laminate. stress – strain relations for a laminate. different types of laminates. in plane and flexural constants of a laminate. hygrothermal stresses and strains in a laminate. failure analysis of a laminate. impact resistance and interlaminar stresses. netting analysis

UNIT IV FABRICATION PROCESS AND REPAIR METHODS  8
Various open and closed mould processes, manufacture of fibers, importance of repair and different types of repair techniques in composites – autoclave and non-autoclave methods.

UNIT V SANDWICH CONSTRUCTIONS  7
Basic design concepts of sandwich construction - materials used for sandwich construction - failure modes of sandwich panels - bending stress and shear flow in composite beams.

TOTAL: 45 PERIODS

OUTCOMES

- Apply the micromechanics for the analysis of composite materials
- Apply the macromechanics for the analysis of composite materials
- Experiment with the laminated composites for various loading cases
- Demonstrate the manufacturing of composites
- Explain the applications and uses of composites in various fields

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CME339 ADDITIVE MANUFACTURING

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)

UNIT III VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION

UNIT IV POWDER BED FUSION AND MATERIAL EXTRUSION

UNIT V OTHER ADDITIVE MANUFACTURING PROCESSES

ADDITIVE 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.

TOTAL: 30 PERIODS
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.

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:
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
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

UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING (ET)

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

UNIT V RADIOGRAPHY (RT)
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.

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**CAE346**

**AEROSPACE MATERIALS**

**COURSE OBJECTIVES:**
- To understand the elements of aerospace materials, mechanical behaviour of materials, ceramics and composites.
• To explain the theory, concepts, principles and governing equations of solid mechanics.
• To analyse the stresses in simple structures as used in the aerospace industry.
• To learn the concepts of corrosion and heat treatment.
• To acquire knowledge in high temperature materials and characterization.

UNIT I ELEMENTS OF AEROSPACE MATERIALS

UNIT II MECHANICAL BEHAVIOUR OF MATERIALS
Linear and non-linear elastic properties – Yielding, strain hardening, fracture, Bauchinger’s effect – Notch effect testing and flaw detection of materials and components – Comparative study of metals, ceramics plastics and composites.

UNIT III CORROSION & HEAT TREATMENT OF METALS AND ALLOYS

UNIT IV CERAMICS AND COMPOSITES

UNIT V HIGH TEMPERATURE MATERIALS & CHARACTERIZATION
Classification, production and characteristics – Methods and testing – Determination of mechanical and thermal properties of materials at elevated temperatures – Application of these materials in Thermal protection systems of Aerospace vehicles – super alloys – High temperature material characterization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Explain the advanced concepts of aerospace materials.
CO2: Describe the necessary mathematical knowledge that are needed in understanding their significance and operation.
CO3: Explain various topics such as elements of aerospace materials, mechanical behaviour of materials, ceramics and composites.
CO4: Deploy the skills effectively in the understanding of aerospace materials.
CO5: Characterize high temperature materials

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COURSE OBJECTIVES:
1. To introduce the basic of avionics and its need for civil and military aircrafts
2. To impart knowledge about the avionic architecture and various avionics data buses
3. To gain more knowledge on various avionics subsystems
4. To understand the concepts of navigation systems.
5. To gain knowledge on auto pilot system

UNIT I  INTRODUCTION TO AVIONICS  9
Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – Introduction to digital computer and memories.

UNIT II  DIGITAL AVIONICS ARCHITECTURE  9

UNIT III  FLIGHT DECKS AND COCKPITS  9
Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

UNIT IV  INTRODUCTION TO NAVIGATION SYSTEMS  9

UNIT V  AIR DATA SYSTEMS AND AUTO PILOT  9
Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

COURSE OUTCOMES:
Students able to
CO1  Built Digital avionics architecture.
CO2  Design Navigation system.
CO3  Integrate avionics systems using data buses.
CO4  Analyze the performance of various cockpit display technologies.
CO5  Design autopilot for small aircrafts using MATLAB.

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CAE348 CONTROL ENGINEERING

COURSE OBJECTIVES:
1. To introduce the mathematical modeling of systems, open loop and closed loop systems and analyses in time domain and frequency domain.
2. To impart the knowledge on the concept of stability and various methods to analyze stability in both time and frequency domain.
3. To introduce sampled data control system.
4. To explain the concept of stability.
5. To understand about digital controllers.

UNIT I INTRODUCTION
Historical review, Simple pneumatic, hydraulic and thermal systems, Series and parallel system, Analogies, mechanical and electrical components, Development of flight control systems.

UNIT II OPEN AND CLOSED LOOP SYSTEMS
Feedback control systems – Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios.

UNIT III CHARACTERISTIC EQUATION AND FUNCTIONS
Laplace transformation, Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.

UNIT IV CONCEPT OF STABILITY
Necessary and sufficient conditions, Routh-Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response.

UNIT V SAMPLED DATA SYSTEMS
Z-Transforms Introduction to digital control system, Digital Controllers and Digital PID controllers

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students able to
CO1 Apply mathematical knowledge to model the systems and analyse the frequency domain.
CO2 Check the stability of the both time and frequency domain.
CO3 Solve simple pneumatic, hydraulic and thermal systems, Mechanical and electrical component analogies-based problems.
CO4 Solve the Block diagram representation of control systems, Reduction of block diagrams, Signal flow graph and problems based on it.

CO5 Explain the digital control system, Digital Controllers and Digital PID Controllers.

TEXT BOOKS:

REFERENCES:

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CAE349 GUIDANCE AND CONTROL

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COURSE OBJECTIVES:
1. To learn about the aircraft equations of motion and method of linearization.
2. To learn about the operating principle of guidance law.
3. To study about the augmentation systems.
4. To study longitudinal stability and to design the longitudinal autopilot.
5. To study lateral stability and to design the lateral autopilot.

UNIT I INTRODUCTION
Introduction to Guidance and control - Definition, Historical background – Coordinate Frame - Equations of motion – Linearization.

UNIT II AUGMENTATION SYSTEMS
Need for automatic flight control systems, Stability augmentation systems, control augmentation systems, Design of Limited authority and Full Authority Augmentation systems - Gain scheduling concepts.

UNIT III LONGITUDINAL AUTOPILOT
Displacement Autopilot - Pitch Orientation Control system, Acceleration Control System, Glide Slope Coupler and Automatic Flare Control and Flight path stabilization, Longitudinal control law design using back stepping algorithm.

UNIT IV LATERAL AUTOPILOT 9

UNIT V MISSILE AND LAUNCH VEHICLE GUIDANCE 9
Operating principles and design of guidance laws, homing guidance laws- short range, Medium range and BVR missiles, Launch Vehicle- Introduction, Mission requirements, Implicit guidance schemes, Explicit guidance, Q guidance schemes

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students able to

CO1 Explain the equations governing the aircraft dynamics and the process of linearizing them.
CO2 Define the various guidance schemes and requirements for aircrafts and missiles.
CO3 Apply the principle of stability and control augmentation systems.
CO4 Analyse the oscillatory modes and methods of suppressing them
CO5 Design the controller for lateral, longitudinal and directional control of aircrafts.

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COURSE OBJECTIVES:

1. To introduce various types of navigation systems.
2. To understand the dead reckoning navigation system and its error correction.
3. To know satellite navigation and hybrid navigation system integration
4. To learn the concepts of radio transmitters and receivers
5. To acquire knowledge about weather radar systems and DME

UNIT I INERTIAL NAVIGATION SYSTEMS

UNIT II RADIO NAVIGATION & SATELLITE NAVIGATION
Different types of radio navigation- ADF, VOR, DME - Doppler – Hyperbolic Navigations -LORAN, DECCA and Omega – TACAN. Introduction to GPS -system description -basic principles -position and velocity determination signal Structure -DGPS, Introduction to Kalman filtering-Estimation and mixed mode navigation Integration of GPS and INS-utilization of navigation systems in aircraft.

UNIT II RADIO TRANSMITTERS AND RECEIVERS
Functions of a Radio transmitter, Microphones, types, Block diagram explanation of a Radio receiver, Block diagram of a simple radio receiver and super heterodyne receiver.

UNIT IV AIRCRAFT COMMUNICATION SYSTEMS
Basics of aircraft communication system, types Very High Frequency Communication system, Description, Principle, Operation of VHF Communication system and its layout on aircraft, High Frequency communication system, Description, Principle and operation of High Frequency communication system and its layout on aircraft. Satellite communication system, Description, Operation and its layout on aircraft.

UNIT V WEATHER RADAR SYSTEM AND DME
Introduction, Description and types of Radar, Primary and Secondary Radar, Weather Radar Description, Analog radar Principal units of Analog radar system. Aircraft weather radar, transmitter-receiver, Indicator, Control panel, Antenna, Radome and wave guide. Radome maintenance and radar safety.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1. Students will understand the advanced concepts of Aircraft Navigation
CO2. To provide the necessary mathematical knowledge those are needed in modeling the navigation process and methods.
CO3. The students will have an exposure on various Navigation systems such as Inertial Measurement systems, Radio Navigation Systems, Satellite Navigation – GPS.
CO4. Landing aids and will be able to deploy these skills effectively in the analysis and understanding of navigation systems in an aircraft.
CO5. Learn and apply the principles of Radar and its related components.

REFERENCE
CAE351 DESIGN OF UAV SYSTEMS

L T P C 3 0 0 3

COURSE OBJECTIVES:
1. To expose students to concepts needed in modelling and analysing an unmanned system.
2. To expose students to the design and development of UAV.
3. To expose students to the type of payloads used in UAV.
4. To study path planning.
5. To understand the avionics hardware used in the UAV.

UNIT I INTRODUCTION TO UAV

UNIT II THE DESIGN OF UAV SYSTEMS

UNIT III AVIONICS HARDWARE

UNIT IV COMMUNICATION PAYLOADS AND CONTROLS
Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range – modems-memory system-simulation-ground test-analysis-trouble shooting.

UNIT V THE DEVELOPMENT OF UAV SYSTEMS
Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students able to

CO1 Design UAV system
CO2 Prepare preliminary design requirements for an unmanned aerial vehicle.
CO3 Identify different hardware for UAV
CO4 Perform system testing for unmanned aerial vehicles.
CO5 Design micro aerial vehicle systems by considering practical limitations.
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CAE352 AERODYNAMICS OF DRONES

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COURSE OBJECTIVES:
1. To introduce students to the basic concepts of payloads in UAV.
2. To understand the various sensor system of an UAV.
3. To introduce with the concepts of data algorithms and architectures.
4. To introduce the concepts of artificial neural networks.
5. To expose students to the concept of fuzzy logic.

UNIT-I PAYLOAD FOR UAV

UNIT-II SENSOR
Data fusion applications to multiple sensor systems - Selection of sensors - Benefits of multiple sensor systems - Influence of wavelength on atmospheric attenuation - Fog characterization - Effects of operating frequency on MMW sensor performance - Absorption of MMW energy in rain and fog - Backscatter of MMW energy from rain - Effects of operating wavelength on IR sensor performance - Visibility metrics - Atmospheric and sensor system computer simulation models

UNIT-III DATA FUSION ALGORITHMS AND ARCHITECTURES
Definition of data fusion - Level 1 processing - Detection, classification, and identification algorithms
for data fusion - State estimation and tracking algorithms for data fusion - Level 2, 3, and 4 processing - Data fusion processor functions - Definition of an architecture - Data fusion architectures - Sensor-level fusion - Central-level fusion - Hybrid fusion

UNIT-IV  ARTIFICIAL NEURAL NETWORKS  9

UNIT-V  FUZZY LOGIC AND FUZZY NEURAL NETWORKS  9
Conditions under which fuzzy logic provides an appropriate solution - Illustration of fuzzy logic in an automobile antilock braking system - Basic elements of a fuzzy system - Fuzzy logic processing - Fuzzy centroid calculation

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students will be able to
CO1 Calculate the payloads in UAV.
CO2 Explain the concepts sensor systems.
CO3 Predict the data fusion algorithms and architectures.
CO4 Learn the basics neural network systems
CO5 Design various network schemes.

TEXT BOOKS:
1. Reg Austin Aeronautical Consultant, AJohn “Unmanned aircraft systems UAVs design, development and deployment” Wiley and Sons, Ltd., Publication, 2010

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AE3001  AIRFRAME MAINTENANCE AND REPAIR  L T P C
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COURSE OBJECTIVE:
To make the students to understand the Airframe components and the tools used to maintain the components. Defect investigation, methods to carry out investigation and the detailed maintenance and practice procedures.

UNIT I  MAINTENANCE OF AIRCRAFT STRUCTURAL COMPONENTS  9
Equipments used in welding shop and their maintenance - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing – laser welding. Sheet metal repair and maintenance: Selection of materials; Repair schemes; Fabrication of replacement patches; Tools - power/hand; Repair techniques; Peening - Close tolerance fasteners; Sealing compounds; forming/shaping; Calculation of weight of completed repair; Effect of weight - change on surrounding structure. Sheet metal inspection - N.D.T. Riveted repair design - Damage investigation - Reverse engineering.

UNIT II  PLASTICS AND COMPOSITES IN AIRCRAFT  9
Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks and holes - various repairs schemes - Scopes. Cleaning of fibre reinforced plastic (FRP) materials prior to repair; Break test - Repair Schemes; FRP/honeycomb sandwich materials; laminated FRP structural members and skin panels; Tools/equipment; Vacuum-bag process. Special precautions – Autoclaves

UNIT III  AIRCRAFT JACKING, ASSEMBLY AND RIGGING  9

UNIT IV  REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM  9
Trouble shooting and maintenance practices - Service and inspection - Inspection and maintenance of landing gear systems. - Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments - handling - Testing - Inspection. Inspection and maintenance of auxiliary systems - Rain removal system - Position and warning system - Auxiliary Power Units (APUs).

UNIT V  SAFETY PRACTICES  9

COURSE OUTCOMES:
Students who successfully complete this course will be able to:
CO1: Identify and apply the principles of function and safe operation to aircraft as per FAA
CO2: Describe general airframe structural repairs, the structural repair manual and structural control programme.
CO3: Explain the nature of airframe structural component inspection, corrosion repair and non-destructive inspection
CO4: Evaluate aircraft component disassembly, reassembly and troubleshooting
CO5: Identify, install, inspect, fabricate and repair aircraft sheet metal and synthetic, material structures.

TEXT BOOK:

REFERENCES:

MAPPING OF COS AND POS:
AE3002 AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE PRACTICES

OBJECTIVES
- To carryout aircraft ground handling procedure.
- To understand about the ground servicing of the various aircraft subsystem.
- To understand the procedure of aircraft system maintenance and safety.
- To understand the importance of periodic inspection of aircraft.
- To understand the specification of aircraft hardware components and its materials.

UNIT I AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT

UNIT II GROUND SERVICING OF VARIOUS SUB SYSTEMS
Air conditioning and pressurization – Oxygen and oil systems – Ground units and their maintenance.

UNIT III MAINTENANCE OF SAFETY AND AIRCRAFT SYSTEM PROCESSES
Shop safety – Environmental cleanliness – Precautions- Hand tools – Precision instruments – Special tools and equipments in an airplane maintenance shop – Identification terminology

UNIT IV INSPECTION

UNIT V AIRCRAFT HARDWARE, MATERIALS, SYSTEM PROCESSES
Specification and correct use of various aircraft hardware (i.e. nuts, bolts, rivets, screws) – American and British systems of specifications – Threads, gears, bearings, – Drills, tapes and reamers – Identification of all types of fluid line fittings. Materials, metallic and non-metallic Plumbing connectors – Cables – Swaging procedures, tests, Advantages of swaging over splicing.

COURSE OUTCOMES:
Student can able to
- CO1: Explain the various ground support system for aircraft operations
- CO2: Illustrate the ground servicing of critical aircraft systems
CO3: Inspect the aircraft by considering the FAA airworthiness regulations and the check list.
CO4: Apply the maintenance procedures to the aircraft subsystem and equipment’s
CO5: Explain the specifications standards of aircraft hardware systems and materials.

TEXT BOOK

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AE3003 CIVIL AVIATION REGULATIONS  
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COURSE OBJECTIVES:
1. Understand the requirement of airworthiness certification in civil aircraft
2: Can understand how to record the various data for future investigation in civil aircraft.
3: Can know the basic requirements and knowledge for institution certification.
4: To provide basic knowledge of eligibility and requirements for maintenance licensing
5: Explore the various flight testing and basic requirements for safe flying.

UNIT-I C.A. R SERIES 'A' - PROCEDURE FOR CIVIL AIR WORTHINESS QUIRMENTS AND ESPONSIBILITY OPERATORS VIS-À-VIS AIR WORTHINESS RECTORATE 9
To introduce the civil aviation regulations followed by directorate general of civil aviation. module I
C.A.R series 'a' - procedure for civil air worthiness quirments and responsibility operators vis-à-vis air worthiness directorate.

UNIT- II C.A.R. SERIES 'C' - DEFECT RECORDING, MONITORING, INVESTIGATION AND REPORTING 9
Defect recording, reporting, investigation, rectification and analysis; flight report; reporting and rectification of defects observed on aircraft; analytical study of in-flight readings & recordings; maintenance control by reliability method. C.A.R. SERIES 'D' - AND AIRCRAFT MAINTENANCE PROGRAMMES: reliability programme (engines); aircraft maintenance programme & their approval; on condition maintenance of reciprocating engines; TBO - revision programme; maintenance of fuel and oil uplift and consumption records - light aircraft engines; fixing routine maintenance Total Hours and component tbo initial & revisions.

UNIT- III C.A.R. SERIES 'E' - APPROVAL OF ORGANISATIONS: 9
Approval of organizations in categories A, B, C, D, E, F, & G; requirements of infrastructure at stations other than parent base. C.A.R. SERIES 'F' - AIR WORTHINESS AND CONTINUED AIR WORTHINESS: Procedure relating to registration of aircraft; procedure for issue / revalidation of type certificate of aircraft and its engines / propeller; issue / revalidation of certificate of airworthiness; requirements for renewal of certificate of airworthiness.

UNIT-IV C.A.R. SERIES 'L' - AIRCRAFT MAINTENANCE ENGINEER LICENSING 9
Issue of AME license, its classification and experience requirements, complete Series 'L'. C.A.R. SERIES 'M' MANDATORY MODIFICATIONS AND INSPECTIONS: mandatory modifications /
inspections. Procedure for issue of type approval of aircraft components and equipment including instruments.

UNIT V  C.A.R. SERIES 'T' - FLIGHT TESTING OF AIRCRAFT

Flight testing of (series) aircraft for issue of C of A; flight testing of aircraft for which C or A had been previously issued. C.A.R. SERIES 'X' MISCELLANEOUS REQUIREMENTS: Registration Markings of aircraft; weight and balance control of an aircraft; provision of first aid kits & physician's kit in an aircraft; use furnishing materials in an aircraft; concessions. Aircraft log books; document to be carried on board on Indian registered aircraft; procedure for issue of taxi permit.

COURSE OUTCOMES:
Students will be able to
CO1. Explain the maintenance requirement for airworthiness of aircraft and systems.
CO2. Describe the procedure followed for airworthiness certificate.
CO3. Describe the Airworthiness procedures based on Regulation Authorities.
CO4. Explain the issuance, renewal and experience requirements of AMEs.

REFERENCES:
2. Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness) ", Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi. "
3. Aeronautical Information Circulars (relating to Airworthiness) ", from DGCA. "
4. Advisory Circulars ", form DGCA, as Managers – Consulting Engineers Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership Sample Code of Conduct

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AE3004  AIRCRAFT ENGINE MAINTENANCE AND REPAIR  L  T  P  C

COURSE OBJECTIVES:
- To make the students to familiarize with the Aircraft engine maintenance procedure and practice.
- To acquire knowledge of basics of Aeronautics and engine components.
- To learn the concepts of Piston engines
- To make students aware of aircraft propellers and repair
- To make students aware of aircraft jet engines and repair

UNIT I  PISTON ENGINES  9
Carburation and Fuel injection systems for small and large engines - Ignition system components - spark plug detail - Engine operating conditions at various altitudes – Engine power measurements – Classification of engine lubricants and fuels – Induction, Exhaust and cooling system - Maintenance and inspection check to be carried out. Inspection and maintenance and troubleshooting - Inspection of all engine components - Daily and routine checks - Overhaul procedures - Compression testing of cylinders - Special inspection schedules - Engine fuel, control and exhaust systems - Engine mount and super charger - Checks and inspection procedures.

UNIT II  PROPPELLERS  9
Propeller theory - operation, construction assembly and installation - Pitch change mechanism- Propeller axially system- Damage and repair criteria - General Inspection procedures - Checks on constant speed propellers - Pitch setting, Propeller Balancing, Blade cuffs, Governor/Propeller operating conditions – Damage and repair criteria.

UNIT III  JET ENGINES  9
Types of jet engines – Fundamental principles – Bearings and seals - Inlets – compressors turbines- exhaust section – classification and types of lubrication and fuels - Materials used – Details of control, starting around running and operating procedures – Inspection and Maintenance- permissible limits of damage and repair criteria of engine components- internal inspection of engines- compressor washing- field balancing of compressor fans- Component maintenance procedures - Systems maintenance procedures - use of instruments for online maintenance - Special inspection procedures-Foreign Object Damage - Blade damage.

UNIT IV  TESTING AND INSPECTION  9

UNIT V  OVERHAULING  9

COURSE OUTCOMES:
Students will be able to
CO1: Apply maintenance procedure to Aircraft Engines
CO2: Identify the engine components and faults
CO3: Apply non-destructive testing procedures to identify the defects
CO4: Apply overhauling procedure to new engines
CO5: Apply the compression testing of cylinders

TEXT BOOK:

REFERENCES:

AE3010  AIR TRAFFIC CONTROL  L T P C
3 0 0 3 163
COURSE OBJECTIVES:
1. To introduce the basic of air traffic control.
2. To impart knowledge about air traffic systems.
3. To gain more knowledge on flight information systems.
4. To learn about aerodrome data.
5. To gain knowledge on navigation systems.

UNIT I  BASIC CONCEPTS
Objectives of air traffic control systems - Parts of ATC services – Scope and Provision of ATCs – VFR & IFR operations – Classification of ATS air spaces – Various kinds of separation – Altimeter setting procedures – Establishment, designation and identification of units providing ATS – Division of responsibility of control.

UNIT II  AIR TRAFFIC SYSTEMS
Area control service, assignment of cruising levels - minimum flight altitude - ATS routes and significant points – RNAV and RNP – Vertical, lateral and longitudinal separations based on time / distance –ATC clearances – Flight plans – position report

UNIT III  FLIGHT INFORMATION SYSTEMS

UNIT IV  AERODROME DATA

UNIT V  NAVIGATION AND OTHER SERVICES
Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area – Markings, general requirements – Various markings – Lights, general requirements – Aerodrome beacon, identification beacon – Simple approach lighting system and various lighting systems – VASI & PAPI - Visual aids for denoting obstacles; object to be marked and lighter – Emergency and other services.

COURSE OUTCOMES:
Students able to
CO1 Classify the requirement of air traffic control systems and types of air traffic control system.
CO2 Explain in flight information systems and rules of air traffic systems.
CO3 Explore the emergency procedure and air rules followed by air traffic control systems.
CO4 Describe the aerodrome data.
CO5 Gain the information of navigation and emergency procedures in the air traffic control systems.

TOTAL: 45 PERIODS

TEXT BOOK

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AE3005       AIRPORT MANAGEMENT       L T P C
            3 0 0 3

COURSE OBJECTIVES:
1. To acquire solid background of managerial skills in airport management
2. To develop personality to face business difficulties.
3. To control multicultural conditions.
4. To identify the relevant analytical and logical skills to deal with problems in the airline industry.
5. To learn the concepts of performing well in teams, professionalism, and the knowledge acquired in the field of airport planning, airport security, passengers forecasting, aerodromes work etc
Objective
To provide the knowledge of airport planning, management and operations that is required to begin an airport management career.

UNIT I  INTRODUCTION
History of aviation - organisation, global, social & ethical environment - history of aviation in India - major players in the airline industry - swot analysis of the different airline companies in India - market potential of airline industry in India - new airport development plans - current challenges in the airline industry - competition in the airline industry - domestic and international from an Indian perspective

UNIT II  AIRPORT INFRASTRUCTURE AND MANAGEMENT
Airport planning - terminal planning design and operation - airport operations - airport functions - organisation structure in an airline - airport authority of India - comparison of global and Indian airport management - role of AAI - air operation privatisation - full privatisation - gradual privatisation - partial privatisation

UNIT III  AIR TRANSPORT SERVICES
Various air services - international air transport services - Indian scenario - an overview of airports in Delhi, Mumbai, Hyderabad and Bangalore - the role of private operators - airport development fees, rates, tariffs

UNIT IV  INSTITUTIONAL FRAMEWORK
Role of DGCA - slot allocation - methodology followed by ATC and DGCA - management of bilateral - economic regulations

UNIT V  CONTROLLING
Role of air traffic control - airspace and navigational aids - control process - case studies in airline industry - Mumbai-Delhi airport privatisation - Navi Mumbai airport tendering process - 6 cases in the airline industry

TOTAL: 45

TEXT BOOKS

REFERENCES

COURSE OUTCOMES:
1. To interpret business difficulties.
2. To dissect multicultural conditions.
3. To identify and apply the relevant analytical and logical skills to deal with problems in the airline industry.
4. To develop well in teams, professionalism etc.
5. To apply the knowledge acquired in the field of airport planning, airport security, passengers forecasting, aerodromes work etc.
AE3006 DESIGN OF GAS TURBINE ENGINE COMPONENTS

COURSE OBJECTIVES:

Of this course are

01. To introduce basic design concepts of jet engine and estimation of required thrust to students.
02. To make students familiarize with the design parameter and off design calculations.
03. To give the students adequate exposure to design procedure to the rotating components of engine such as compressor and turbine along with staging.
04. To make the students learn the aspects of combustion processes, flame stabilization issue, igniters design and NOx controls.
05. To make students familiarize with the concept of design inlet and nozzle for various on - off design conditions.

UNIT I GAS TURBINE ENGINE DESIGN FUNDAMENTALS

Design Process- compressible flow relationship; Constraint Analysis - Concept-Design tools- preliminary estimates; Mission analysis - Aircraft weight and fuel consumption data-Example problems on Constrain analysis, Mission analysis.

UNIT II ON DESIGN AND OFF-DESIGN PARAMETRIC ANALYSIS

Total and static properties-corrected mass flow rate-Engine Cycle Design- One-Dimensional Through flow Area-Flow path force on components- aircraft constraint analysis, aircraft mission analysis, engine parametric (design point) analysis, engine performance (off-design) analysis, engine installation drag and sizing.

UNIT III DESIGN OF ROTATING COMPONENTS


UNIT IV COMBUSTION CHAMBER DESIGN


UNIT V INLET AND NOZZLE DESIGN
Inlets and Exhaust Nozzles Design: Elements of a Successful Inlet-Engine Integration Program -
Definition of Subsonic Inlet-Engine Operational Requirements - Definition of Supersonic Inlet-

TOTAL: 45 PERIODS

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

CO1: Do preliminary weight and fuel estimation for an aircraft mission.
CO2: Identify variation in parametric analysis of ON and OFF design calculations.
CO3: Explain the principle design of compressor and turbine and selection of suitable materials.
CO4: Estimate the total pressure losses and able to predict ignition delay.
CO5: Determine the basic design factors affects ON and OFF design operation of inlets and nozzle on engine performance.

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AE3007 VIBRATION AND AERO ELASTICITY L T P C
3 0 0 3

COURSE OBJECTIVES:
- To study the effect of time dependent forces on mechanical systems and to get the natural characteristics of system of single degree of freedom system
- To study the solving methods of multi degree of freedom systems.
To introduce the approximates method to solve vibration problems.
To make the student to understand the solving techniques of vibration of continuous system
To study the aeroelastic effects of aircraft wings.

UNIT I  SINGLE DEGREE OF FREEDOM SYSTEMS  9

UNIT II  MULTI DEGREE OF FREEDOM SYSTEMS  9
Two degrees of freedom systems - static and dynamic couplings - vibration absorber- Multi degree of freedom systems - principal co-ordinates - principal modes and orthogonal conditions - Eigen value problems - Hamilton’s principle - Lagrangean equations and application.

UNIT III  CONTINUOUS SYSTEMS  9
Vibration of elastic bodies - Vibration of strings – longitudinal, lateral and torsional vibrations

UNIT IV  APPROXIMATE METHODS  9

UNIT V  ELEMENTS OF AEROELASTICITY  9
Vibration due to coupling of bending and torsion - aeroelastic problems - Collars triangle - wing divergence - aileron control reversal – flutter – buffeting. – elements of servo elasticity

COURSE OUTCOMES:
CO1: Solve single and multi-degree vibrating systems
CO2: Distinguish types of vibrations according to dampness and particle motion.
CO3: Solve the different numerical methods to solve continuous system.
CO4: Solve approximate methods to find natural frequency of a system
CO5: Examine Collars Triangle and Aero Elastic Problems
CO6: Examine the effect of Aileron reversal, flutter and wing divergence.

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ME3393 MANUFACTURING PROCESSES

COURSE OBJECTIVES:

1. To illustrate the working principles of various metal casting processes.
2. To learn and apply the working principles of various metal joining processes.
3. To analyse the working principles of bulk deformation of metals.
4. To learn the working principles of sheet metal forming process.
5. To study and practice the working principles of plastics molding.

UNIT I METAL CASTING PROCESSES

UNIT II METAL JOINING PROCESSES

UNIT III BULK DEFORMATION PROCESSES

UNIT IV SHEET METAL PROCESSES

UNIT V MANUFACTURE OF PLASTIC COMPONENTS
OUTCOMES:
At the end of the course the students would be able to
1. Explain the principle of different metal casting processes.
2. Describe the various metal joining processes.
3. Illustrate the different bulk deformation processes.
4. Apply the various sheet metal forming process.
5. Apply suitable molding technique for manufacturing of plastics components.

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CAE353 TURBO MACHINES L T P C 3 0 0 3

COURSE OBJECTIVES
1. To study the energy transfer in rotor and stator parts of the turbo machines.
2. To study the function of various elements of centrifugal fans and blowers.
3. To evaluating the working and performance of centrifugal compressor
4. To analyzing flow behavior and flow losses in axial flow compressor.
5. To study the types and working of axial and radial flow turbines.

UNIT – I WORKING PRINCIPLES 9

UNIT – II CENTRIFUGAL FANS AND BLOWERS 9

UNIT – III CENTRIFUGAL COMPRESSOR 9
Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses. Geometry and performance calculation.

UNIT – IV AXIAL FLOW COMPRESSOR 9

UNIT – V AXIAL AND RADIAL FLOW TURBINES 9

TOTAL : 45 PERIODS

OUTCOMES: At the end of the course the students would be able to
1. Explain the energy transfer in rotor and stator parts of the turbo machines.
2. Explain the function of various elements of centrifugal fans and blowers
3. Evaluate the working and performance of centrifugal compressor.
4. Analyze flow behavior and flow losses in axial flow compressor.
5. Explain the types and working of axial and radial flow turbines

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AE3008 HELICOPTER THEORY L T P C
3 0 0 3

COURSE OBJECTIVE:
To make the student familiarize with
• the principals involved in helicopters

172
• The performance and stability aspects of Helicopter under different operating conditions.
• Understand aerodynamics of rotor blades
• Dynamic stability of helicopters
• Considerations of helicopter design

UNIT I INTRODUCTION
Helicopter as an aircraft, Basic features, Layout, Generation of lift, Main rotor, Gearbox, tail rotor, power plant, considerations on blade, flapping and feathering, Rotor controls and various types of rotor, Blade loading, Effect of solidity, profile drag, compressibility etc., Blade area required, number of Blades, Blade form, Power losses, Rotor efficiency.

UNIT II AERODYNAMICS OF ROTOR BLADE
Aerofoil characteristics in forward flight, Hovering and Vortex ring state, Blade stall, maximum lift of the helicopter calculation of Induced Power, High speed limitations; parasite drag, power loading, ground effect.

UNIT III POWER PLANTS AND FLIGHT PERFORMANCE
Piston engines, Gas turbines, Ramjet principle, Comparative performance, Horsepower required, Range and Endurance, Rate of Climb, Best Climbing speed, Ceiling in vertical climb, Autorotation.

UNIT IV STABILITY AND CONTROL
Physical description of effects of disturbances, Stick fixed Longitudinal and lateral dynamic stability, lateral stability characteristics, control response. Differences between stability and control of airplane and helicopter.

UNIT V ROTOR VIBRATIONS

COURSE OUTCOMES:
At the end of the course, Students will be able to
CO1: Make use of Aerodynamics calculation of Rotor blade
CO2: Apply stability and control characteristics of Helicopter
CO3: Experiment with control Rotor vibration
CO4: Apply Momentum and simple blade element theories to helicopter’s rotor blades.
CO5: Analyse the power requirements in forward flight and associated stability problems of helicopter.

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TOTAL: 45 PERIODS
CAE354 SMART MATERIALS AND STRUCTURES L T P C
3 0 0 3

COURSE OBJECTIVES:
Of this course are
1. To familiarize with the fundamentals of structural health monitoring.
2. To impart knowledge in the areas of Vibration based techniques in structural health monitoring, fibre optics and Piezo electric sensors.
3. To familiarize with the fundamentals of fabrication, modelling, analysis, and design of smart materials and structures.
4. To enable the student to get exposed to the state of the art of smart materials and systems, spanning piezo electrics, shape memory, alloys, electro active polymers.
5. To familiarize with artificial neural networks and image processing.

UNIT I OVERVIEW AND INTRODUCTION

UNIT II PIEZOELECTRIC THEORY

UNIT III BEAM MODELLING WITH PIEZOELECTRIC MATERIAL

UNIT IV UNDERSTANDING SHAPE MEMORY ALLOYS (SMA)

UNIT V CONSTITUTIVE MODELLING AND SMA BEHAVIOUR

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, Students will be able to
- CO1: Classify the various forms of functional materials.
- CO2: Investigate the Piezoelectric material behaviour.
- CO3: Investigate the behaviour of SMA material.
- CO4: Model a beam with Piezoelectric patch.
- CO5: Impart knowledge on modelling of SMA material.

TEXT BOOKS:
1. Inderjit Chopra and Jayant Sirohi, ‘Smart Structures Theory’, Cambridge University Press, 2014.

REFERENCES:

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COURSE OBJECTIVES:
Of this course are
- To acquaint students with the fundamental concepts in boundary layer flow and with the governing equations of viscous flow
- To make students familiarize with obtaining analytical solutions for low speed viscous flow problems commonly found in engineering applications
- To introduce the basic concepts in laminar boundary layer theory and its applications in engineering to students
- To elucidate students on the complex phenomenon in turbulent boundary layer theory and turbulence modelling
- To make students knowledgeable on the techniques used for boundary layer control.

UNIT I  FUNDAMENTAL EQUATIONS OF VISCOUS FLOW
Fundamental equations of viscous flow, Conservation of mass, Conservation of Momentum-Navier-Stokes equations, Energy equation, Mathematical character of basic equations, Dimensional parameters in viscous flow, Non - dimensionlisation the basic equations and boundary conditions, vorticity considerations, creeping flow and boundary layer flow.

UNIT II  SOLUTIONS OF VISCOUS FLOW EQUATIONS
Solutions of viscous flow equations, Couette flows, Hagen-Poiseuille flow, Flow between rotating concentric cylinders, Combined Couette-Poiseuille Flow between parallel plates, Creeping motion, Stokes solution for an immersed sphere, Development of boundary layer, Displacement thickness, momentum and energy thickness.

UNIT III LAMINAR BOUNDARY LAYER
Laminar boundary layer equations, Flat plate Integral analysis of Karman – Integral analysis of energy equation – Laminar boundary layer equations – boundary layer over a curved body-Flow separation- similarity solutions, Blasius solution for flat-plate flow, Falkner–Skan wedge flows, Boundary layer temperature profiles for constant plate temperature –Reynold’s analogy – Pohlhausen method.

UNIT IV TURBULENT BOUNDARY LAYER
Turbulence-physical and mathematical description, Two-dimensional turbulent boundary layer equations — Velocity profiles – The law of the wall – The law of the wake – Turbulent flow in pipes and channels – Turbulent boundary layer on a flat plate – Boundary layers with pressure gradient, Eddy Viscosity and mixing length.

UNIT V  BOUNDARY LAYER CONTROL
Boundary layer control in laminar flow-Methods of Boundary layer control: Acceleration of the boundary layer-Suction- Injection of a different gas-Prevention of transition - Cooling of the wall-Boundary layer suction- Practical examples of Boundary Layer Control.

COURSE OUTCOMES:
Upon completion of this course, Students will be able to
CO1: Apply fundamental equations of the viscous flow for practical examples.
CO2: Analyze the viscous flow problems for solutions.
CO3: Explain the importance of viscosity and shear flow adjacent to the airframe of the aerospace vehicles.
CO4: Build an understanding about the laminar boundary layer concepts and solution methods.
CO5: Illustration about the importance of turbulence boundary layer in an aerospace engineering problem.

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CAE356 THEORY OF ELASTICITY

OBJECTIVES:
- To study the effect of periodic and a periodic forces on mechanical systems
- To learn the natural characteristics of large sized problems using approximate methods.
- To learn the concepts of plane stress and plane strain problems
- To understand the natural frequency of vibrations of the beams and torsional vibrations of systems.
- To make students aware of theory of plates and shells

UNIT I  BASIC EQUATIONS OF ELASTICITY
Definition of Stress and Strain: Stress - Strain relationships - Equations of Equilibrium, Compatibility equations, Boundary Conditions, Saint Venant’s principle - Principal Stresses, Stress Ellipsoid - Stress invariants.

UNIT II  PLANE STRESS AND PLANE STRAIN PROBLEMS
Airy’s stress function, Bi-harmonic equations, Polynomial solutions, Simple two-dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.

UNIT III  POLAR COORDINATES
Equations of equilibrium, Strain - displacement relations, Stress – strain relations, Airy’s stress function, Axi – symmetric problems, Introduction to Dunder’s table, Curved beam analysis, Lame’s, Kirsch, Michell’s and Boussinesque problems – Rotating discs.

UNIT IV  TORSION
Navier’s theory, St. Venant’s theory, Prandtl’s theory on torsion, semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections. Membrane Analogy.

UNIT V  INTRODUCTION TO THEORY OF PLATES AND SHELLS
Classical plate theory – Assumptions – Governing equations – Boundary conditions – Navier’s method of solution for simply supported rectangular plates – Levy’s method of solution for rectangular plates under different boundary conditions.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, Students will be able to
CO1: Estimate the linear elasticity in the analysis of structures such as beams, plates etc.
CO2: Determine the fracture mechanics of the curved beam subject to loads.
CO3: Interpret the two dimensional problems in cartesian and polar coordinates
CO4: Determine the response of elastomers based objects
CO5: Explain the structural section subjected to torsion

TEXT BOOKS:

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CAE357 STRUCTURAL DYNAMICS L T P C 3 0 0 3

OBJECTIVE:
- To study the effect of periodic and aperiodic forces on mechanical systems
- To learn the natural characteristics of large sized problems using approximate methods.
- To understand the natural frequency of vibrations of the beams and torsional vibrations of systems.
- To introduce the free and forced vibration of systems.
- To acquire knowledge in approximate methods of structural dynamics

UNIT I FORCE DEFLECTION PROPERTIES OF STRUCTURES 9

UNIT II PRINCIPLES OF DYNAMICS 9
Free and forced vibrations of systems with finite degrees of freedom – Response to periodic excitation – Impulse Response Function – Convolution Integral

UNIT III NATURAL MODES OF VIBRATION 9

UNIT IV ENERGY METHODS

UNIT V APPROXIMATE METHODS
Approximate methods of evaluating the Eigen frequencies and eigen vectors by reduced, subspace, Lanczos, Power, Matrix condensation and QR methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students will be able to
CO1: Determine the various options of mathematical modelling of structures 
CO2: Evaluate the response of structures under various dynamically loaded conditions
CO3: Explain the natural modes of vibration of structures
CO4: Interpret the knowledge in numerical and approximate methods of evaluating natural modes of vibration.
CO5: Justify the natural frequencies and mode shapes of a multi degree of freedom system

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CAE358 HEAT TRANSFER

COURSE OBJECTIVE:
- To impart knowledge on various modes of heat transfer and methods of solving problems. 
  Also to give exposure to numerical methods employed to solve heat transfer problems.

UNIT I CONDUCTION
Governing equation in cartesian, cylindrical and spherical coordinates. 1-D steady state heat conduction with and without heat generation. composite wall- electrical analogy – critical thickness
of insulation – heat transfer from extended surface – effect of temperature on conductivity- 1-D transient analysis

UNIT II \hspace{1cm} CONVECTION


UNIT III \hspace{1cm} RADIATION


UNIT IV \hspace{1cm} NUMERICAL METHODS IN HEAT TRANSFER


UNIT V \hspace{1cm} HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING

Heat transfer problems in gas turbines, rocket thrust chambers- aerodynamic heating – ablathe heat transfer

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able to

CO1: Explain the difference between various modes of Heat Transfer and the Resistance Concept used in Heat Conduction.

CO2: Apply the basic methods in Conduction. Understand the concept of Lump Parameter analysis and when it is applicable and earn the concepts of boundary layer.

CO3: Apply various correlation used in Convective Heat Transfer and Understand the concepts of Black Body, Grey Body, View factor, Radiation shielding.

CO4: Design/size Heat Exchanger and understand the concept of Mass transfer, its types & laws associated with it.

CO5: Apply various technique used for high speed flow heat transfer.

TEXT BOOKS:


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COURSE OBJECTIVES: Of this course are
1. Explain structural concepts such as elastic stiffness, inertia, influence coefficients, elastic axis, and shear center.
2. Describe structural dynamics of wings, including bending and torsion modes of vibration and their associated natural frequencies.
3. Apply aeroelastic concepts of divergence, flutter, lift and roll effectiveness, aileron reversal, and mode coalescence.
4. Knowledge to formulate and derive static and dynamic aeroelastic equations of motion.
5. To Apply Rayleigh-Ritz Method for Approximate continuous aeroelastic systems able to Interpret velocity-damping and velocity-frequency flutter diagrams.

UNIT I AERO ELASTICITY PHENOMENA
Vibration of beams due to coupling between bending and torsion - The aero-elastic triangle of forces - Stability versus response problems – Aeroelasticity in Aircraft Design – Vortex induced vibration – Introduction to aero servo elasticity.

UNIT II DIVERGENCE OF A LIFTING SURFACE

UNIT III STEADY STATE AEROELASTIC PROBLEMS
Loss and reversal of aileron control – Critical aileron reversal speed – Aileron efficiency – Semi rigid theory and successive approximations – Lift distributions – Rigid and elastic wings.

UNIT IV FLUTTER ANALYSIS

UNIT V EXAMPLES OF AEROELASTIC PROBLEMS
Galloping of transmission lines and flow induced vibrations of tall slender structures and suspension bridges – Aircraft wing flutter- Vibrational problems in Helicopters.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, Students will be able to
CO1: Formulate and perform classical solutions of aeroelastic problems.
CO2: Calculate divergence of a lifting surface in the aerospace vehicles.
CO3: Formulate aeroelastic equations of motion and use them to derive fundamental relations for aeroelastic analysis.
CME393 ADVANCED VEHICLE ENGINEERING  L   T   P   C
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COURSE OBJECTIVES
1. To introduce the basic concepts of electric vehicle and their characteristics
2. To introduce different types of motors and the selection of motor for vehicle applications.
3. To acquaint the student with different sensors and systems used in autonomous and connected vehicles.
4. To give an overview of networking with sensors and systems.
5. To introduce the modern methods of diagnosing on-board the vehicle troubles.

UNIT – I ELECTRIC VEHICLES
EV architectures, advantages and disadvantages, Electrical and mechanical energy storage technologies, battery management. Performance of Electric Vehicles, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving.

UNIT – II ELECTRIC VEHICLE MOTORS

UNIT – III AUTONOMOUS AND CONNECTED VEHICLES

UNIT – IV AUTOMOTIVE NETWORKING
Bus Systems – Classification, Applications in the vehicle, Coupling of networks, networked vehicles, Buses - CAN Bus, LIN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces.

UNIT – V ONBOARD TESTING
Integration of Sensor Data to On-Board Control Systems (OBD), OBD requirements, certification, enforcement, systems, testing, Catalytic converter and Exhaust Gas Recirculation system monitoring, Introduction to Cyber-physical system.

TOTAL: 45 PERIODS
OUTCOMES: At the end of the course the students would be able to
1. Acquire an overview of electric vehicles and their importance in automotive.
2. Discuss the characteristics and the selection of traction motor.
3. Comprehend the vehicle-to-vehicle and autonomous technology.
4. Explain the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems.
5. Be familiar with on-board diagnostics systems.

TEXT BOOKS:

REFERENCES:
4. Advanced Vehicle Technology by Heinz Heisler MSc BSc FIMI MIRTE MCIT | 17 July 2002
5. Advanced Motorsport Engineering: Units for Study at Level 3by Andrew Livesey | 1 September 2011

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Low (1) ; Medium (2) ; High (3)
UNIT II  FEMINIST THEORY
Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

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

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

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

TOTAL : 45 PERIODS

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

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

1. COURSE CONTENTS
   Introduction to Elements of Literature

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

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

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

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

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

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

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

**TOTAL : 45 PERIODS**

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

**MX3083 FILM APPRECIATION**

L T P C 3 0 0 0

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

**Theme - A: The Component of Films**
   A-1: The material and equipment
   A-2: The story, screenplay and script
   A-3: The actors, crew members, and the director
   A-4: The process of film making… structure of a film

**Theme - B: Evolution of Film Language**
   B-1: Film language, form, movement etc.
   B-2: Early cinema… silent film (Particularly French)
   B-3: The emergence of feature films: Birth of a Nation
B-4: Talkies

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

Theme – D: Development of Films
D-1: Representative Soviet films
D-2: Representative Japanese films
D-3: Representative Italian films
D-4: Representative Hollywood film and the studio system

Theme - E: Indian Films
E-1: The early era
E-2: The important films made by the directors
E-3: The regional films
E-4: The documentaries in India

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

MX3084 DISASTER RISK REDUCTION AND MANAGEMENT L T P C 3 0 0 0

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

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS 9
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced – Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills - Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - -, Inter relations between Disasters and Sustainable development Goals

UNIT II DISASTER RISK REDUCTION (DRR) 9
Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT 9
Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)
UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT


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

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COURSE OBJECTIVES:

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

UNIT I HEALTH AND ITS IMPORTANCE

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


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

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

UNIT II DIET

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


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

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

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

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 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 - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal

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

UNIT IV MENTAL WELLNESS 3+4

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


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

Immunity - Types and importance - Ways to develop immunity

UNIT V YOGA 2+12

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

TOTAL : 45 PERIODS

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

REFERENCES:
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001
1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
2. Simple lifestyle modifications to maintain health https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.
3. Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html
10. CAM: https://www.hindawi.com/journals/ecam/2013/376327/
11. Preventive herbs: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/

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

MX3086 HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA L T P C 3 0 0 0

UNIT-I CONCEPTS AND PERSPECTIVES
Meaning of History
Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history
Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation versus evidence, concept of historical inevitability, Historical Positivism.
Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

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

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

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

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

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

**TOTAL : 45 PERIODS**

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**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 Kumarappa)

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

(Refs: Adam smith, J S Mill)

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

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

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

Welfare state. Relation with human desires. Empowered human beings, satisfaction. (3 lectures)
Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one’s lives. Relationship with nature. (6 lectures)

(Refs: M K Gandhi, Schumacher, Kumarappa)

Essential elements of Indian civilization. (3 lectures)

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

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

Conclusion (2 lectures)

Total lectures: 39

Preferred Textbooks: See Reference Books

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

GRADING:

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TOTAL : 45 PERIODS

OUTCOME:

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

MX3088 STATE, NATION BUILDING AND POLITICS IN INDIA  L T P C  3 0 0 0

OBJECTIVE:

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

TOPICS:

Understanding the need and role of State and politics.

Development of Nation-State, sovereignty, sovereignty in a globalized world.

1857 and the national awakening.

1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India.
Goals, objective and philosophy.
Why a federal system?
National integration and nation-building.

Challenges of nation-building – State against democracy (Kothari)
New social movements.
The changing nature of Indian Political System, the future scenario. What can we do?

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

SUGGESTED READING:


MX3089 INDUSTRIAL SAFETY

OBJECTIVES
- To Understand the Introduction and basic Terminologies 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.

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

REFERENCES
5. Society of Safety Engineers, USA

ONLINE RESOURCES

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**Industrial safety** | 3 3 3 2 1 3 2 2 3 2 1 3 3 3 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

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

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

UNIT IV SUPERVISED LEARNING

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

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

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

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

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

TOTAL PERIODS: 60

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

REFERENCES

OCS352 IOT CONCEPTS AND APPLICATIONS

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

UNIT I INTRODUCTION TO INTERNET OF THINGS

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

UNIT IV OPEN PLATFORMS AND PROGRAMMING

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

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

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

TOTAL PERIODS: 60

TEXTBOOKS

REFERENCES
1. Perry Lea, “Internet of things for architects”, Packt, 2018
COURSE OBJECTIVES:
● Familiarize students with the data science process.
● Understand the data manipulation functions in Numpy and Pandas.
● Explore different types of machine learning approaches.
● Understand and practice visualization techniques using tools.
● Learn to handle large volumes of data with case studies.

UNIT I  INTRODUCTION
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.

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**

**CCS333  AUGMENTED REALITY/VIRTUAL REALITY**

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

**UNIT I  INTRODUCTION**

**UNIT II  VR MODELING**

**UNIT III  VR PROGRAMMING**
VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D.
UNIT IV APPLICATIONS

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

PRACTICAL EXERCISES:
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.

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 modelling techniques
CO5: Develop AR/VR applications in different domains

TOTAL PERIODS: 60

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

CO’s – PO’s & PSO’s MAPPING

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201
OBJECTIVE:
- To impart knowledge about the basics of lean principles, tools and techniques, and implementation in the construction industry.

UNIT I  INTRODUCTION  9
Introduction and overview of the construction project management - Review of Project Management & Productivity Measurement Systems - Productivity in Construction - Daily Progress Report - The state of the industry with respect to its management practices - construction project phases - The problems with current construction management techniques.

UNIT II  LEAN MANAGEMENT  9
Introduction to lean management - Toyota’s management principle - Evolution of lean in construction industry - Production theories in construction - Lean construction value - Value in construction - Target value design - Lean project delivery system - Forms of waste in construction industry - Waste Elimination.

UNIT III  CORE CONCEPTS IN LEAN  9

UNIT IV  LEAN TOOLS AND TECHNIQUES  9

UNIT V  LEAN IMPLEMENTATION IN CONSTRUCTION INDUSTRY  9
Lean construction implementation - Enabling lean through information technology - Lean in design - Design Structure - BIM (Building Information Modelling) - IPD (Integrated Project Delivery) – Sustainability through lean construction approach.

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

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

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

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

### 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%

### TEXT BOOK:

### REFERENCE BOOKS:

### Websites
- http://www.examenglish.com/
- http://www.ets.org/
- http://www.bankxams.com/
- http://civilservicesmentor.com/
- http://www.educationobserver.com
- http://www.cambridgeenglish.org/in/

### OMG352 NGOS AND SUSTAINABLE DEVELOPMENT

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### COURSE OBJECTIVES
- To understand the importance of sustainable development
- To acquire a reasonable knowledge on the legal frameworks pertaining to pollution control and environmental management
- To comprehend the role of NGOs in attaining sustainable development
UNIT I ENVIRONMENTAL CONCERNS
Introduction to sustainable development goals, Global responsibility of environmental concern, Importance of environmental preservation, Environmental threats, Pollution and its types, Effects of Pollution, Pollution control, Treatment of wastes

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

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

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

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

TOTAL 45 : PERIODS

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

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

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

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

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

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

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

TOTAL 45 : PERIODS

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

CME365 RENEWABLE ENERGY TECHNOLOGIES  L T P C
3 0 0 3

COURSE OBJECTIVES
1. To know the Indian and global energy scenario
2. To learn the various solar energy technologies and its applications.
3. To educate the various wind energy technologies.
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

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

TEXT BOOKS:

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Low (1) ; Medium (2) ; High (3)
OBJECTIVES:
The course aims to
- Introduce tools & techniques of design thinking for innovative product
- Illustrate customer-centric product innovation using on simple case studies
- Use cases Demonstrate development of Minimum usable Prototypes
- Outline principles of solution concepts & their evaluation
- Describe system thinking principles as applied to complex systems

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

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

UNIT III APPLIED DESIGN THINKING TOOLS 9
Concept of Minimum Usable Prototype [MUP] - MUP challenge brief - Designing & Crafting the value proposition - Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design

UNIT IV CONCEPT GENERATION 9
Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts

UNIT V SYSTEM THINKING 9
System Thinking, Understanding Systems, Examples and Understandings, Complex Systems

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
MF3003 REVERSE ENGINEERING LT P C 3 0 0 3

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

UNIT I INTRODUCTION & GEOMETRIC FORM

UNIT II MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION

UNIT III DATA PROCESSING

UNIT IV 3D SCANNING AND MODELLING

UNIT V INDUSTRIAL APPLICATIONS

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.
engineering of product design and development.

- Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
- Analyze the various legal aspect
- Applications of reverse engineering in product design and development.

TEXT BOOKS:

REFERENCES:

OPR351 SUSTAINABLE MANUFACTURING L T P C 3 0 0 3

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

UNIT – I ECONOMIC SUSTAINABILITY

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

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

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


TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial

AU3791 ELECTRIC AND HYBRID VEHICLES

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

UNIT I DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES
Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various

UNIT II  ENERGY SOURCES

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

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

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

TOTAL: 45 PERIODS

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

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OAS352 SPACE ENGINEERING

OBJECTIVES:

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

UNIT I STANDARD ATMOSPHERE

History of aviation – standard atmosphere - pressure, temperature and density altitude.

UNIT II AERODYNAMICS

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

UNIT III PERFORMANCE AND PROPULSION

Viscous and pressure drag - flow separation - aerodynamic drag - thrust calculations -thrust/power available and thrust/power required.

UNIT IV AIRCRAFT STABILITY AND STRUCTURAL THEORY


UNIT V SPACE APPLICATIONS

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

TOTAL: 45 PERIODS

OUTCOMES:

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

TEXT BOOKS:


REFERENCE:


OIM351 INDUSTRIAL MANAGEMENT

COURSE OBJECTIVES:

➢ To introduce fundamental concepts of industrial management
➢ To understand the approaches to the study of Management
➢ To learn about Decision Making, Organizing and leadership
➢ To analyze the Managerial Role and functions
➢ To know about the Supply Chain Management’
UNIT I INTRODUCTION

UNIT II FUNCTIONS OF MANAGEMENT

UNIT III ORGANIZATIONAL BEHAVIOUR

UNIT IV GROUP DYNAMICS

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

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

REFERENCES:
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  9

UNIT II  CONTROL CHARTS  9
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.

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.

TOTAL: 45 PERIODS

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

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

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

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

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

UNIT V WORKING AT HEIGHTS

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

REFERENCES:

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OML351 INTRODUCTION TO NON-DESTRUCTIVE TESTING L T P C
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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
- Understanding the basic importance of NDT in quality assurance.
- Imbibing the basic principles of various NDT techniques, its applications, limitations, codes and standards.
- Equipping themselves to locate a flaw in various materials, products.
- Applying apply the testing methods for inspecting materials in accordance with industry specifications and standards.
- Acquiring the knowledge on the selection of the suitable NDT technique for a given application.

UNIT I INTRODUCTION TO NDT & VISUAL TESTING 9

UNIT II LIQUID PENETRANT & MAGNETIC PARTICLE TESTING 9
Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, Methods & Interpretation.
Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, Testing Procedure, demagnetization, advantages and limitations, – Interpretation and evaluation of test indications.
UNIT III  EDDY CURRENT TESTING & THERMOGRAPHY  9
Thermography- Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods, applications.

UNIT IV  ULTRASONIC TESTING & AET  9

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

TOTAL: 45 PERIODS

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

UNIT – I  INTRODUCTION AND SENSORS

UNIT – II  8085 MICROPROCESSOR

UNIT – III PROGRAMMABLE PERIPHERAL INTERFACE

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

UNIT – V ACTUATORS AND MECHATRONICS SYSTEM DESIGN

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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TEXT BOOKS

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ORA351 FOUNDATION OF ROBOTICS

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

UNIT – I FUNDAMENTALS OF ROBOT


UNIT – II ROBOT KINEMATICS

Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.
UNIT – III  ROBOT DRIVE SYSTEMS AND END EFFECTORS  9


UNIT – IV  SENSORS IN ROBOTICS  9

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

UNIT – V  PROGRAMMING AND APPLICATIONS OF ROBOT  9

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

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

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

UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION

UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL

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

UNIT IV SENSING TECHNIQUES

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- On completion of the course, the student is expected to
- Understand the concepts and laws related to remote sensing
- 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

TEXT BOOKS:

REFERENCES:

CO-PO MAPPING

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OAI351  URBAN AGRICULTURE  L T P C  3 0 0 3

OBJECTIVES:
- To introduce the students the principles of agricultural crop production and the production practices of crops in modern ways.
- To delineate the role of agricultural engineers in relation to various crop production practices.
UNIT I INTRODUCTION
Benefits of urban agriculture- economic benefits, environmental benefits, social and cultural benefits, educational, skill-building and job training benefits, health, nutrition and food accessibility benefits.

UNIT II VERTICAL FARMING

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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OEN351 DRINKING WATER SUPPLY AND TREATMENT

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

UNIT I SOURCES OF WATER

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

UNIT I  ROTATING POWER CONVERTERS  9

UNIT II  STATIC POWER CONVERTERS  9
Working and Characteristics of Power Diodes, MOSFET and IGBT. Working of uncontrolled rectifiers, controlled rectifiers (Single phase and Three phase), DC choppers, single and three phase inverters, Multilevel inverters and Matrix Converters.

UNIT III  CONTROL OF DC AND AC MOTOR DRIVES  9
Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, Transformation theory, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives.

UNIT IV  HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS  9

UNIT V  MECHANICS OF HYBRID ELECTRIC VEHICLES AND CONTROL OF VEHICLES  9
Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of HEV's - motor torque and power rating and battery capacity. HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode

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.

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REFERENCES:

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

COURSE OBJECTIVES:
1. Understand basic PLC terminologies digital principles, PLC architecture and operation.
2. Familiarize different programming language of PLC.
3. Develop PLC logic for simple applications using ladder logic.
4. Understand the hardware and software behind PLC and SCADA.
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
PLC Basic Instructions: PLC Ladder Language- Function block Programming- Ladder/Function Block functions- PLC Basic Instructions, Basic Examples (Start Stop Rung, Entry/Reset Rung)- Configuration of Sensors, Switches, Solid State Relays-Interlock examples- Timers, Counters, Examples.

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

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

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

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5
1. Market survey of the recent PLCs and comparison of their features.
2. Summarize the PLC standards
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)
4. Market survey of Communication Network Used for PLC/SCADA.
COURSE OUTCOMES:
CO1 Know the basic requirement of a PLC input/output devices and architecture. (L1)
CO2 Ability to apply Basics Instruction Sets used for ladder Logic and Function Block Programming.(L2)
CO3 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.(L3)
CO4 Able to develop a PLC logic for a specific application on real world problem. (L5)
CO5 Ability to Understand the Concepts of Communication used for PLC/SCADA.(L1)

TEXT BOOKS:
1. Frank Petruzulla, 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 andApplications, Pearson publication

List of Open Source Software/ Learning website:
1. https://nptel.ac.in/courses/108105063

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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OCH351        NANO TECHNOLOGY                          L     T     P     C     3     0     0     3

UNIT I       INTRODUCTION                          8
General definition and size effects–important nano structured materials and nano particles-
importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and
magnetic properties of nanomaterials- surface area - band gap energy and applications.
Photochemistry and Electrochemistry of nanomaterials –Ionic properties of nanomaterials- Nano
catalysis.

UNIT II Synthesis of Nanomaterials                          8
Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel
technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron
sputtering and laser deposition methods – laser ablation, sputtering.
UNIT III NANO COMPOSITES

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>Program Outcome</th>
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<tr>
<td>CO1</td>
<td>understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications</td>
<td>PO1 2 PO3 3 PO4 3 PO5 2 PO6 - PO7 - PO8 1 PO9 - PO10 - PO11 1 PO12 - PS O1 1 O2 3 O3 3</td>
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<td>CO2</td>
<td>acquire knowledge about the different types of nano material synthesis</td>
<td>PO1 2 PO3 1 PO4 3 PO5 3 PO6 - PO7 - PO8 1 PO9 1 PO10 - PO11 3 PO12 2 PS O1 3 O2 1 O3 3</td>
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<td>CO3</td>
<td>describes about the shape, size, structure</td>
<td>PO1 2 PO3 2 PO4 3 PO5 1 PO6 1 PO7 1 PO8 1 PO9 1 PO10 3 PO11 2 PS O1 3 O2 1 O3 3</td>
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</table>
OBJECTIVE:

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

UNIT I  INTRODUCTION

UNIT II  MOLECULAR SELF ASSEMBLY

UNIT III  BIO-INSPIRED MATERIALS

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

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

TOTAL: 45 PERIODS

OUTCOME:

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

REFERENCE:

OFD352 TRADITIONAL INDIAN FOODS

OBJECTIVE:
• To help students acquire a sound knowledge on diversities of foods, food habits and patterns in India with focus on traditional foods.

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

UNIT II TRADITIONAL METHODS OF FOOD PROCESSING

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

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

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

TOTAL: 45 PERIODS

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

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

UNIT I PROCESSING OF FOOD AND ITS IMPORTANCE 9
Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.

UNIT II METHODS OF FOOD HANDLING AND STORAGE 9
Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.

UNIT III LARGE-SCALE FOOD PROCESSING 12
Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods.

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS/REFERENCES:
COURSE OBJECTIVES:

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

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

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

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

UNIT IV  ENFORCEMENT AND PRACTICAL ASPECTS OF IPR  9

UNIT V  INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY  9

TOTAL:45 PERIODS

TEXT BOOKS:

REFERENCES:
2. Basic Principles of patent law – Basics principles and acquisition of IPR. Ramakrishna T. CIPRA, NLSIU, Bangalore, 2005
Course Outcome
The student will be able to
C1 Understand and differentiate the categories of intellectual property rights.
C2 Describe about patents and procedure for obtaining patents.
C3 Distinguish plant variety, traditional knowledge and geographical indications under IPR.
C4 Provide the information about the different enforcements and practical aspects involved in protection of IPR.
C5 Provide different organizations role and responsibilities in the protection of IPR in the international level.
C6 Understand the interrelationships between different Intellectual Property Rights on International Society

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OTT351 BASICS OF TEXTILE FINISHING L T P C 3 0 0 3

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

UNIT I RESIN FINISHING

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

UNIT III SOIL RELEASE AND ANTISTATIC FINISHES

UNIT IV MECHANICAL FINISHES

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

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

TEXT BOOKS:

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

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

OBJECTIVES:
- To enable the students to learn about basics of industrial engineering and different tools of industrial engineering and its application in apparel industry

UNIT I INTRODUCTION 9
Scope of industrial engineering in apparel Industry, role of industrial engineers.
Productivity: Definition - Productivity, Productivity measures. Reduction of work content due to the product and process, Reduction of ineffective time due to the management, due to the worker. Causes for low productivity in apparel industry and measures for improvement.

UNIT II WORK STUDY 9
Definition, Purpose, Basic procedure and techniques of work-study.
Work environment – Lighting, Ventilation, Climatic condition on productivity. Temperature control, humidity control, noise control measures. Safety and ergonomics on work station and work environment
Material Handling – Objectives, Classification and characteristics of material handling equipments, Specialized material handling equipments.

UNIT III METHOD STUDY 9
Definition, Objectives, Procedure, Process charts and symbols. Various charts – Charts indicating process sequence: Outline process chart, flow process chart (man type, material type and equipment type); Charts using time scale – multiple activity chart. Diagrams indicating movement – flow diagram, string diagram, cycle graph, chrono cycle graph, travel chart
MOTION STUDY: Principle of motion economy, Two handed process chart, micro motion analysis – therbligs, SIMO chart.

UNIT IV WORK MEASUREMENT 9
Definition, purpose, procedure, equipments, techniques. Time study - Definition, basics of time study- equipments. Time study forms, Stop watch procedure. Predetermined motion time standards (PMTS). Time Study rating, calculation of standard time, Performance rating – relaxation and other allowances. Calculation of SAM for different garments, GSD.
UNIT V WORK STUDY APPLICATION

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

TOTAL: 45 PERIODS

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

TEXTBOOKS:

REFERENCES

REFERENCES
2. V.Ramesh Babu “Industrial Engineering in Apparel Production” Woodhead publishing India PVT Ltd, 2012
Course Articulation Matrix:

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

OTT353 BASICS OF TEXTILE MANUFACTURE

L T P C 3 0 0 3

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

UNIT I NATURAL FIBRES
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

REFERENCES:
Course Articulation Matrix:

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

OPE351 INTRODUCTION TO PETROLEUM REFINING AND PETROCHEMICALS LTPC 3003

OBJECTIVE:
The course is aimed to
Gain knowledge about petroleum refining process and production of petrochemical products.

UNIT I ORIGIN, FORMATION AND REFINING OF CRUDE OIL 9

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

UNIT III REFORMING AND HYDROTREATING 9

UNIT IV INTRODUCTION TO PETROCHEMICALS 9
Petrochemicals - Cracking of Naphtha and Feed stock gas for the production of Ethylene, Propylene, Isobutylene and Butadiene. Production of Acetylene from Methane, and Extraction of Aromatics.
UNIT V  PRODUCTION OF PETROCHEMICALS
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

OBJECTIVES:
At the end of the course, the student is expected to

- understand and analyse the energy data of industries
- carry out energy accounting and balancing
- conduct energy audit and suggest methodologies for energy savings and
- utilise the available resources in optimal ways

UNIT I  INTRODUCTION

UNIT II  ELECTRICAL SYSTEMS

UNIT III  THERMAL SYSTEMS
Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and
encon measures. Steam: Distribution & Use: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

UNIT IV ENERGY CONSERVATION IN MAJOR UTILITIES 9
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V ECONOMICS 9
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing – ESCO concept

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

UNIT II EXTRUSION

UNIT III INJECTION MOLDING
Injection molding – Principles and processing outline, machinery, accessories and functions, specifications, process variables, mould cycle. Types of clamping: hydraulic and toggle mechanisms. Start-up and shut down procedures-Cylinder nozzles- Press capacity projected area -Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables. Basic mould types. Reciprocating vs. plunger type injection moulding. Thermoplastic vs. thermostetting 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

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.

TOTAL HOURS: 45
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 L T P C 3 0 0 3

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

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9
Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids, Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

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

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 9

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 9
Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT)– Properties of DTFT - Z Transform & Properties
COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: determine if a given system is linear/causal/stable
CO2: determine the frequency components present in a deterministic signal
CO3: characterize continuous LTI systems in the time domain and frequency domain
CO4: characterize discrete LTI systems in the time domain and frequency domain
CO5: compute the output of an LTI system in the time and frequency domains

TEXT BOOKS:

REFERENCES:
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
Advantages of negative feedback—Analysis of Voltage / Current, Series, Shunt feedback Amplifiers—positive feedback—Condition for oscillations, phase shift—Wien bridge, Hartley, Colpitts and Crystal oscillators.

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

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

TEXT BOOKS:

REFERENCES:
CBM348  FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT  L T P C 3 0 0 3

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

UNIT I  BASICS OF PRODUCT DEVELOPMENT

UNIT II  REQUIREMENTS AND SYSTEM DESIGN

UNIT III  DESIGN AND TESTING

UNIT IV  SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT
Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation -
Sustenance - Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY


TOTAL: 45 PERIODS

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

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

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

REFERENCES:

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

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CBM333 ASSISTIVE TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:
The student should be made to:
- To know the hardware requirement various assistive devices
- To understand the prosthetic and orthotic devices
- To know the developments in assistive technology
UNIT I  CARDIAC ASSIST DEVICES 9
Cardiac functions and parameters, principle of External counter pulsation techniques, intra aortic balloon pump, Auxiliary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, cardiac pacemaker.

UNIT II  HEMODIALYSERS 9
Physiology of kidney, Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.

UNIT III  HEARING AIDS 9
Anatomy of ear, Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT IV  PROSTHETIC AND ORTHODIC DEVICES 9
Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices.

UNIT V  RECENT TRENDS 9
Transcutaneous electrical nerve stimulator, bio-feedback, assistive devices in drug delivery

TOTAL :45 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Interpret the various mechanical techniques that will help in assisting the heart functions.
CO2: Describe the underlying principles of hemodialyzer machine.
CO3: Indicate the methodologies to assess the hearing loss.
CO4: Evaluate the types of assistive devices for mobilization.
CO5: Explain about TENS and biofeedback system.

TEXT BOOKS

REFERENCES
4. Cardiac Assist Devices, Daniel Goldstein (Editor), Mehmet Oz (Editor), Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1

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OBJECTIVES:
This course will help the students to
- determine the optimum solution for Linear programming problems.
- study the Transportation and assignment models and various techniques to solve them.
- acquire the knowledge of optimality, formulation and computation of integer programming problems.
- acquire the knowledge of optimality, formulation and computation of dynamic programming problems.
- determine the optimum solution for non-linear programming problems.

UNIT I  LINEAR PROGRAMMING

UNIT II  TRANSPORTATION AND ASSIGNMENT PROBLEMS

UNIT III  INTEGER PROGRAMMING

UNIT IV  DYNAMIC PROGRAMMING PROBLEMS

UNIT V  NON-LINEAR PROGRAMMING PROBLEMS

TOTAL:45 PERIODS

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

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OMA353 ALGEBRA AND NUMBER THEORY L T P C 3 0 0 3

OBJECTIVES:
- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To examine the key questions in the Theory of Numbers.
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

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

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

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

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

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

TOTAL: 45 PERIODS

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.

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OMA354          LINEAR ALGEBRA   L T P C 3 0 0 3

**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


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

REFERENCES

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

UNIT II MICROBIAL TECHNIQUES
Sterilization – types – physical and chemical sterilization, Decontamination, Preservation methods, fermentation, Cultivation and growth of microbes, Diagnostic methods.
UNIT III PATHOGENIC MICROBES
Infectious Disease – Awareness, Causative agent, Prevention and control - Cholera, Dengu, Malaria, Diarrhea, Tuberculosis, Typhoid, Covid, HIV.

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS

OBT353 BASICS OF BIOMOLECULES

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

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

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

UNIT III AMINO ACIDS AND PROTEIN.
UNIT IV  NUCLEIC ACIDS  9
Introduction to nucleic acid, Difference between nucleotide and nucleoside, composition of DNA &
RNA. Structure of Nitrogen bases in DNA and RNA along with the nomenclature- DNA double
helix (Watson and crick) model, types of DNA, RNA.

UNIT V  VITAMINS AND HORMONES  9
Different types of vitamins, their diverse biochemical functions and deficiency related diseases.
Overview of hormones. Hormone mediated signaling. Mechanism of action of steroid hormones,
epinephrine, glucagons and insulin. Role of vitamins and hormones in metabolism; Hormonal
disorders; Therapeutic uses of 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
   W.H.Freeman and Company 2017

REFERENCES
   Sons Inc., 2010.

OBT354  FUNDAMENTALS OF CELL AND MOLECULAR BIOLOGY  L T P C
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OBJECTIVES:
☐ To provide knowledge on the fundamentals of cell biology.
☐ To understand the signalling mechanisms.
☐ Understand basic principles of molecular biology at intracellular level to regulate growth,
   division and development.

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

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

UNIT III  BIO-MEMBRANE TRANSPORT  9
Physicochemical properties of cell membranes. Molecular constitute of membranes, asymmetrical
organisation of lipids and proteins. Solute transport across membrane’s-fick's law, simple diffusion,
passive-facilitated diffusion, active transport- primary and secondary, group translocation, transport
ATPases, membrane transport in bacteria and animals. Transport mechanism - mobile carriers and pores mechanisms. Transport by vesicle formation, endocytosis, exocytosis, cell respiration.

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

UNIT V  CENTRAL DOGMA  

TOTAL: 45 PERIODS

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

TEXTBOOKS:

REFERENCES:
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).
COURSE OBJECTIVE
The Course will enable Learners to,

- Understand the essentials of project writing.
- Perceive the difference between general writing and technical writing
- Assimilate the fundamental features of report writing.
- Understand the essential differences that exist between general and technical writing.
- Learn the structure of a technical and project report.

UNIT I

UNIT II

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

UNIT IV

UNIT V

OUTCOMES
By the end of the course, learners will be able to

- Write effective project reports.
- Use statistical tools with confidence.
- Explain the purpose and intension of the proposed project coherently and with clarity.
- Create writing texts to suit achieve the intended purpose.
- Master the art of writing winning proposals and projects.

TOTAL:45 PERIODS

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REFERENCES

OMA355    ADVANCED NUMERICAL METHODS     L T P C
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UNIT I    ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEM   9

UNIT II   INTERPOLATION   9
Central difference: Stirling and Bessel's interpolation formulae ; Piecewise spline interpolation: Piecewise linear, piecewise quadratic and cubic spline ; Least square approximation for continuous data (upto 3rd degree).

UNIT III   NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS   9

UNIT IV   FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS   9
Laplace and Poisson's equations in a rectangular region : Five point finite difference schemes - Leibmann's iterative methods - Dirichlet's and Neumann conditions – Laplace equation in polar coordinates : Finite difference schemes.

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

TOTAL : 45 PERIODS

TEXT BOOKS :

REFERENCES:
OBJECTIVES:

- To introduce the basic concepts of probability, one and two dimensional random variables with applications to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in communication networks.
- To acquaint with specialized random processes which are apt for modelling the real time scenario.
- To understand the concept of correlation and spectral densities.
- To understand the significance of linear systems with random inputs.

UNIT I  RANDOM VARIABLES


UNIT II  RANDOM PROCESSES


UNIT III  SPECIAL RANDOM PROCESSES


UNIT IV  CORRELATION AND SPECTRAL DENSITIES


UNIT V  LINEAR SYSTEMS WITH RANDOM INPUTS

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

TOTAL: 45 PERIODS

OUTCOMES

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

- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept random processes in engineering disciplines.
- Understand and apply the concept of correlation and spectral densities.
- Get an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.
- Analyze the response of random inputs to linear time invariant systems.
TEXT BOOKS

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OMA357 QUEUEING AND RELIABILITY MODELLING L T P C
3 0 0 3

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

UNIT I RANDOM PROCESSES

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

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

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

TOTAL: 45 PERIODS

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

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

TEXT BOOKS

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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 1 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 2 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 3 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 4 PRODUCTION & OPERATIONS MANAGEMENT PROCESS

UNIT 5 CONTROLING PRODUCTION & OPERATIONS MANAGEMENT

TOTAL 45 : PERIODS

Upon completion of this course the learners will be able :
CO 1 To understand the basics and functions of Production and Operation Management for business owners.
CO 2 To learn about the Production & Operation Systems.
CO 3 To acquaint on the Production & Operations Planning Techniques followed by entrepreneurs in Industries.
CO 4 To known about the Production & Operations Management Processes in industries.
CO 5 To comprehend the techniques of controlling , Production and Operations in industries.

REFERENCES
OBJECTIVE:

- To know various multivariate data analysis techniques for business research.

UNIT I INTRODUCTION

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

UNIT II PREPARING FOR MULTIVARIATE ANALYSIS

Conceptualization of research model with variables, collection of data — Approaches for dealing with missing data – Testing the assumptions of multivariate analysis.

UNIT III MULTIPLE LINEAR REGRESSION ANALYSIS, FACTOR ANALYSIS

Multiple Linear Regression Analysis – Inferences from the estimated regression function – Validation of the model. - Approaches to factor analysis – interpretation of results.

UNIT IV LATENT VARIABLE TECHNIQUES

Confirmatory Factor Analysis, Structural equation modelling, Mediation models, Moderation models, Longitudinal studies.

UNIT V ADVANCED MULTIVARIATE TECHNIQUES

Multiple Discriminant Analysis, Logistic Regression, Cluster Analysis, Conjoint Analysis, multidimensional scaling.

TOTAL: 45 PERIODS

OUTCOMES:

- Demonstrate a sophisticated understanding of the concepts and methods; know the exact scopes and possible limitations of each method; and show capability of using multivariate techniques to provide constructive guidance in decision making.
- Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.
- Show substantial understanding of the real problems; conduct deep analysis using correct methods; and draw reasonable conclusions with sufficient explanation and elaboration.
- Write an insightful and well-organized report for a real-world case study, including thoughtful and convincing details.
- Make better business decisions by using advanced techniques in data analytics.

REFERENCES:

COURSE OBJECTIVES:
To introduce the development, capabilities, applications, of Additive Manufacturing (AM), and its business opportunities.
To be acquainted with vat polymerization and material extrusion processes
To be familiar with powder bed fusion and binder jetting processes.
To gain knowledge on applications of direct energy deposition, and material jetting processes.
To impart knowledge on sheet lamination and direct write technologies.

UNIT I INTRODUCTION

UNIT II VAT POLYMERIZATION AND MATERIAL EXTRUSION

UNIT III POWDER BED FUSION AND BINDER JETTING

UNIT IV MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION

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

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

REFERENCES:

CME343 NEW PRODUCT DEVELOPMENT L T P C
3 0 0 3

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

UNIT – I FUNDAMENTALS OF NPD

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

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

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

TOTAL : 45 PERIODS

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

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

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

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Low (1) ; Medium (2) ; High (3)
OBJECTIVES:
The course aims to
- Outline Fundamental concepts in UI & UX
- Introduce the principles of Design and Building an mobile app
- Illustrate the use of CAD in product design
- Outline the choice and use of prototyping tools
- Understanding design of electronic circuits and fabrication of electronic devices

UNIT I UI/UX

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

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

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

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

TOTAL: 45 PERIODS

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

Text Books

References
MF3010 MICRO AND PRECISION ENGINEERING

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

- Learn about the precision machine tools
- Learn about the macro and micro components.
- Understand handling and operating of the precision machine tools.
- Learn to work with miniature models of existing machine tools/robots and other instruments.
- Learn metrology for micro system

UNIT I INTRODUCTION TO MICROSYSTEMS 9
Design, and material selection, micro-actuators: hydraulic, pneumatic, electrostatic/ magnetic etc. for medical to general purpose applications. Micro-sensors based on Thermal, mechanical, electrical properties; micro-sensors for measurement of pressure, flow, temperature, inertia, force, acceleration, torque, vibration, and monitoring of manufacturing systems.

UNIT II FABRICATION PROCESSES FOR MICRO-SYSTEMS: 9
Additive, subtractive, forming process, microsystems-Micro-pumps, micro-turbines, micro engines, micro-robot, and miniature biomedical devices

UNIT III INTRODUCTION TO PRECISION ENGINEERING 9
Machine tools, holding and handling devices, positioning fixtures for fabrication/ assembly of microsystems. Precision drives: inch worm motors, ultrasonic motors, stick-slip mechanism and other piezo-based devices.

UNIT IV PRECISION MACHINING PROCESSES 9
Precision machining processes for macro components - Diamond turning, fixed and free abrasive processes, finishing processes.

UNIT V METROLOGY FOR MICRO SYSTEMS 9
Metrology for micro systems - Surface integrity and its characterization.

TOTAL : 45 PERIODS

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

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

TEXT BOOKS:
REFERENCE:

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

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

UNIT – I INTRODUCTION TO COSTING CONCEPTS 9
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT – II INTRODUCTION TO PROJECT MANAGEMENT 9
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as 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 9
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing

UNIT – IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

UNIT – V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

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 9
Li-ion Batteries-different formats, chemistry, safe operating area, efficiency, aging. Characteristics-SOC,DOD, SOH. Balancing-Passive Balancing Vs Active Balancing. Other Batteries-NCM and NCA Batteries. NCR18650B specifications.

UNIT II BATTERY PACK 9
Battery Pack- design, sizing, calculations, flow chart, real and simulation Model.Peak power – definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging.

UNIT III BATTERY MODELLING 9
Battery Modelling Methods-Equivalent Circuit Models, Electrochemical Model, Neural Network Model. ECM Comparisons- Rint model, Thevenin model, PNGV model. State space Models-Introduction. Battery Modelling software/simulation frameworks

UNIT IV BATTERY STATE ESTIMATION 9
UNIT V   BMS ARCHITECTURE AND REAL TIME COMPONENTS  9
Battery Management System- need, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex Ray-CANedge1 package. 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

OAU352   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  9

UNIT II   VARIABLE RESISTANCE AND INDUTANCE SENSORS  9
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermostors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT

UNIT III  VARIABLE AND OTHER SPECIAL SENSORS  9
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.

UNIT IV   AUTOMOTIVE ACTUATORS  9
Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings
for electrical machines. Working principles, construction and location of actuators viz. Solenoid, relay, stepper motor etc.

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

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

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.

TOTAL: 45 PERIODS

OAS353  SPACE VEHICLES

OIM352  MANAGEMENT SCIENCE

COURSE OBJECTIVES:
Of this course are
1. To introduce fundamental concepts of management and organization to students.
2. To impart knowledge to students on various aspects of marketing, quality control and marketing strategies.
3. To make students familiarize with the concepts of human resources management.
4. To acquaint students with the concepts of project management and cost analysis.
5. To make students familiarize with the concepts of planning process and business strategies.
UNITI  INTRODUCTION TO MANAGEMENT AND ORGANISATION  

UNITII  OPERATIONS AND MARKETING MANAGEMENT  

UNITIII  HUMAN RESOURCES MANAGEMENT  
Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Wage and Salary Administration, Promotion, Transfer, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating - Capability Maturity Model (CMM) Levels.

UNITIV  PROJECT MANAGEMENT  
Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method(CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

UNITV  STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES  

TOTAL: 45 PERIODS

COURSEOUTCOMES:
Upon completion of the course, Students will be able to

CO1: Plan an organizational structure for a given context in the organisation to carry out production 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 organisation.

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TEXTBOOKS:

REFERENCE:

OIM353 PRODUCTION PLANNING AND CONTROL

COURSE OBJECTIVES:
- To understand the concept of production planning and control act work study,
- To apply the concept of product planning,
- To analyze the production scheduling,
- To apply the Inventory Control concepts.
- To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION
Objectives and benefits of planning and control-Functions of production control-Types of production-job- batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration-Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT II WORK STUDY
Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING
Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

UNIT IV PRODUCTION SCHEDULING

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC
Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic

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COURSE OUTCOMES:
Upon completion of this course,
   CO1: The students can able to prepare production planning and control act work study,
   CO2: The students can able to prepare product planning,
   CO3: The students can able to prepare production scheduling,
   CO4: The students can able to prepare Inventory Control.
   CO5: They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

TEXT BOOKS:

REFERENCES

OIE353 OPERATIONS MANAGEMENT L T P C
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COURSE OBJECTIVE:
- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm's competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
- Relate the interdependence of the operations function with the other key functional areas of a firm.
- Teach analytical skills and problem-solving tools to the analysis of the operations problems.
- Apply scheduling and Lean Concepts for improving System Performance.
UNIT I  INTRODUCTION TO OPERATIONS MANAGEMENT  9
Operations Management – Nature, Importance, historical development, transformation processes,
differences between services and goods, a system perspective, functions, challenges, current
priorities, recent trends; Operations Strategy – Strategic fit, framework; Supply Chain
Management

UNIT II  FORECASTING, CAPACITY AND FACILITY DESIGN  9
Demand Forecasting – Need, Types, COURSE OBJECTIVES and Steps. Overview of
Qualitative and Quantitative methods. Capacity Planning - Long range, Types, Developing capacity
alternatives. Overview of sales and operations planning. Overview of MRP, MRP II and ERP.
Facility Location – Theories, Steps in Selection, Location Models. Facility Layout – Principles,
Types, Planning tools and techniques.

UNIT III  DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS  9
Product Design – Influencing factors, Approaches, Legal, Ethical and Environmental issues.
OBJECTIVES, Procedure. Method Study and Motion Study. Work Measurement and
Productivity – Measuring Productivity and Methods to improve productivity.

UNIT IV  MATERIALS MANAGEMENT  9
Materials Management – COURSE OBJECTIVES, Planning, Budgeting and Control. Purchasing
– COURSE OBJECTIVES, Functions, Policies, Vendor rating and Value Analysis. Stores
Management – Nature, Layout, Classification and Coding. Inventory – COURSE OBJECTIVES,
Costs and control techniques. Overview of JIT.

UNIT V  SCHEDULING AND PROJECT MANAGEMENT  9
Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature,
importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson”s
Algorithm – Gantt charts; personnel scheduling in services.  TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: The students will appreciate the role of Production and Operations management in enabling
and enhancing a firm’s competitive advantages in the dynamic business
environment.

CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production
and Service Systems.

CO3: The students will be able to Formulate and Assess Aggregate Planning strategies and
Material Requirement Plan.

CO4: The students will be able to develop analytical skills to calculate capacity requirements and
developing capacity alternatives.

CO5: The students will be able to apply scheduling and Lean Concepts for improving System
Performance.

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TEXT BOOKS

REFERENCES

OSF352  INDUSTRIAL HYGIENE  L T P C
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COURSE OBJECTIVES:
1. Demonstrate an understanding of how occupational hygiene standards are set and used in work health and safety.
2. Compare and contrast the roles of environmental and biological monitoring in work health and safety.
3. Outline strategies for identifying, assessing and controlling risks associated with airborne gases, vapours and particulates.
4. Discuss how personal protective equipment can be used to reduce risks associated with workplace exposures.
5. Provide high-level advice on managing and controlling noise and noise-related hazards.

UNIT I : INTRODUCTION AND SCOPE 9

UNIT II : MONITORING FOR SAFETY, HEALTH & ENVIRONMENT 9
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 9

UNIT IV : OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT 9
UNIT-V INDUSTRIAL HAZARDS

i. Radiation: Types and effects of radiation on human body, Measurement and detection of radiation intensity. Effects of radiation on human body, Measurement – disposal of radioactive waste, Control of radiation


TOTAL PERIODS: 45

COURSE OUTCOMES:
Students able to
CO1: Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems
CO2: Specify designs that avoid occupation related injuries
CO3: Define and apply the principles of work design, motion economy, and work environment design.
CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.
CO5: Acknowledge the impact of workplace design and environment on productivity

TEXT BOOKS:

REFERENCES:
2. Frank P Lees - Loss of prevention in Process Industries, Vol. 1 and 2,

CO’s- PO’s & PSO’s MAPPING

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OSF353 CHEMICAL PROCESS SAFETY

COURSE OBJECTIVES
- Teach the principles of safety applicable to the design, and operation of chemical process plants.
- Ensure that potential hazards are identified and mitigation measures are in place to prevent unwanted release of energy.
• Learn about the hazardous chemicals into locations that could expose employees and others to serious harm.
• Focuses on preventing incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals.
• Ensure that the general design of the plant is capable of complying with the dose limits in force and with the radioactive releases.

UNIT I SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES
Types of storage - general considerations for storage layouts - atmospheric venting, pressure and temperature relief - relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation - pipe line transport - safety in chemical laboratories.

UNIT II CHEMICAL REACTION HAZARDS
Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self - heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening.

UNIT III SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS
Design principles - Process design development - types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares - new concepts in safety design and operation - Pressure vessel testing standards - Inspection techniques for boilers and reaction vessels.

UNIT IV SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS
Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards - standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures - condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

UNIT V SAFETY AND ANALYSIS
Safety vs reliability - quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students able to
CO1 Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.
CO2 Develop thorough knowledge about safety in the operation of chemical plants.
CO3 Apply the principles of safety in the storage and handling of gases.
CO4 Identify the conditions that lead to reaction hazards and adopt measures to prevent them.
CO5 Develop thorough knowledge about

TEXT BOOK

REFERENCES:

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OML352 ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS L T P C
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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Understanding the importance of various materials used in electrical, electronics and magnetic applications
2. Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
3. Gaining knowledge on the selection of suitable materials for the given application
4. Knowing the fundamental concepts in Semiconducting materials
5. Getting equipped with the materials used in optical and optoelectronic applications.

UNIT- I DIELECTRIC MATERIALS
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

UNIT – II MAGNETIC MATERIALS
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis

UNIT – III SEMICONDUCTOR MATERIALS
Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on specific superconducting materials; comments on fabrication and engineering applications.

UNIT – IV MATERIALS FOR ELECTRICAL APPLICATIONS
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetallic fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

UNIT – V OPTICAL AND OPTOELECTRONIC MATERIALS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
1. Understand various types of dielectric materials, their properties in various conditions.
2. Evaluate magnetic materials and their behavior.
3. Evaluate semiconductor materials and technologies.
4. Select suitable materials for electrical engineering applications.
5. Identify right material for optical and optoelectronic applications

TEXT BOOKS:

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

1. Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications
2. Gaining knowledge on dimensionality effects on different properties of nanomaterials
3. Getting acquainted with the different processing techniques employed for fabricating nanomaterials
4. Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
5. Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

UNIT I  NANOMATERIALS  9
Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.

UNIT II THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS  9
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.

UNIT III PROCESSING  9
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.

UNIT IV STRUCTURAL CHARACTERISTICS  9
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis

UNIT V  APPLICATIONS  9
Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries

TOTAL: 45 PERIODS

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

1. Evaluate nanomaterials and understand the different types of nanomaterials
2. Recognise the effects of dimensionality of materials on the properties
3. Process different nanomaterials and use them in engineering applications
4. Use appropriate techniques for characterising nanomaterials
5. Identify and use different nanomaterials for applications in different engineering fields.

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OMR352 HYDRAULICS AND PNEUMATICS

L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To know the fluid power principles and working of hydraulic pumps
2. To obtain the knowledge in hydraulic actuators and control components
3. To understand the basics in hydraulic circuits and systems
4. To obtain the knowledge in pneumatic and electro pneumatic systems
5. To apply the concepts to solve the trouble shooting

UNIT – I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS

UNIT – II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS

UNIT – III HYDRAULIC CIRCUITS AND SYSTEMS
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT – IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS
Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade

UNIT – V | TROUBLE SHOOTING AND APPLICATIONS 9


TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO 1: Analyze the methods in fluid power principles and working of hydraulic pumps
CO 2: Recognize the concepts in hydraulic actuators and control components
CO 3: Obtain the knowledge in basics of hydraulic circuits and systems
CO 4: Know about the basics concept in pneumatic and electro pneumatic systems
CO 5: Apply the concepts to solve the trouble shooting hydraulic and pneumatics

| Mapping of COs with POs and PSOs |
|----------------------------------|-----------------|-----------------|-----------------|
| COs/POs & PSOs                   | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 1   | 2   | 3   |
| CO1                             | 3   | 2   | 1   | 2   | 2   | 1   | 1   | 2   | 2   | 1   |
| CO2                             | 3   | 2   | 1   | 2   | 2   | 1   | 1   | 2   | 2   | 1   |
| CO3                             | 3   | 2   | 1   | 2   | 2   | 1   | 1   | 2   | 2   | 1   |
| CO4                             | 3   | 2   | 1   | 2   | 2   | 1   | 1   | 2   | 2   | 1   |
| CO5                             | 3   | 2   | 1   | 2   | 2   | 1   | 1   | 2   | 2   | 1   |
| CO/PO & PSO Average             | 3   | 2   | 1   | 2   | 2   | 1   | 1   | 2   | 2   | 1   |

1 – Slight, 2 – Moderate, 3 – Substantial

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 9

UNIT – II KINEMATICS 9
UNIT – III PERCEPTION

UNIT – IV LOCALIZATION

UNIT – V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Evaluate the appropriate mobile robots for the desired application.
CO2: Create the kinematics for given wheeled and legged robot.
CO3: Analyse the sensors for the intelligence of mobile robotics.
CO4: Create the localization strategies and mapping technique for mobile robot.
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.

TEXTBOOK

REFERENCES:

MV3501 MARINE PROPULSION

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 1 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 2 SHIPS MOVEMENTS AND SHIP STABILIZATION**

9
Thrust augmented devices, Ship hull, modern ship propulsion design, bow thruster – Advantages, various methods to stabilize the ship- passive and active stabilizer, fin stabilizer, bilge keel - stabilizing and securing ship in port- effect of tides on ship – effect of river water and sea water sailing vessel, Load line and load line of marking- draught markings.

**UNIT 3 SHIPS SPEED AND ITS PERFORMANCE**

9
Ship propulsion factors, factors affecting ships speed, various velocities of ship, hull drag, effects of fouling on ships hull, ship wake, relation between powers, Fuel consumption of ship, cavitations - effects of cavitation’s, ship turning radius.

**UNIT 4 BASICS OF PROPELLER**

9

**UNIT 5 BASICS OF Rudder**

9
Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings- Rudder pintle - Rudder types- Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits of various types of rudders, Propeller and rudder interaction, Rudder stopper, movement of rudders, Basic construction of Rudder

TOTAL: 45 PERIODS

**COURSE OUTCOMES:**

Upon successful completion of the course, students should be able to:
CO1: Explain the basics of propulsion system and ship dynamic movements
CO2: Familiarize with various components assisting ship stabilization.
CO3: Demonstrate the performance of the ship.
CO4: Classify the Propeller and its types, Materials etc.
CO5: Categories the Rudder and its types, design criteria of rudder.

**TEXT BOOKS:**


**REFERENCES BOOKS:**


**MAPPING OF COS AND POS:**

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OBJECTIVES:
At the end of the course, students are expected to acquire
1. Knowledge on basics of Hydrostatics
2. Familiarization on types of merchant ships
3. Knowledge on Shipbuilding Materials
4. Knowledge on marine propeller and rudder
5. Awareness on governing bodies in shipping industry

UNIT I  INTRODUCTION TO HYDROSTATICS  9
Archimedes Principle- Laws of floatation– Meta centre – stability of floating and submerged bodies-
Density, relative density - Displacement –Pressure –centre of pressure.

UNIT II  TYPES OF SHIP  10
General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers-
Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gas carriers - Chemical tankers -
Passenger ships

UNIT III  SHIPBUILDING MATERIALS  9
Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys, Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced Composites

UNIT IV  MARINE PROPELLER AND RUDDER  8
Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its effects on propeller

UNIT V  GOVERNING BODIES FOR SHIPPING INDUSTRY  9
Role of IMO (International Maritime Organization), SOLAS (International Convention for the Safety of Life at Sea), MARPOL (International Convention for the Prevention of Pollution from Ships ), MLC (Maritime Labour Convention), STCW 2010 (International Convention on Standards of Training, Certification and Watch keeping for Seafarers), Classification societies Administration authorities

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
OBJECTIVES:
At the end of the course, students are expected to
1. Understand the role of Marine machinery systems
2. Be familiar with Marine propulsion machinery system
3. Acquaint with Marine Auxiliary machinery system
4. Have acquired basics of Marine Auxiliary boiler system
5. Be aware of ship propellers and steering system

UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS 9
Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems

UNIT II MARINE PROPULSION MACHINERY SYSTEM 9
Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system

UNIT III MARINE AUXILIARY MACHINERY SYSTEM 9
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications

UNIT IV MARINE BOILER SYSTEM 9
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories

UNIT V SHIP PROPELLERS AND STEERING MECHANISM 9
Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear

OUTCOMES:
At the end of the course, students should able to,
1. Distinguish the role of various marine machinery systems
2. Relate the components of marine propulsion machinery system
3. Explain the importance of marine auxiliary machinery system
4. Acquire knowledge of marine boiler system
5. Understand the importance of ship propellers and steering system

TEXT BOOKS:

REFERENCES:
1. Alan L. Rowen, "Introduction to Practical Marine Engineering, Volume 1 & 2", The Institute of Marine Engineers (India), Mumbai, 2006
2. A.S. Tambwekar, "Naval Architecture and Ship Construction", The Institute of Marine Engineers (India), Mumbai, 2015

CRA332  DRONE TECHNOLOGIES  L  T  P  C
3  0  0  3

COURSE OBJECTIVES:
1. To understand the basics of drone concepts
2. To learn and understand the fundamentals of design, fabrication and programming of drone
3. To impart the knowledge of an flying and operation of drone
4. To know about the various applications of drone
5. To understand the safety risks and guidelines of fly safely

UNIT – I  INTRODUCTION TO DRONE TECHNOLOGY  9
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

UNIT – II  DRONE DESIGN, FABRICATION AND PROGRAMMING  9
Classifications of the UAV - Overview of the main drone parts- Technical characteristics of the parts - Function of the component parts - Assembling a drone - The energy sources - Level of autonomy- Drones configurations - The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization - Flight modes - Wi-Fi connection.

UNIT – III  DRONE FLYING AND OPERATION  9
Concept of operation for drone - Flight modes - Operate a small drone in a controlled environment - Drone controls Flight operations - management tool - Sensors - Onboard storage capacity - Removable storage devices - Linked mobile devices and applications

UNIT – IV  DRONE COMMERCIAL APPLICATIONS  9
Choosing a drone based on the application - Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution - Drones in filming and panoramic picturing

UNIT – V  FUTURE DRONES AND SAFETY  9
The safety risks- Guidelines to fly safely - Specific aviation regulation and standardization- Drone license- Miniaturization of drones - Increasing autonomy of drones - The use of drones in swarms

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Know about a various type of drone technology, drone fabrication and programming.
CO2: Execute the suitable operating procedures for functioning a drone
CO3: Select appropriate sensors and actuators for Drones
CO4: Develop a drone mechanism for specific applications
CO4: Create the programs for various drones

CO-PO MAPPING:

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TEXT BOOKS

REFERENCES

OGI352 GEOGRAPHICAL INFORMATION SYSTEM L T P C 3 0 0 3

OBJECTIVES:
To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.

UNIT I FUNDAMENTALS OF GIS

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

TEXTBOOKS:

REFERENCES:

CO – PO – PSO MAPPING: GEOGRAPHIC INFORMATION SYSTEM

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OAI352          AGRICULTURE ENTREPRENEURSHIP DEVELOPMENT        L T P C
                      3 0 0 3
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.

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

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<tr>
<td>PSO1 To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill</td>
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<td>PSO2 To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.</td>
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<td>PSO3 To inculcate entrepreneurial skills through strong Industry-Institution linkage.</td>
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OEN352 BIODIVERSITY CONSERVATION

OBJECTIVE:
The identification of different aspects of biological diversity and conservation techniques.

UNIT I INTRODUCTION
9
Concept of Species, Variation; Introduction to Major Plant Groups; Evolutionary relationships between Plant Groups; Nomenclature and History of plant taxonomy; Systems of Classification and their Application; Study of Plant Groups; Study of Identification Characters; Study of important families of Angiosperms; Plant Diversity Application.

UNIT II INTRODUCTION TO ANIMAL DIVERSITY AND TAXONOMY
9
Principles and Rules of Taxonomy; ICZN Rules, Animal Study Techniques; Concepts of Taxon, Categories, Holotype, Paratype, Topotype etc; Classification of Animal kingdom, Invertebrates, Vertebrates, Evolutionary relationships between Animal Groups.

UNIT III MICROBIAL DIVERSITY
9
Microbes and Earth History, Magnitude, Occurrence and Distribution. Concept of Species, Criteria for Classification, Outline Classification of Microorganisms (Bacteria, Viruses and Protozoa); Criteria for Classification and Identification of Fungi; Chemical and Biochemical Methods of Microbial Diversity Analysis.

UNIT IV MEGA DIVERSITY
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

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<thead>
<tr>
<th>CO’s</th>
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Note: The average value of this course to be used for program articulation matrix.

OEE353 INTRODUCTION TO CONTROL SYSTEMS  L  T  P  C
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298
OBJECTIVES
- To impart knowledge on various representations of systems.
- To familiarize time response analysis of LTI systems and steady state error.
- To analyze the frequency responses and stability of the systems
- To analyze the stability of linear systems in frequency domain and time domain
- To develop linear models mainly state variable model and transfer function model

UNIT I MATHEMATICAL MODELS OF PHYSICAL SYSTEMS
Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction—Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS & ROOTLOCUS TECHNIQUE

UNIT III FREQUENCY RESPONSE ANALYSIS
Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV STABILITY CONCEPTS & ANALYSIS

UNIT V STATE VARIABLE ANALYSIS
Concept of state – State Variable & State Model – State models for linear & continuous time systems—Solution of state & output equation—controllability & observability.

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.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
2. Control System Dynamics" by Robert Clark, Cambridge University Press, 1996 USA.

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
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</table>
INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS

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

UNIT I  INTRODUCTION

UNIT II  AUTOMATION COMPONENTS
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT III  COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS
Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

UNIT IV  PROGRAMMABLE LOGIC CONTROLLERS
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT V  DISTRIBUTED CONTROL SYSTEM
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL: 45 PERIODS

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

COURSE OUTCOMES:
Students able to
CO1 Design a signal conditioning circuits for various application (L3).
CO2 Acquire a detail knowledge on data acquisition system interface and DCS system (L2).
CO3 Understand the basics and Importance of communication buses in applied automation Engineering (L2).

CO4 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.(L3)

CO5 Able to develop a PLC logic for a specific application on real world problem. (L5)

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1. https://archive.nptel.ac.in/courses/108/105/108105062/
2. https://nptel.ac.in/courses/108105063

<table>
<thead>
<tr>
<th>CO’s- PO’s &amp; PSO’s MAPPING</th>
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<td><strong>CO’s</strong></td>
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OCH353 ENERGY TECHNOLOGY

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UNIT I INTRODUCTION

Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources.

UNIT II CONVENTIONAL ENERGY

Conventional energy resources. Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III NON-CONVENTIONAL ENERGY

Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills,
types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV  BIOMASS ENERGY  10
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT V  ENERGY CONSERVATION  9
Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.

TOTAL : 45 PERIODS

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

Course articulation matrix

<table>
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<tr>
<th>Course Outcomes</th>
<th>Program Outcomes</th>
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<tr>
<td>Statements</td>
<td>PO 1</td>
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<tr>
<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>
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<tr>
<td>Students will excel as professionals in the various fields of energy engineering</td>
<td>2</td>
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</tbody>
</table>
Compare different renewable energy technologies and choose the most appropriate based on local conditions.

Explain the technological basis for harnessing renewable energy sources.

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.

OBJECTIVE:

- To enable the students to analyze properties of a surfaces and correlate them to structure, chemistry, and physics and surface modification technique.

UNIT I SURFACE STRUCTURE AND EXPERIMENTAL PROBES

Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, absorbate structure, Band and Vibrational structure, Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy

UNIT II ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT SURFACES

Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods

UNIT III LIQUID INTERFACES

Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells

UNIT IV HETEROGENEOUS CATALYSIS

Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, 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

Origin of surface forces, Role of stress and strain in epitaxial growth, Energetic and growth modes, Nucleation theory, Nonequilibrium growth modes, MBE, CVD and ablation techniques, Catalytic
growth of nanotubes, Etching of surfaces, Formation of nanopillars and nanorods and its application in photoelectrochemical processes, Polymer surfaces and biointerfaces.

**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:**

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**OFD354 FUNDAMENTALS OF FOOD ENGINEERING**

**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 electrodialysis, gel filtration, ion exchange, per-evaporation and osmotic dehydration.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to
CO1 understand the importance of food polymers
CO2 understand the effect of various methods of processing on the structure and texture of food materials
CO3 understand the interaction of food constituents with respect to thermal, electrical properties to develop new technologies for processing and preservation.

TEXTBOOKS:

OFD355 FOOD SAFETY AND QUALITY REGULATION 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 9
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 6
Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoochemicals and microbes in food, plants, animals and microbes.

UNIT II PHYTOCHEMICALS AS NUTRACEUTICALS 11
Phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, lycopene, chitin, carotenoids. Manufacturing practice of selected nutraceuticals such as lycopene, isoflavonoids, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals - stability, analytical and labelling issues.

UNIT III ASSESSMENT OF ANTIOXIDANT ACTIVITY 11
In vitro and in vivo methods for the assessment of antioxidant activity, Comparison of different in vitro methods to evaluate the antioxidant, antioxidant mechanism, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

UNIT IV ROLE IN HEALTH AND DISEASE 11
The health benefit of - Soy protein, Spirulina, Tea, Olive oil, plant sterols, Broccoli, omega3 fatty acid and eicosanoids. Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and synbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

UNIT V SAFETY ISSUES 6
Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues
International and national.

TOTAL: 45 PERIODS

TEXT BOOKS:
3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006

REFERENCES:
1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007

COURSE OUTCOME - NUTRACEUTICALS

<table>
<thead>
<tr>
<th>CO</th>
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<tbody>
<tr>
<td>CO 1</td>
<td>acquire knowledge about the Nutraceuticals and functional foods, their classification and benefits.</td>
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<td>CO 2</td>
<td>acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes</td>
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<td>CO 3</td>
<td>attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods.</td>
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<td>CO 4</td>
<td>distinguish the various <em>In vitro</em> and <em>In vivo</em> assessment of Antioxidant activity of compounds from plant sources.</td>
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<td>CO 5</td>
<td>gain information about the health benefits of various functional foods and nutraceuticals in the prevention and treatment of various lifestyle diseases.</td>
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<td>CO 6</td>
<td>Attain the knowledge of the regulatory and safety issues of nutraceuticals at national and international level.</td>
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CO – PO MAPPING

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OBJECTIVE:
- To enable the students to learn about the basics of Pretreatment, dyeing, printing and machinery in textile processing.

UNIT I INTRODUCTION
Impurities present in different fibres, Inspection of grey goods and lot preparation. Shearing,

UNIT II PRE TREATMENT

UNIT III DYEING

UNIT IV PRINTING
Definition of printing – Difference between printing and dyeing- Classification thickeners – Requirements to be good thickener, printing paste Preparation - different styles of printing.

UNIT V MACHINERIES

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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<td>CO1</td>
<td>Classification of fibres and production of natural fibres</td>
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<tr>
<td>CO2</td>
<td>Regenerated and synthetic fibres</td>
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**FT3201**  
**FIBRE SCIENCE**  
**L T P C**  
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**COURSE OBJECTIVES**
- To enable the students to learn about the types of fibre and its properties

**UNIT I**  
**INTRODUCTION TO TEXTILE FIBRES**  
Definition of various forms of textile fibres - staple fibre, filament, bicomponent fibres. Classification of Natural and Man-made fibres, essential and desirable properties of Fibres. Production and cultivation of Natural Fibers: Cotton, Silk, Wool - Physical and chemical structure of the above fibres.

**UNIT II**  
**REGENERATED FIBRES**  
Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel, Tencel

**UNIT III**  
**SYNTHETIC FIBRES**  
Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass, carbon. Introduction to spin finishes and texturization
UNIT IV  SPECIALITY FIBRES  9
Properties and end uses of high tenacity and high modulus fibres, high temperature and flame retardant fibres, Chemical resistant fibres

UNIT V  FUNCTIONAL SPECIALITY FIBRES  9
Properties and end uses: Fibres for medical application – Biodegradable fibres based on PLA, Super absorbent fibres elastomeric fibres, ultra-fine fibres, electrospun nano fibres, metallic fibres – Gold and Silver coated.

TOTAL : 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the student would be able to
- Understand the process sequence of various fibres
- Understand the properties of various fibres

TEXT BOOKS:

REFERENCES:

OTT355  GARMENT MANUFACTURING TECHNOLOGY  L T P C
3 0 0 3

OBJECTIVE:
- To enable the students to understand the basics of pattern making, cutting and sewing.
- To expose the students to various problems & remedies during garment manufacturing

UNIT I  PATTERN MAKING, MARKER PLANNING, CUTTING  9
Anthropometry, specification sheet, pattern making – principles, basic pattern set drafting, grading, marker planning, spreading & cutting

UNIT II  TYPES OF SEAMS, STITCHES AND FUNCTIONS OF NEEDLES  9
Different types of seams and stitches; single needle lock stitch machine – mechanism and accessories; needle – functions, special needles, needlepoint

UNIT III  COMPONENTS AND TRIMS USED IN GARMENT  9
Sewing thread-construction, material, thread size, packages, accessories – labels, linings, interlinings, wadding, lace, braid, elastic, hook and loop fastening, shoulder pads, eyelets and laces, zip fasteners, buttons
UNIT IV  GARMENT INSPECTION AND DIMENSIONAL CHANGES  9
Raw material, in process and final inspection; needle cutting; sewability of fabrics; strength properties of apparel; dimensional changes in apparel due to laundering, dry-cleaning, steaming and pressing.

UNIT V  GARMENT PRESSING, PACKING AND CARE LABELING  9
Garment pressing – categories and equipment, packing; care 311abelling of apparels

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to Understand
CO1: Pattern making, marker planning, cutting
CO2: Types of seams, stitches and functions of needles
CO3: Components and trims used in garment
CO4: Garment inspection and dimensional changes
CO5: Garment pressing, packing and care 311abelling

TEXT BOOKS:
2. Gerry Cooklin, “Introduction to Clothing Manufacture” Blackwell Science Ltd., 1995. 64

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OBJECTIVES:

OPE353  INDUSTRIAL SAFETY  L T P C
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311
To educate about the health hazards and the safety measures to be followed in the industrial environment.
Describe industrial legislations (Factories Acts, Workmen's Compensation and other laws) enacted for the protection of employees health at work settings
Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I INTRODUCTION
Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.

UNIT II OCCUPATIONAL HEALTH AND HYGIENE

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS

UNIT IV HAZARDS AND RISK MANAGEMENT

UNIT V ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT

OUTCOMES:
After completion of this course, the student is expected to be able to:
- Describe, with example, the common work-related diseases and accidents in occupational setting
- Name essential members of the Occupational Health team
- What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee

OPE354 UNIT OPERATIONS IN PETRO CHEMICAL INDUSTRIES

OBJECTIVES:
- To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.

UNIT I FLUID MECHANICS CONCEPTS
Fluid definition and classification of fluids, types of fluids. Rheological behaviour of fluids & Newton's Law of viscosity. Fluid statics-Pascal’s law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems).Basic equations of fluid flow - Continuity equation, Euler’s
equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits - Hagen Poiseuille equation (no derivation). Flow through stagnant fluids – theory of Settling and Sedimentation – Equipment (cyclones, thickeners) Conceptual numericals.

UNIT II FLOW MEASUREMENTS & MECHANICAL OPERATIONS

UNIT III CONDUCTIVE & CONVECTIVE HEAT TRANSFER
Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).

UNIT IV BASICS OF MASS TRANSFER

UNIT V MASS TRANSFER OPERATIONS
Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction). Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method. Drying- drying operations, batch and continuous drying. Conceptual numerical.

TOTAL: 45 PERIODS

Course Outcomes:
At the end of the course the student will be able to:
- State and describe the nature and properties of the fluids.
- Study the different flow measuring instruments, the principles of various size reductions, conveying equipment’s, sedimentation and mixing tanks.
- Comprehend the laws governing the heat and mass transfer operations to solve the problems.
- Design the heat transfer equipment suitable for specific requirement.

TEXTBOOK(S)
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008

REFERENCE BOOKS
2. Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996
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 1 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 2 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 3 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 4 MISCELLANEOUS PLASTICS FOR END APPLICATIONS

Miscellaneous plastics- Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbazole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers-their synthesis, properties and applications

UNIT 5 PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS

Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers- poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications

TOTAL HOURS: 45

COURSE OUTCOMES

- To study the importance, advantages and classification of plastic materials
- Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics
- To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins
- Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU
- To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

REFERENCES


**COURSE OBJECTIVES**

- To understand the relevance of standards and specifications as well as the specimen preparation for polymer testing.
- To study the mechanical properties and testing of polymer materials and their structural property relationships.
- To understand the thermal properties of polymers and their testing methods.
- To gain knowledge on the electrical and optical properties of polymers and their testing methods.
- To study about the environmental effects and prevent polymer degradation.

**UNIT 1 INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS**


**UNIT 2 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 3 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 4 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 5 ENVIRONMENTAL AND CHEMICAL RESISTANCE**


**TOTAL HOURS: 45**
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

OEC353 VLSI AND CHIP DESIGN L T P C
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OBJECTIVES:
- Understand the fundamentals of IC technology components and their characteristics.
- Understand combinational logic circuits and design principles.
- Understand sequential logic circuits and clocking strategies.
- Understand Interconnects and Memory Architecture.
- Understand the design of arithmetic building blocks

UNIT I MOS TRANSISTOR PRINCIPLES
MOS logic families (NMOS and CMOS), Ideal and Non Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor DC transfer Characteristics, small signal analysis of MOSFET.

UNIT II COMBINATIONAL LOGIC CIRCUITS

UNIT III SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES

UNIT IV INTERCONNECT, MEMORY ARCHITECTURE
Interconnect Parameters – Capacitance, Resistance, and Inductance, Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks.

UNIT V DESIGN OF ARITHMETIC BUILDING BLOCKS
Arithmetic Building Blocks: Data Paths, Adders-Ripple Carry Adder, Carry-Bypass Adder, Carry Select Adder, Carry-Look Ahead Adder, Multipliers, Barrel Shifter, power and speed tradeoffs.

OUTCOMES:
Upon successful completion of the course the student will be able to
CO1: Understand the working principle and characteristics of MOSFET
CO2: Design Combinational Logic Circuits
CO3: Design Sequential Logic Circuits and Clocking systems
CO4: Understand Memory architecture and interconnects
CO5: Design of arithmetic building blocks.

TEXTBOOKS

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

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES 9
Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.
UNIT III WIRELESS HEALTH SYSTEMS

UNIT IV SMART TEXTILE

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

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

TOTAL PERIODS:45

TEXT BOOKS

REFERENCES

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CBM356 MEDICAL INFORMATICS L T P C
Preamble:
1. To study the applications of information technology in health care management.
2. This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.
UNIT I  INTRODUCTION TO MEDICAL INFORMATICS  9
Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues , Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics

UNIT II  COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING  9
Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III  COMPUTERISED PATIENT RECORD  9
Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT IV  COMPUTER ASSISTED MEDICAL DECISION-MAKING  9
Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer–assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis inclinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V  RECENT TRENDS IN MEDICAL INFORMATICS  9
Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.

TOTAL : 45 PERIODS

Course Outcomes:
Upon completion of the course, students will be able to:
1. Explain the structure and functional capabilities of Hospital Information System.
2. Describe the need of computers in medical imaging and automated clinical laboratory.
3. Articulate the functioning of information storage and retrieval in computerized patient record system.
4. Apply the suitable decision support system for automated clinical diagnosis.
5. Discuss the application of virtual reality and telehealth technology in medical industry.

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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
# OBT356
## LIFESTYLE DISEASES

<table>
<thead>
<tr>
<th>UNIT</th>
<th>TOPIC</th>
<th>L T P C</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>INTRODUCTION</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Lifestyle diseases – Definition; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise.</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>CANCER</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>CARDIOVASCULAR DISEASES</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Coronary atherosclerosis – Coronary artery disease; Causes -Fat and lipids, Alcohol abuse -- Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>DIABETES AND OBESITY</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>RESPIRATORY DISEASES</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

**REFERENCES:**

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# OBT357
## BIOTECHNOLOGY IN HEALTH CARE

<table>
<thead>
<tr>
<th>UNIT</th>
<th>TOPIC</th>
<th>L T P C</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>PUBLIC HEALTH</td>
<td>9</td>
</tr>
<tr>
<td>II</td>
<td>CLINICAL DISEASES</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>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</td>
<td></td>
</tr>
</tbody>
</table>
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:
UNIT IV FINANCING AND DIVIDEND DECISION

Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - - Determinants of Dividend Policy

UNIT V WORKING CAPITAL DECISION

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
2. Prasanna Chandra, Financial Management,
OBJECTIVES:
1. Describe the investment environment in which investment decisions are taken.
2. Explain how to Value bonds and equities
3. Explain the various approaches to value securities
4. Describe how to create efficient portfolios through diversification
5. Discuss the mechanism of investor protection in India.

UNIT1: THE INVESTMENT ENVIRONMENT
The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.

UNIT2: FIXED INCOME SECURITIES
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.

UNIT3: APPROACHES TO EQUITY ANALYSIS
Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT4: PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India.

UNIT5: INVESTOR PROTECTION
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors’ awareness and activism.

TOTAL: 45 PERIODS

REFERENCES
OBJECTIVES

- Understand the Banking system in India
- Grasp how banks raise their sources and how they deploy it
- Understand the development in banking technology
- Understand the financial services in India
- Understand the insurance Industry in India

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM

Overview of Banking system – Structure – Functions – Banking system in India - Key Regulations in Indian Banking sector – RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT II MANAGING BANK FUNDS/ PRODUCTS


UNIT III DEVELOPMENT IN BANKING TECHNOLOGY


UNIT IV FINANCIAL SERVICES


UNIT V INSURANCE


REFERENCES:

TOTAL : 45 PERIODS
UNIT II INTRODUCTION TO CRYPTOCURRENCY
Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments –
Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin –
Zcash – Smart Contracts – Ricardian Contracts- Deploying smart contracts on a blockchain

UNIT III Ethereum
Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network

UNIT IV WEB3 AND HYPERLEDGE

UNIT V EMERGING TRENDS

REFERENCE
2. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018

CMG335 FINTECH PERSONAL FINANCE AND PAYMENTS

UNIT I CURRENCY EXCHANGE AND PAYMENT

UNIT II DIGITAL FINANCE AND ALTERNATIVE FINANCE
A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity,. Introduction to the concept of Initial Coin Offering

UNIT III INSURETECH
InsurTech Introduction , Business model disruption AI/ML in InsurTech • IoT and InsurTech , Risk Modeling ,Fraud Detection Processing claims and Underwriting Innovations in Insurance Services

UNIT IV PEER TO PEER LENDING
P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies , Concept of Crowdfunding Crowdfunding Architecture and Technology ,P2P and Crowdfunding unicorns and business models , SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations

UNIT V REGULATORY ISSUES
INTRODUCTION TO FINTECH

OBJECTIVES:
1. To learn about the history, importance, and evolution of Fintech
2. To acquire the knowledge of Fintech in the payment industry
3. To acquire the knowledge of Fintech in the insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I INTRODUCTION
Fintech — Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY
Fintech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry - Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III INSURANCE INDUSTRY

UNIT IV FINTECH AROUND THE GLOBE
UNIT V FUTURE OF FINTECH

How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

REFERENCES
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
6. Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018

VERTICAL 2: ENTREPRENEURSHIP

CMG337 FOUNDATIONS OF ENTREPRENEURSHIP

Course Objectives
- To develop and strengthen the entrepreneurial quality and motivation of learners.
- To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of entrepreneurship and management in Technology oriented businessess.
- To empower the learners to run a Technology driven business efficiently and effectively

UNIT 1 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 2 BUSINESS OWNERSHIP & ENVIRONMENT

UNIT 3 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 4 APPLICATIONS OF TECHNOPRENEURSHIP
Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing
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 technopreneurship and successful technopreneurs
CO 5 Acquaint with the recent and emerging trends in entrepreneurship

TEXT BOOKS:
2) Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning,

REFERENCES:
4) David Sheff 2002, China Dawn: The Story of a Technology and Business Revolution,
7) Basics of Technopreneurship: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP
8) Journal articles pertaining to Entrepreneurship

CMG338 TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS

COURSE OBJECTIVES
- To develop and strengthen the Leadership qualities and motivation of learners.
- To impart the Leadership skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of Team Building in managing Technology oriented businesses.
- To empower the learners to build robust teams for running and leading a business efficiently and effectively

UNIT 1 INTRODUCTION TO MANAGING TEAMS
Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) -Multicultural Teams.
UNIT 2 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 3 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 4 LEADERSHIP IN ORGANISATIONS

UNIT 5 LEADERSHIP EFFECTIVENESS

TOTAL 45 : PERIODS

COURSE OUTCOMES
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of managing teams for business.
CO 2 Understand developing effective teams for business management.
CO 3 Understand the fundamentals of leadership for running a business.
CO 4 Learn about the importance of leadership for business development.
CO 5 Acquaint with emerging trends in leadership effectiveness for entrepreneurs.

REFERENCES:

CMG339 CREATIVITY & INNOVATION IN ENTREPRENEURSHIP

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

TOTAL 45 : PERIODS

Upon completion of this course, the student should be able to:
CO 1 Learn the basics of creativity for developing Entrepreneurship
CO 2 Understand the importance of creative intelligence for business growth
CO 3 Understand the advances through Innovation in Industries
CO 4 Learn about applications of innovation in building successful ventures
CO 5 Acquaint with developing innovative business models to run the business efficiently and effectively

Suggested Readings:
Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand
Strategic Innovation: Building and Sustaining Innovative Organizations- Course Era, Raj Echambadi.
CMG340 PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS

COURSE OBJECTIVES:
To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.

UNIT 1 INTRODUCTION TO MARKETING MANAGEMENT 9

UNIT 2 MARKETING ENVIRONMENT 9

UNIT 3 PRODUCT AND PRICING MANAGEMENT 9

UNIT 4 PROMOTION AND DISTRIBUTUION MANAGEMENT 9

UNIT 5 CONTEMPORARY ISSUES IN MARKETING MANAGEMENT 9

COURSE OUTCOMES:
After completion of this course, the students will be able to:
CO1 Have the awareness of marketing management process
CO 2 Understand the marketing environment
CO 3 Acquaint about product and pricing strategies
CO 4 Knowledge of promotion and distribution in marketing management.
CO 5 Comprehend the contemporary marketing scenarios and offer solutions to marketing issues.

REFERENCES:
OBJECTIVES:
1. To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
2. To create an awareness of the roles, functions and functioning of human resource department.
3. To understand the methods and techniques followed by Human Resource Management practitioners.

UNIT 1 INTRODUCTION TO HRM

UNIT 2 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 3 RECRUITMENT AND SELECTION
Sources of recruitment - Internal Vs. External - Domestic Vs. Global Sources - eRecruitment - Selection Process - Selection techniques - eSelection - Interview Types - Employee Engagement.

UNIT 4 TRAINING AND EMPLOYEE DEVELOPMENT

UNIT 5 CONTROLLING HUMAN RESOURCES

Upon completion of this course the learners will be able:
CO 1 To understand the Evolution of HRM and Challenges faced by HR Managers
CO 2 To learn about the HR Planning Methods and practices.
CO 3 To acquaint about the Recruitment and Selection Techniques followed in Industries.
CO 4 To know 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 1 ESSENTIALS OF NEW BUSINESS VENTURE

UNIT 2 INTRODUCTION TO VENTURE FINANCING

UNIT 3 SOURCES OF DEBT FINANCING

UNIT 4 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 5 METHODS OF FUND RAISING FOR NEW VENTURES

OUTCOMES:
Upon completion of this course, the students should be able to:
CO 1 Learn the basics of starting a new business venture.
CO 2  Understand the basics of venture financing.
CO 3  Understand the sources of debt financing.
CO 4  Understand the sources of equity financing.
CO 5  Acquaint with the methods of fund raising for new business ventures.

REFERENCES:
1) Principles of Corporate Finance by Brealey and Myers et al., 12TH ed, McGraw Hill Education (India) Private Limited, 2018

VERTICAL 3: PUBLIC ADMINISTRATION
CMG343 PRINCIPLES OF PUBLIC ADMINISTRATION L T P C
3 0 0 3

UNIT-I
1. Meaning, Nature and Scope of Public Administration
2. Importance of Public Administration
3. Evolution of Public Administration

UNIT-II
1. New Public Administration
2. New Public Management
3. Public and Private Administration

UNIT-III
1. Relationships with Political Science, History and Sociology
2. Classical Approach
3. Scientific Management Approach

UNIT-IV
1. Bureaucratic Approach: Max Weber
2. Human Relations Approach: Elton Mayo
3. Ecological Approach: Riggs

UNIT-V
1. Leadership: Leadership - Styles - Approaches
2. Communication: Communication Types - Process - Barriers

TOTAL: 45 PERIODS

REFERENCES:
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.

CMG344          CONSTITUTION OF INDIA          L T P C
                        3 0 0 3

UNIT-I
1. Constitutional Development Since 1909 to 1947
3. Constituent Assembly

UNIT-II
1. Fundamental Rights
2. Fundamental Duties
3. Directive Principles of State Policy

UNIT-III
1. President
2. Parliament
3. Supreme Court

UNIT-IV
1. Governor
2. State Legislature
3. High Court

UNIT-V
1. Secularism
2. Social Justice
3. Minority Safeguards

TOTAL: 45 PERIODS

REFERENCES:
3. Johari J.C.: Indian Politics, Vishal Publications Ltd, New Delhi
4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi

CMG345          PUBLIC PERSONNEL ADMINISTRATION          L T P C
                        3 0 0 3

UNIT-I
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

UNIT-II

336
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

TOTAL: 45 PERIODS

REFERENCES:
1. Stahl Glean O: Public Personnel Administration
4. Dwivedi O.P and Jain R.B: India’s Administrative state.
7. Davar R.S. Personnel Management & Industrial Relations

CMG346 ADMINISTRATIVE THEORIES L T P C
3 0 0 3

UNIT I
Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a
discipline and Identity of Public Administration

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)

CMG347 INDIAN ADMINISTRATIVE SYSTEM L T P C 3 0 0 3

UNIT I
Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India

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

CMG348 PUBLIC POLICY ADMINISTRATION L T P C 3 0 0 3

UNIT-I

UNIT-II
Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System’s Approach – Dror’s Optimal Model

UNIT-III
UNIT-IV 
Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.

UNIT-V 
Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.

TOTAL: 45 PERIODS

REFERENCES:
4. Pradeep Saxena : Public Policy Administration and Development

VERTICAL 4: BUSINESS DATA ANALYTICS
CMG349 STATISTICS FOR MANAGEMENT L T P C 3 0 0 3

OBJECTIVE:
➢ To learn the applications of statistics in business decision making.

UNIT I INTRODUCTION
Basic definitions and rules for probability, Baye’s theorem and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT II SAMPLING DISTRIBUTION AND ESTIMATION
Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters.

UNIT III TESTING OF HYPOTHESIS - PARAMETRIC TESTS
Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.

UNIT IV NON-PARAMETRIC TESTS

UNIT V CORRELATION AND REGRESSION

TOTAL:45 PERIODS

OUTCOMES:
➢ To facilitate objective solutions in business decision making.
➢ To understand and solve business problems
➢ To apply statistical techniques to data sets, and correctly interpret the results.
➢ To develop skill-set that is in demand in both the research and business environments
To enable the students to apply the statistical techniques in a work setting.

REFERENCES:

CMG350                  DATAMINING FOR BUSINESS INTELLIGENCE                                L T P C
3 0 0 3

OBJECTIVES:
➢ To know how to derive meaning from huge volume of data and information.
➢ To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION
Data mining, Text mining, Web mining, Data warehouse.

UNIT II DATA MINING PROCESS
Datamining process – KDD, CRISP-DM, SEMMA
Prediction performance measures

UNIT III PREDICTION TECHNIQUES
Data visualization, Time series – ARIMA, Winter Holts,

UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES
Classification, Association, Clustering.

UNIT V MACHINE LEARNING AND AI
Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization

OUTCOMES:
1. Learn to apply various data mining techniques into various areas of different domains.
2. Be able to interact competently on the topic of data mining for business intelligence.
3. Apply various prediction techniques.
4. Learn about supervised and unsupervised learning technique.
5. Develop and implement machine learning algorithms

REFERENCES:
1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
7. G. K. Gupta, Introduction to Data mining with Case Studies, Prentice hall of India, 2011
9. Elizabeth Vitt, Michael Luckevich Stacia Misner, Business Intelligence, Microsoft, 2011

CMG351 HUMAN RESOURCE ANALYTICS

OBJECTIVE:
- To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
- To know the different types of HR metrics and understand their respective impact and application.
- To understand the impact and use of HR metrics and their connection with HR analytics.
- To understand common workforce issues and resolving them using people analytics.

UNIT I - INTRODUCTION TO HR ANALYTICS
People Analytics - stages of maturity - Human Capital in the Value Chain : impact on business – HR metrics and KPIs.

UNIT II - HR ANALYTICS I: RECRUITMENT
Recruitment Metrics : Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio- Quality of hire.

UNIT III - HR ANALYTICS - TRAINING AND DEVELOPMENT
Training & Development Metrics : Percentage of employees trained- Internally and externally trained -Training hours and cost per employee - ROI.

UNIT IV - HR ANALYTICS EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION
Employee Engagement Metrics : Talent Retention index - Voluntary and involuntary turnover- grades, performance, and service tenure - Internal hired index Career Progression Metrics: Promotion index - Rotation index - Career path index.

UNIT V - HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT
Workforce Diversity and Development Metrics : Employees per manager – Workforce age profiling - Workforce service profiling - Churnover index - Workforce diversity index - Gender mix

TOTAL: 45 PERIODS

OUTCOME:
- The learners will be conversant about HR metrics and ready to apply at work settings.
- The learners will be able to resolve HR issues using people analytics.

REFERENCES:

CMG352 MARKETING AND SOCIAL MEDIA WEB ANALYTICS L T P C 3 0 0 3

OBJECTIVE:
➢ To showcase the opportunities that exist today to leverage the power of the web and social media

UNIT I - MARKETING ANALYTICS
Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT II - COMMUNITY BUILDING AND MANAGEMENT
History and Evolution of Social Media - Understanding Science of Social Media - Goals for using Social Media - Social Media Audience and Influencers - Digital PR - Promoting Social Media Pages - Linking Social Media Accounts - The Viral Impact of Social Media.

UNIT III - SOCIAL MEDIA POLICIES AND MEASUREMENTS
Social Media Policies - Etiquette, Privacy - ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV - WEB ANALYTICS
Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT V - SEARCH ANALYTICS
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

TOTAL: 45 PERIODS

OUTCOME:
➢ The Learners will understand social media, web and social media analytics and their potential impact.

REFERENCES:
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
Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains.

UNIT II - WAREHOUSING DECISIONS
P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.

UNIT III - INVENTORY MANAGEMENT
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV - TRANSPORTATION NETWORK MODELS

UNIT V - MCDM MODELS
Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic an Techniques, the analytical network process (ANP), TOPSIS.

TOTAL: 45 PERIODS

OUTCOME:
> To enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.

REFERENCES:
OBJECTIVE:
- This course introduces a core set of modern analytical tools that specifically target finance applications.

UNIT I - CORPORATE FINANCE ANALYSIS
Basic corporate financial predictive modelling - Project analysis - cash flow analysis - cost of capital, Financial Break even modelling, Capital Budget model - Payback, NPV, IRR.

UNIT II - FINANCIAL MARKET ANALYSIS
Estimation and prediction of risk and return (bond investment and stock investment) - Time series - examining nature of data, Value at risk, ARMA, ARCH and GARCH.

UNIT III - PORTFOLIO ANALYSIS
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models - binomial model for options, Black Scholes model and Option implied volatility.

UNIT IV - TECHNICAL ANALYSIS

UNIT V - CREDIT RISK ANALYSIS
Credit Risk analysis - Data processing, Decision trees, logistic regression and evaluating credit risk model.

TOTAL: 45 PERIODS

OUTCOME
- The learners should be able to perform financial analysis for decision making using excel, Python and R.

REFERENCES:

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  9

UNIT III  SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES  9

UNIT IV  SUSTAINABLE CONSTRUCTION MATERIALS  9

UNIT V  SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS  9

TOTAL: 45 PERIODS

OUTCOME:
On completion of the course, the student is expected to be able to
CO1 Understand the environment sustainability goals at global and Indian scenario.
CO2 Understand risks in development of projects and suggest mitigation measures.
CO3 Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
CO4 Explain Life Cycle Analysis and life cycle cost of construction materials.
CO5 Explain the new technologies for maintenance of infrastructure projects.

REFERENCES:
5. New Building Materials and Construction World magazine
7. Munier N, "Introduction to Sustainability", Springer 2005

**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

**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  9
Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT IV  ENERGY AND WASTE MANAGEMENT  9
Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V  EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS  9
Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS

3. OUTCOME

- On completion of the course, the student is expected to be able to

CO1 Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture

CO2 Discuss the sustainable ways in managing soil health, nutrients, pests and diseases

CO3 Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources

CO4 Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas

CO5 Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

REFERENCES:

1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020


4. CO – PO Mapping - SUSTAINABLE AGRICULTURE PRACTICES

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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-1 INTRODUCTION TO BIOMATERIALS


UNIT-2 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 –Polyurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT-3 BIO CERAMICS AND BIOCOMPOSITES

General properties- Bio ceramics -Silicate glass - Alumina (Al2O3) -Zirconia (ZrO2)-Carbon- Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites-Polymer Matrix Composite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)--glass ceramics - Orthopedic implants-Tissue engineering scaffolds

UNIT-4 METALS AS BIOMATERIALS

Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys- Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants -- biological tolerance of implant metals

UNIT-5 NANOBIOMATERIALS


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

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-1 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-2 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-3 FUEL CELLS

UNIT-4 PHOTOVOLTAICS
cells – Measurement and characterization of solar cells - Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensional Graphene, organic or Small molecule-based solar cells materials - copper-phthalocyanine and perylenetetracarboxylicbis - benzine – fullerenes - boron subphthalocyanine- tin (II) phthalocyanine)

UNIT-5 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.

TOTAL : 45 PERIODS

OUTCOMES
• Students will acquire knowledge about energy sustainability.
• Students understand the principles of different electrochemical devices.
• Students learn about the working of fuel cells and their application.
• Students will learn about various Photovoltaic applications and the materials used.
• The students gain knowledge on different types of supercapacitors and the performance of various materials

REFERENCES
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh

CES335 GREEN TECHNOLOGY L T P C 3 0 0 3

COURSE OBJECTIVE:
• To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.
• To provide green engineering solutions to energy demand, reduced energy footprint.
UNIT I  PRINCIPLES OF GREEN CHEMISTRY  9
Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.

UNIT II  POLLUTION TYPES  9
Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT III  GREEN REAGENTS AND GREEN SYNTHESIS  9
Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions

UNIT IV  DESIGNING GREEN PROCESSES  9
Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention

UNIT V  GREEN NANOTECHNOLOGY  9
Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology．

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: To understand the principles of green engineering and technology
CO2: To learn about pollution using hazardous chemicals and solvents
CO3: To modify processes and products to make them green and safe.
CO4: To design processes and products using green technology
CO5 – To understand advanced technology in green synthesis

TEXT BOOKS

REFERENCE BOOKS
1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

CES336  ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS  L T P C  3 0 0 3

OBJECTIVES:
- to understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.

UNIT I: ENVIRONMENTAL MONITORING AND STANDARDS  9
UNIT II: MONITORING OF ENVIRONMENTAL PARAMETERS


UNIT 3: 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 4 : ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISKASSESSMENT


UNIT 5: AUTOMATED DATA ACQUISITION AND PROCESSING

Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks -Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

TOTAL: 45 PERIODS

COURSE OUTCOMES
After completion of this course, the students will know

| CO1 | Basic concepts of environmental standards and monitoring. |
| CO2 | the ambient air quality and water quality standards; |
| CO3 | the various instrumental methods and their principles for environmental monitoring |
| CO4 | The significance of environmental standards in monitoring quality and sustainability of the environment. |
| CO5 | the various ways of raising environmental awareness among the people. |
| CO6 | Know the standard research methods that are used worldwide for monitoring the environment. |

TEXTBOOKS
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and soilid 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
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
Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG) -
Social development: Poverty, conceptual issues and measures, impact of poverty. Globalization

UNIT IV RENEWABLE ENERGY TECHNOLOGY
Renewable Energy – Sources and Potential – Technologies for harnessing from Solar, Wind, Hydro,
Biomass and Oceans – Principle of operation, relative merits and demerits

UNIT V ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT
National & State Energy Policy - National solar mission - Framework of Central Electricity Authority
- National Hydrogen Mission - Energy and climate policy - State Energy Action Plan, RE integration,
Road map for ethanol blending, Energy Efficiency and Energy Mix

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

CES337 INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT

COURSE OBJECTIVES:
1. To create awareness on the energy scenario of India with respect to world
2. To understand the fundamentals of energy sources, energy efficiency and resulting
environmental implications of energy utilisation
3. Familiarisation on the concept of sustainable development and its benefits
4. Recognize the potential of renewable energy sources and its conversion technologies for
attaining sustainable development
5. Acquainting with energy policies and energy planning for sustainable development

UNIT I ENERGY SCENARIO
Comparison of energy scenario – India and World (energy sources, generation mix, consumption
pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy
security

UNIT II ENERGY AND ENVIRONMENT
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution –
Environmental standards - measurement and controls

UNIT III SUSTAINABLE DEVELOPMENT
Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG) -
Social development: Poverty, conceptual issues and measures, impact of poverty. Globalization

UNIT IV RENEWABLE ENERGY TECHNOLOGY
Renewable Energy – Sources and Potential – Technologies for harnessing from Solar, Wind, Hydro,
Biomass and Oceans – Principle of operation, relative merits and demerits

UNIT V ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT
National & State Energy Policy - National solar mission - Framework of Central Electricity Authority
- National Hydrogen Mission - Energy and climate policy - State Energy Action Plan, RE integration,
Road map for ethanol blending, Energy Efficiency and Energy Mix

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the world and Indian energy scenario
2. Analyse energy projects, its impact on environment and suggest control strategies
3. Recognise the need of Sustainable development and its impact on human resource
development
4. Apply renewable energy technologies for sustainable development
5. Fathom Energy policies and planning for sustainable development.

REFERENCES:
7. https://www.niti.gov.in/verticals/energy

CES338 ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT L T P C 3 0 0 3

COURSE OBJECTIVES:
1. To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
2. To create awareness on energy audit and its impacts
3. To acquaint the techniques adopted for performance evaluation of thermal utilities
4. To familiarise on the procedures adopted for performance evaluation of electrical utilities
5. To learn the concept of sustainable development and the implication of energy usage

UNIT I ENERGY AND ENVIRONMENT 9
Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT II ENERGY AUDITING 9
Need and types of energy audit. Energy management (audit) approach-understanding energy costs, benchmarking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES 9
Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression

UNIT IV ENERGY CONSERVATION IN ELECTRICAL UTILITIES 9
Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

UNIT V SUSTAINABLE DEVELOPMENT 9

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the prevailing energy scenario
2. Familiarise on energy audits and its relevance
3. Apply the concept of energy audit on thermal utilities
4. Employ relevant techniques for energy improvement in electrical utilities
5. Understand Sustainable development and its impact on human resource development

REFERENCES: