PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

I. To prepare students to excel in research and to succeed in the areas of materials science and metallurgical engineering.
II. To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve materials science and metallurgical engineering problems.
III. To train students to have sound knowledge on the production, processing, characterization, structural properties correlation and application of all different engineering materials.
IV. To inculcate students with professional and ethical attitude, effective communication skills, teamwork skills and multidisciplinary approach.
V. To develop student with an academic excellence, leadership qualities, leading to life-long learning for a successful professional career.

PROGRAM OUTCOMES (POs)

PO Graduate Attribute

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and
norms of the engineering practice.

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

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

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

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

**PROGRAM SPECIFIC OUTCOMES (PSOs)**

1. Graduates will have an ability to identify, analyse and provide solution to the problems related to Materials and metallurgical engineering

2. Graduates will have the ability to implement/use appropriate characterisation techniques, analytical skills, and latest/recent development in materials technology to solve engineering problems related to materials selection and design.

3. Graduates will be able to design and develop materials and processing techniques to meet the industry needs within the realistic constraints economic, environmental, social, ethical, health and safety, manufacturability and sustainability.

**PEO’s – PO’s & PSO’s MAPPING:**

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ANNA UNIVERSITY, CHENNAI  
NON-AUTONOMOUS AFFILIATED COLLEGES  
REGULATIONS 2021  
CHOICE BASED CREDIT SYSTEM  
B. E. MATERIALS SCIENCE AND ENGINEERING  
CURRICULUM AND SYLLABI FOR SEMESTERS I TO VIII  
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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.

\[ ^{\text{1}} \text{Skill Based Course} \]
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§ Skill Based Course

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# NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
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**TOTAL** = 21

*Two weeks Summer Internship carries one credit and it will be done during IV semester summer vacation and same will be evaluated in V semester.

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

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**TOTAL** = 20

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

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

# NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
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*Two weeks Summer Internship carries one credit and it will be done during VI semester summer vacation and same will be evaluated in VII semester.

*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
### ELECTIVE – MANAGEMENT COURSES

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### MANDATORY COURSES I*

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*Mandatory Courses are offered as Non-Credit courses

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<td>Vertical 1</td>
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<td>MECHANICAL BEHAVIOUR AND MATERIALS</td>
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<tr>
<td>CHARACTERIZATION</td>
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<td>Fracture Mechanics and Failure Analysis</td>
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<td>Electron Microscopy</td>
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<td>X-ray Diffraction and Associated</td>
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<td>Techniques</td>
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<td>Advanced Metallographic Techniques</td>
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| Vertical 2                               |
| ADVANCED MATERIALS AND PROCESSING        |
| Fundamentals of Nano Science             |
| Metallurgy of Tool Materials and Special Steels |
| Automotive Materials                     |
| Additive Manufacturing                    |
| Cryogenic Treatment of Materials         |
| Nuclear Materials                        |
| Composite Materials                      |
| Advanced Ceramics                        |

| Vertical 3                               |
| MATERIALS FOR ELECTRICAL, ELECTRONIC     |
| AND MAGNETIC APPLICATIONS               |
| Smart Materials                         |
| Energy Storage Devices                  |
| Fuel Cell Technology                     |
| Semiconductors and optoelectronic Materials and Devices |
| Advanced Materials Characterisation      |
| Thin Film Technology                     |
| MEMS and Nanotechnology                  |
| Micro and Nano Fabrication               |

| Vertical 4                               |
| DIVERSIFIED COURSES GROUP 1             |
| Introduction to Transport Phenomena      |
| Materials Selection and design          |
| Materials for Green Engineering         |
| Unconventional Machining Processes      |
| Laser Processing of Materials           |
| Making and Metallurgy of Stainless steels |
| Fuels, Furnaces and Refractories        |
| High Temperature Materials              |

Registration of Professional Elective Courses from Verticals:

Refer to the Regulations 2021, Clause 6.3. (Amended on 27.07.2023)
### Vertical 1: Mechanical Behaviour and Materials Characterization

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### Vertical 3: Materials for Electrical, Electronic and Magnetic Applications

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

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

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### B.E. MATERIALS SCIENCE AND ENGINEERING

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

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

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

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

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

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

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### VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

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

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

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

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

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

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

(i) Physical Activity

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

(ii) Creative Arts

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

(iii) Universal Human Values

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

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

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

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

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.

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.

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.

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  1
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  8
Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Why/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II  NARRATION AND SUMMATION  9
Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing -- Paragraph writing Short Report on an event (field trip etc.) Grammar –Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

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

UNIT IV  CLASSIFICATION AND RECOMMENDATIONS  9
Reading – Newspaper articles; Journal reports –and Non Verbal Communication (tables, pie charts etc.). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart, graph etc, to verbal mode) Grammar – Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions.

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

TOTAL : 45 PERIODS
LEARNING OUTCOMES:
At the end of the course, learners will be able
- To use appropriate words in a professional context
- To gain understanding of basic grammatical structures and use them in right context.
- To read and infer the denotative and connotative meanings of technical texts
- To read and interpret information presented in tables, charts and other graphic forms
- To write definitions, descriptions, narrations and essays on various topics

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.

CO-PO & PSO MAPPING

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

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

PH3151          ENGINEERING PHYSICS          L  T  P  C
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COURSE OBJECTIVES
- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to be successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I MECHANICS

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

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

TOTAL: 45 PERIODS

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

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/

COs- PO’s & PSO’s MAPPING

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GE3152  தமிழ் மொழி

अर्थ I  महत्त्वमध्ये विषयांमध्ये:

अर्थ II  महत्त्वमध्ये विषयांमध्ये विषयांमध्ये
UNIT I

LANGUAGE AND LITERATURE

3

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

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

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

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

TEXT-CUM-REFERENCE BOOKS  
1. தமிழ்நாடு வரலை மக்களும் பணி பொடும் மகுள் (தின்னபூல்: தமிழ்நாடு பொட்புணியம் பள்ளித் துறை).
2. கணினித் தமிழ் முமனவர் இல.சுந்தரம் (விகடன் பிரசுரம்).
3. நொகரிகம் (ததொல்லியல் துமறதவளியீடு).
4. பொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்.
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand 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

BS3171 PHYSICS AND CHEMISTRY LABORATORY

PHYSICS LABORATORY: (Any Seven Experiments)

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

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

TOTAL: 30 PERIODS

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

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

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

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

TOTAL : 30 PERIODS

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

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

UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION

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

UNIT II NARRATION AND SUMMATION

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

UNIT III DESCRIPTION OF A PROCESS / PRODUCT

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

UNIT IV CLASSIFICATION AND RECOMMENDATIONS

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

UNIT V EXPRESSION

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

TOTAL : 30 Periods
LEARNING OUTCOMES:
At the end of the course, learners will be able
- To listen 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.

HS3252 PROFESSIONAL ENGLISH - II

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

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

TOTAL : 30 PERIODS

OUTCOMES:
At the end of the course, learners will be able
- To compare and contrast products and ideas in technical texts.
- To identify 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 Joevani, Department of English, Anna University.

REFERENCES:

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

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

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

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

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

UNIT III  SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS  9+3

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

UNIT V  NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS  9+3

TOTAL: 60 PERIODS

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

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

REFERENCES:

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CY3202 SOLID STATE CHEMISTRY  
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COURSE OBJECTIVES:
- To understand and apply the basics of principles of solid state chemistry.
- To identify and apply the concepts involved in the syntheses, structure and physical properties of crystalline inorganic solids.
- To apply various techniques for the preparation of different types of solids.
- To understand the principles of solid characterization techniques.

UNIT I CRYSTAL STRUCTURE 9
Solids-Types-Crystalline, Amorphous and poly crystalline; Properties: Isotropy and anisotropy-interfacial angles-symmetry in crystal systems-elements of symmetry – space lattice and unit cell, Bravias lattice-seven crystal systems. Bond types: molecular, covalent, metallic and ionic. Born-Heber Cycle, Lattice energy, Imperfections in crystal-stoichiometric defects-Schottky, Frenkel, Non-stoichiometric defects-Colour Centre, F-Centre

UNIT II ELECTRICAL PROPERTIES 9
Band theory of solids -metals and their properties; semiconductors – extrinsic and intrinsic, insulators – dielectric, ferroelectric, pyroelectric and piezoelectric properties, multiferroics. Superconductivity: Basics, discovery and high Tc materials.
UNIT III  MAGNETIC PROPERTIES  
Dia, para, ferro, ferri, and antiferro magnetic types; soft and hard magnetic materials; select magnetic materials such as spinels, garnets and perovskites, hexaferrites and lanthanide-transition metal compounds; magneto resistance

UNIT IV  SYNTHETIC METHODS
Thin film-Electro chemical methods, PVD & CVD: Crystal growth-Thermal methods-Bridgman, Stockbarger and Zone refining, High temperature ceramic methods. Particle size reduction, precursor method. Sol-Gel, Co-precipitation, microwave assisted synthesis, combustion synthesis, High pressure methods for preparing single crystals-Czochralski, molecular beam epitaxy-Flame and plasma fusion methods, intercalated compounds.

UNIT V  SOLID CHARACTERIZATION TECHNIQUES
Powder x-ray diffraction, indexing the powder XRD patterns, Systematic absences, Structure factor, determination of lattice type, unit cell parameter and density for fcc, bcc and hcp metals, Thermal analysis: TGA, DTA, DSC

COURSE OUTCOME:
At the end of the course, the learners should be able to:
- Arrive at the chemical compositions based on unit cell contents and fractional coordinates.

TEXT BOOKS:

REFERENCES:

CO-PO & PSO MAPPING

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- 1-low, 2-medium, 3-high, "-"- no correlation
COURSE OBJECTIVES:
- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics
- To introduce the functional elements and working of measuring instruments

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

UNIT II ELECTRICAL MACHINES

UNIT III ANALOG ELECTRONICS

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

UNIT V MEASUREMENTS AND INSTRUMENTATION

COURSE OUTCOMES:
After completing this course, the students will be able to
1. Compute the electric circuit parameters for simple problems
2. Explain the working principle and applications of electrical machines
3. Analyze the characteristics of analog electronic devices
4. Explain the basic concepts of digital electronics
5. Explain the operating principles of measuring instruments

TEXT BOOKS:
REFERENCES:

Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial

GE3251 ENGINEERING GRAPHICS

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

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

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

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

UNIT III PROJECTION OF SOLIDS AND FREEHAND SKETCHING 6+12
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles — Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects.
Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)
UNIT IV  PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES  6 +12
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.
Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

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

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

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

TEXT BOOK:

REFERENCES:

Publication of Bureau of Indian Standards:

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

GE3252 கதிரமொழியியல்

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அண்டு I தமிழ் மாதிரியும் பார்வமொழியியல்:

tablular format with details in Tamil

அண்டு II தமிழ் மாதிரியும் பார்வமொழியியல்:

tablular format with details in Tamil

அண்டு III கழுத்தியல் தாமை:

tablular format with details in Tamil

அண்டு IV கொலனாசோ மருமம் கிளுமொழியியல் தாமை:

tablular format with details in Tamil
TEXT-CUM-REFERENCE BOOKS
1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
3. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
4. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
5. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
6. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.
UNIT III  MANUFACTURING TECHNOLOGY  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
Development of Scientific Tamil - Tamil computing - Digitalization of Tamil Books - Development of Tamil Software - Tamil Virtual Academy - Tamil Digital Library - Online Tamil Dictionaries - Sorkuvai Project.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. தமிழக வரலை – மக்களும் பண பொடும் – மக.மக. பிள்மள (தவளியீடு: தமிழ்நொடு பொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முமனவர் இல.சுந்தரம். (விகடன் பிரசுரம்).
3. இலநமை – தொழிலாசு கிளிக்கையில் சாமகக் கால நேர்ப்பிள்ளை (தொலோக்விளிப்பு தடுத்து வரலை)
4. பொருளியல் – தமிழகத்தை நேர்ப்பிள்ளை. (தாமாக்கியம் தடுத்து வரலை)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
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11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
## NCC CREDIT COURSE LEVEL 1*

### (ARMY WING) NCC CREDIT COURSE LEVEL - I

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### NCC GENERAL

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### NATIONAL INTEGRATION AND AWARENESS

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### PERSONALITY DEVELOPMENT

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### LEADERSHIP

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### SOCIAL SERVICE AND COMMUNITY DEVELOPMENT

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

NX3252  (NAVAL WING) NCC CREDIT COURSE LEVEL - 1

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

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### NCC GENERAL

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### NATIONAL INTEGRATION AND AWARENESS

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### PERSONALITY DEVELOPMENT

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### LEADERSHIP

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### SOCIAL SERVICE AND COMMUNITY DEVELOPMENT

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

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

GROUP – A (CIVIL & ELECTRICAL)

PART I  CIVIL ENGINEERING PRACTICES

PLUMBING WORK:

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

WOOD WORK:

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

Wood Work Study:

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

PART II  ELECTRICAL ENGINEERING PRACTICES

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
g) Study of emergency lamp wiring/Water heater
WELDING WORK:
   a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
   b) Practicing gas welding.

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

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

SHEET METAL WORK:
   a) Making of a square tray

FOUNDRY WORK:
   a) Demonstrating basic foundry operations.

PART IV  ELECTRONIC ENGINEERING PRACTICES  15

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

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

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

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
2. Wire various electrical joints in common household electrical wire work.
3. Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
4. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

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Low (1) ; Medium (2) ; High (3)
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. 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
12
Speaking: Role Play Exercises Based on Workplace Contexts, - talking about competition-
- discussing progress toward goals - talking about experiences - talking about events in life - discussing past events - Writing: writing emails (formal & semi-formal).

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

UNIT III
12
Speaking: discussing predictions - describing the climate - discussing forecasts and scenarios -
- talking about purchasing - discussing advantages and disadvantages - making comparisons - discussing likes and dislikes - discussing feelings about experiences - discussing imaginary scenarios - Writing: short essays and reports - formal/semi-formal letters.

UNIT IV
12
Speaking: discussing the natural environment - describing systems - describing position and movement - explaining rules - (example - discussing rental arrangements) - understanding technical instructions - Writing: writing instructions - writing a short article.

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

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

Assessment Pattern
- One online / app based assessment to test speaking and writing skills.
- Proficiency certification is given on successful completion of speaking and writing.
MA3351  TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS  L T P C

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

UNIT I  PARTIAL DIFFERENTIAL EQUATIONS  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
COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS:

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ML3301 POLYMER SCIENCE AND ENGINEERING L T P C 3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Understanding the basics of polymers, its formation and polymerization types.
2. Getting acquainted with the significance and the molecular weights of polymers.
3. Characterizing the polymers for their thermal behaviour and solution properties.
4. Gaining knowledge on the thermodynamics of polymer dissolution and the factors influencing them.
5. Identifying suitable polymer processing methods for polymer products.
UNIT I  POLYMERS AND POLYMERIZATION  9

UNIT II  MOLECULAR WEIGHTS OF POLYMERS  9
Number average and weight average molecular weights – Degree of polymerization – Molecular weight distribution – Polydispersity – Molecular weight determination-Methods – Viscometry - Gel Permeation Chromatography.

UNIT III  TRANSITIONS IN POLYMERS  9

UNIT IV  SOLUTION PROPERTIES OF POLYMERS  9

UNIT V  POLYMER PROCESSING  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Describe the basics concepts and fundamental principles of polymers and polymerization.
2. Evaluate and determine the molecular weights of polymers.
3. Characterize and evaluate the thermal and solution properties of polymers.
4. Analyse the thermodynamics of polymer dissolution.
5. Produce tailor-made polymers to suit the demanding applications.

TEXT BOOKS

REFERENCES:
COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Having an overview on the fundamental concepts in metallurgical thermodynamics
2. Gaining knowledge about the state functions such as internal energy, entropy and criteria of equilibrium.
3. Getting an insight to the auxiliary functions, heat capacities and thermodynamic potentials.
4. Knowing the essentials of thermodynamic behaviour of solutions,
5. Having an exposure on thermodynamics of electrochemical cells, surfaces and defects.

UNIT  I  FUNDAMENTAL CONCEPTS  9+3
Definition of thermodynamic terms; concept of states, systems and surroundings, Types of systems, equilibrium. Equation of states, extensive and intensive properties, homogeneous and heterogeneous, micro-macro systems. Phase diagrams and its classification, Internal energy, heat capacity, enthalpy, isothermal, and adiabatic processes.

UNIT II  INTERNAL ENERGY AND ENTROPY  9+3
First law of Thermodynamics: Relation between Heat and work, Internal energy and Enthalpy. The Second law of thermodynamics: Spontaneous process, Degree of measure of reversibility and irreversibility, Maximum work, criteria of equilibrium. Combined statement of first and second laws on thermodynamics. Statistical interpretation of entropy: Concept of microstate, most probable microstate, Thermal equilibrium, Boltzman equation, configurational entropy

UNIT III  AUXILLARY FUNCTIONS AND THERMODYNAMIC POTENTIALS  9+3

UNIT IV  THERMODYNAMICS OF SOLUTIONS  9+3
UNIT V THERMODYNAMICS OF REACTIONS


TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Recognize the nature of the system and properties.
2. Explain the concept of internal energy, entropy and criteria for equilibrium.
3. Realize the importance of auxiliary functions and thermodynamic potentials
4. Apply the concepts of thermodynamics in the behaviour of solutions.
5. Outline the thermodynamic approaches towards electrochemical cells, surfaces and defects.

TEXT BOOKS:

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

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

UNIT I    STRESS, STRAIN AND DEFORMATION OF SOLIDS

UNIT II   TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM

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

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

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

TOTAL: 45 PERIODS

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

1. Apply the principle concepts behind stress, strain and deformation of solids for various engineering applications.
2. Analyse the transverse loading on beams and stresses in beam for various engineering applications.
3. Solve problems based on the torsion principles involved in shafts and springs for various engineering applications.
4. Interpret the results of the deflection of beams.
5. Analyse the thin and thick shells and principal stresses in beam for various engineering applications.
**TEXT BOOKS:**


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**ME3351 ENGINEERING MECHANICS**

**COURSE OBJECTIVES:**

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

**UNIT – ISTATICS OF PARTICLES**

UNIT – II  EQUILIBRIUM OF RIGID BODIES

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

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

UNIT V  DYNAMICS OF PARTICLES

TOTAL : 45 PERIODS

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

TEXT BOOKS:

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

1. Acquiring a sound background in predicting the behaviour of a metallic material to a certain application.
2. Understanding the fundamental principles of Physical Metallurgy.
3. Getting familiarized with the interpretation of phase diagrams.
4. Having an insight on the thermodynamics aspect of physical metallurgy.
5. Gaining knowledge on the various strengthening mechanisms in materials.

UNIT I STRUCTURE OF SOLIDS & SOLIDIFICATION OF PURE METALS

Atomic Bonding & Crystal Structure: Metallic bond, unit cell, atomic packing, interstitial sites, Miller indices, crystal orientation, stereographic projection.

Phase rule, Concept of Free Energy, Entropy, Surface Energy (grain boundary) & under cooling, Nucleation & Growth, homogeneous & heterogeneous nucleation, directional solidification. Mechanisms (slip & twin), critical resolved shear stress, single crystal tensile test (FCC), theoretical strength of ideal crystal.

UNIT II CRYSTAL IMPERFECTIONS AND DIFFUSION

Vacancy, interstitial, substitutional, free energy of mixing, dislocation (elementary concepts only), edge / screw dislocation, partial dislocation, stacking fault, dislocation lock, dislocation pile up, Hall Petch relation, grain boundary structure.

Elementary concepts of phenomenological & atomistic approaches in Diffusion.

UNIT III SOLIDIFICATION OF BINARY ALLOYS

Limits of solubility, isomorphous system, lever rule, constitutional super cooling, effect of non-equilibrium cooling, eutectic, peritectic, eutectoid & peritectoid system, complex phase diagram, ternary diagram, structure of cast metal, segregation & porosity, iron-carbon diagram, steel & cast iron. Phase Diagrams of common commercial alloys: Cu-Ni, Ni-Cr, Al-Si, Al-Zn, Cu-Zn, Cu-Al, Ti-Al, Ti-V, interpretation of microstructure & properties.

UNIT IV COLD WORKING, ANNEALING AND PRECIPITATION


UNIT V APPLICATIONS OF PHYSICAL METALLURGY

Strengthening mechanism, strength vs. toughness (ductility), thermo-mechanical processing, micro alloyed steel, ultra-high strength steel, superalloy, control of texture.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of the Course, the students will be able to
1. Recognize the basic nomenclature, microstructure, and associated terms with the appropriate structure / phenomena and differentiate between related structure / phenomena.
2. Perform simple calculations to quantify material properties and microstructural characteristics.
3. Interpret the effect of composition and microstructure on material properties.
4. Perform phase equilibrium calculation and construct phase diagram.
5. Discuss on the various strengthening mechanisms and thermal mechanical processing.

TEXT BOOKS

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COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Having hands on experience on the preparation of samples for microscopic examination.
2. Analysing the microstructure of plain carbon steels and its influence on the properties of materials.
3. Interpreting the microstructure of the cast irons and its effect on the mechanical properties.
4. Distinguishing the microstructures of the different stainless steels and high-speed steels.
5. Examining the banded structures in steels, structure of welded joints and copper alloys.

LIST OF EXPERIMENTS
1. Mounting and preparation of metallurgical samples.
2. Study of metallurgical microscope and sample preparation.
3. Quantitative Metallography & image analysis.
4. Macro etching - cast, forged and welded components.
5. Electrolytic Etching and Polishing.
6. Microscopic examination of cast irons - Gray, White, Malleable and Nodular types.
7. Microscopic examination of Plain carbon steels (low carbon, medium carbon, high carbon steels).
8. Microscopic examination of Austenitic Stainless steels and High Speed Steels.
10. Microscopic examination of Copper alloys.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of the Course, the students will be able to:
1. Prepare the samples for microscopic examination.
2. Recognize the microstructures of various ferrous and non-ferrous materials.
3. Differentiate the different types of cast irons based on their morphology and analyse the effect of the processing on the microstructure.
4. Interpret the microstructures of various materials and also understand the effect of the various phase constituents on the properties of the materials.
5. Perform a quantitative analysis on any given microstructure.

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COURSE OBJECTIVES:
To study the mechanical properties of metals, wood and spring by testing in laboratory

LIST OF EXPERIMENTS
1. Tension test on mild steel rod
2. Torsion test on mild steel rod
3. Compression test on wood
4. Deflection test on metal beam
5. Double shear test on metal
6. Impact test on metal specimen (Izod and Charpy)
7. Hardness test on metal (Rockwell and Brinell Hardness)
8. Compression test on helical spring
9. Deflection test on carriage spring

TOTAL: 60 PERIODS

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

CO1 Determine the tensile and torsion properties of steel rod by testing
CO2 Determine the elastic modulus of a metal beam by conducting deflection test
CO3 Determine the shear strength and impact strength of metals.
CO4 Determine the hardness of various metals.
CO5 Determine the stiffness properties of helical and carriage spring.

CO – PO Mapping – STRENGTH OF MATERIALS LABORATORY

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<td>PO2 Problem analysis</td>
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<td>PO12 Life Long Learning</td>
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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:

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

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

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

ML3401 CHARACTERISATION OF MATERIALS

COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Understanding the various techniques of structural characterization of materials.
2. Interpreting the microstructure, crystal structure and surface structure of materials.
3. on X-Ray diffraction techniques and analysis
4. To import knowledge on different electron microscopy techniques used for characterisation
5. To import knowledge on different electron microscopy techniques used for characterisation
6. To import knowledge on techniques of elemental chemical composition and structure of
surface.

UNIT I METALLOGRAPHIC TECHNIQUES
Macro examination -applications, metallurgical microscope - construction and principle of working,
specimen preparation, light material interaction – Rayleigh Scattering, Abbes theory; magnification,
numerical aperture, resolving power, depth of focus, depth of field, different light sources; lenses
aberrations and their remedial measures, Principles of microscopy -bright field , dark field, phase-
contrast, polarization, differential interference contrast, high temperature microscopy; Quantitative
metallography – Image analysis for grain size distribution and grain/precipitate shape.

UNIT II X-RAY DIFFRACTION TECHNIQUES
Reciprocal lattice, Stereographic projection, X-ray generation, absorption edges, characteristic and
continuous spectrum, Bragg’s law, Ewald’s Sphere, Diffraction methods – Laue, rotating crystal and
powder methods. Intensity of diffracted beams –structure factor calculations and other factors.
Diffractometer – General features and optics, Counters - Proportional, Scintillating, Geiger counters
and semiconductor based.

UNIT III ANALYSIS OF X-RAY DIFFRACTION
Line broadening-crystallite size, residual stress; Texture Analysis; Crystal structure determination-
indexing -Phase identification- ASTM catalogue of Materials identification, quantitative phase
estimation, Phase diagram determination, Precise lattice parameter calculation, Determination of
residual stress – double angle diffraction.

UNIT IV ELECTRON MICROSCOPY
Electron specimen interaction; Construction and operation of Transmission electron microscope
(TEM) – specimen preparation techniques- Diffraction mode and image mode, Sources of contrast-
Selected Area Electron Diffraction, Zone axis, indexing ; Construction, modes of operation and
sources of contrast of Scanning electron microscope(SEM), Electron probe micro analysis, Basics
of Field ion microscopy (FIB), Scanning Tunnelling Microscope (STM) and Atomic Force
Microscope(AFM).

UNIT V SURFACE ANALYSIS
X-ray emission spectroscopy - Energy Dispersive Spectroscopy- Wave Dispersive Spectroscopy-
Ultraviolet Photo Electron Spectroscopy (UPS), X ray Photoelectron Spectroscopy (XPS), Auger
Electron Spectroscopy (AES), Electron Energy Analysers, Secondary ion mass spectrometry -
Quadrupole mass spectrometer ; Surface Structure -Unit meshes of five types of surface nets -

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of course, the student will be able to
1. Describe the principle of metallography and its application.
2. Explain the principle of XRD and its scope for metallurgical analysis.
3. Interpret and analyse the XRD results.
4. Discuss the various techniques of electron microscopy and their applications.
5. Describe the different techniques for the analysis of elemental chemical composition and structure of surface.

TEXT BOOKS:

REFERENCES:
5. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Hong Kong University of Science and Technology, John Wiley & Sons (Asia) Pte Ltd. 2010.

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ML3402 IRON AND STEEL MAKING

COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Acquiring the basic knowledge on the need for the beneficiation of iron ores and the different preliminary treatments given to the iron ores.
2. Discussing the various parts of blast furnace and the reactions that take place in the various zones of blast furnace.
3. Understanding the principles and kinetics of pig iron production as well as steel making.
5. Producing the different types of steels by adopting the ladle metallurgy technique.
UNIT I  RAW MATERIALS AND BURDEN PREPARATION  
Iron ore classification, Indian iron ores, limestone and coking coal deposits, problems associated with Indian raw materials, Iron ore beneficiation and agglomeration, Briquetting, sintering, Nodulising and pelletizing, testing of burden materials, burden distribution on blast furnace performance.

UNIT II  PRINCIPLES AND PROCESSES OF IRON MAKING  
Blast furnace parts, construction and design aspects, ancillary equipment for charging, preheating the blast, hot blast stoves, gas cleaning, Blast furnace operation, irregularities and remedies, Blast furnace instrumentation and control of furnace Compositional control of metal and slag in blast furnace, modern trends in blast furnace practice. Reduction of iron ores and oxides of iron by solid and gaseous reductions-thermodynamics and kinetics study of direct and indirect reduction, Gruner's theorem, blast furnace reactions. C-O and Fe-C-O equilibria, Rist diagrams, Ellingham diagram, material and heat balance- Sponge Iron making.

UNIT III  PRINCIPLES OF STEEL MAKING  

UNIT IV  STEEL MAKING PROCESSES  

UNIT V  LADLE METALLURGY  

COURSE OUTCOMES:
Upon the completion of the course, the students will be able to:
1. Identify the suitable preliminary treatments to be given to the iron ore for the beneficiation of ores.
2. Discuss the construction of Blast furnace, its operation and the various reactions that takes place in the various zones of blast furnace.
3. Interpret the slag theories and slag functions in the steel making processes.
4. Compare the various steel making processes and analyse the advantages and limitations of the different processes.
5. Select the suitable secondary refining processes for producing a good quality steel.

TOTAL: 45 PERIODS

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ML3403 MECHANICAL BEHAVIOUR OF MATERIALS L T P C 3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Having an overview of elastic and plastic behaviour of materials
2. Getting enlightened with the different strengthening mechanisms.
3. Obtaining an insight into the types of fracture and mechanics of fracture.
4. Interpreting the fatigue behaviour of materials.
5. Having an insight on the high temperature behaviour of materials.

UNIT I ELASTIC AND PLASTIC BEHAVIOUR
Elastic behaviour of materials - Hooke’s law, plastic behaviour; dislocation theory, Types of dislocations-Burger’s vectors and dislocation loops, dislocations in the FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, dislocation climb, intersections of dislocations, Jogs, dislocation sources, multiplication of dislocations, dislocation pile-ups, Slip and twinning. Methods of observing dislocations

UNIT II STRENGTHENING MECHANISMS
Elementary discussion of cold working, grain boundary strengthening. Solid solution strengthening, Martensitic strengthening, Precipitation strengthening, Particulate Strengthening, Dispersion strengthening, Fibre strengthening, Yield point phenomenon, strain aging and dynamic strain aging

UNIT III FRACTURE AND FRACTURE MECHANICS
Types of fracture, Basic mechanisms of ductile and brittle fracture, Griffith’s theory of brittle fracture, Orowan’s modification. Izod and Charpy Impacts tests, Ductile to Brittle Transition Temperature (DBTT), Factors affecting DBTT, Determination of DBTT. Fracture mechanics-Introduction, Modes of fracture, Stress intensity factor, Fracture toughness and Determination of KIC.
UNIT IV  FATIGUE BEHAVIOUR AND TESTING  9

UNIT V  CREEP BEHAVIOUR AND TESTING  9
Creep curve, Stages in creep curve and explanation, Structural changes during creep, Creep mechanisms, Metallurgical factors affecting creep. High temperature alloys, Stress rupture testing, Creep testing machines, creep life prediction-Omega (Damage rate) method, Larson-Miller (parametric) method. Deformation Mechanism Maps according to Frost/Ashby, Super plasticity.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Identify the role of dislocations and the mechanisms of plastic deformation.
2. Explain the strengthening mechanisms of polycrystalline and composite materials.
3. Analyse the nature of fracture and its underlying mechanism.
4. Appraise the micro-mechanics, factors and life predictions of components under fatigue loading.
5. Assess the behaviour of materials under high temperature, metallurgical factors and life prediction of high temperature materials.

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COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Having necessary background to design/select the necessary heat treatment for attaining the appropriate microstructure for the desired properties.
2. Getting a comprehensive understanding of the various transformation reactions associated with the changes in microstructures and properties that occur due to controlled heat treatment.
3. Understanding different case hardening techniques used in industries
4. Distinguishing the various Heat treatment furnaces, Quenching media and the heat treatment of some special alloys.
5. Getting an insight on the heat treatments employed for special alloys

UNIT I TRANSFORMATIONS IN STEELS

UNIT II HEAT TREATMENT PROCESSES

UNIT III CASE HARDENING

UNIT IV FURNACES, ATMOSPHERE AND PROCESS CONTROL
Various heating atmosphere used for heat treatment, temperature and atmosphere control– carburising atmosphere and carbon potential measurement, Temperature Measurement Control devices – Nitriding gas atmospheres, quenching media and their characteristics, Stages of Quenching, polymer quenching, Various Heat Treatment furnaces- Roller and Mesh type continuous furnaces- fluidised bed furnaces, cryo-chamber, cryo-treatment of steels, sealed quench furnace, Vacuum furnace, Plasma equipment-Elements of Process control systems-PLC ,PID controllers and continuous monitoring systems.

UNIT V HEAT TREATMENT OF SPECIFIC ALLOYS

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Discuss the various transformation reactions associated with the changes in microstructures and properties that occur due to controlled heat treatment.
2. Explain the various heat treatment processes that can be applied for different ferrous and non-ferrous alloys.
3. Analyse the effect of various case hardening treatments on the metals and alloys.
4. Compare the various heat treatment furnaces, quenching media and furnace atmospheres.
5. Interpret the results of heat treatments on the various other non-ferrous materials, alloy steels and cast irons.

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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 its variations - Work saved by fitting air vessels - Rotary pumps.

TOTAL: 60 PERIODS

COURSE 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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GE3451 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY

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
Definition, scope and importance of environment – need for public awareness. Eco-system and
Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem
diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats
to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic
species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION
6
Management system (OHASMS). Environmental protection, Environmental protection acts.

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
Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment,
Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy
efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-
carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-
economical and technological change.

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:
   2016.
   Studies, Prentice Hall.
5. Bradley, A. S; Adebayo, A. O., Maria, P. Engineering applications in sustainable design and
   development, Cengage learning.
7. Mackenthun, K. M., Basic Concepts in Environmental Management, Lewis Publication,
REFERENCES:

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1-low, 2-medium, 3-high, ‘-‘ no correlation
### NCC Credit Course Level 2*

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

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#### PERSONALITY DEVELOPMENT  
9

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

- **PD 5**  
  Public Speaking  
  3

#### LEADERSHIP  
7

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

#### DISASTER MANAGEMENT  
13

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

- **DM 2**  
  Initiative Training, Organising Skills, Do’s & Don’ts, Natural Disasters, Man Made Disasters  
  9

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

#### ENVIRONMENTAL AWARENESS & CONSERVATION  
3

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

#### GENERAL AWARENESS  
4

- **GA 1**  
  General Knowledge  
  4

#### ARMED FORCES  
6

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

#### ADVENTURE  
1

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

#### BORDER & COASTAL AREAS  
2

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

**TOTAL: 45 PERIODS**

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### NCC Credit Course Level 2*

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

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#### PERSONALITY DEVELOPMENT  
9

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

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

ADVENTURE
AD 1 Introduction to Adventure Activities

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

TOTAL: 45 PERIODS
# NCC Credit Course Level 2*

**NX3453** *(AIR FORCE WING) NCC Credit Course Level - II*

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COURSE OBJECTIVES:

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

1. Gaining practical experience on handling sophisticated instruments.
2. Obtaining hands-on-practice for sample preparation.
3. Experiencing the procedure involved in the instrumentation methods.
4. Calibrating and standardizing the sensitive instruments.
5. Using the spectrometers, electron microscopes and thermal analysers for analysing the specimens.

LIST OF EXPERIMENTS:

1. Verification of Beer Lambert’s law using Absorption Spectrophotometer.
2. Determination of concentration of metal ions using UV Visible spectrophotometer.
3. Determination of thermal coefficient using dilatometer.
4. Determination of conductivity using conductivity meter.
5. Identification of organic compounds using IR spectroscopy.
6. Quantitative analysis using column chromatography.
7. Qualitative identification of species using TLC.
8. Thermal degradation analysis using TGA
9. Thermal transition analysis using DSC.
10. Analysis of electron microscopic images

COURSE OUTCOMES:

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

1. Apply the theoretical principles and concepts of spectroscopy in characterization of materials.
2. Analyse and interpret the results obtained from the instrumental methods.
3. Demonstrate the use of suitable equipment to analyse the thermal behaviour of materials.
4. Examine the mixture of materials using chromatography technique.
5. Analyse and interpret the microstructural images obtained by electron microscopy.

TOTAL: 60 PERIODS
COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Performing heat treatment operations on the plain carbon steels
2. Interpreting the effect of quenching media and tempering temperature and time on the hardness of the steels
3. Enhancing the case hardness of the low carbon steels by carburizing treatment
4. Measuring the case depth of the case-hardened steels
5. Identifying the suitable heat treatment for non-ferrous materials.

LIST OF EXPERIMENTS:
1. Hardening and tempering of High carbon steels
2. Annealing and normalizing of hardened steels
3. Spheroidization annealing of high carbon steels
4. Effect of quenching media on hardening of steel
5. Effect of tempering temperature and time on tempering of steel
6. Effect of carbon percentage on the hardening of steel
7. Carburizing of low carbon steel
8. Case hardness depth measurements
9. Hardenability test – Jominy End Quench Test
10. Heat treatment of cast iron
11. Heat treatment of Stainless Steels and High speed steels
12. Heat treatment of non-ferrous alloys

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Perform various heat treatment processes on plain carbon steels and analyze the effect of the processes on steels.
2. Execute the case hardening effect on low carbon steel and to analyze the case depth measurements.
3. Interpret the effect of quenching media and the carbon percentage on the hardening of steel
4. Exemplify the effect of Jominy end quench test on the hardenability of steel.
5. Apply heat treatment on the various non-ferrous materials and analyze the effect of heat treatment on these materials.

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ML3591  METAL AND POWDER FORMING TECHNIQUES  L T P C
3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
• Describing types of deformations and classification of forming processes.
- Classifying and explain bulk forming processes.
- Describing sheet metal forming processes
- Distinguishing differences between conventional forming and special forming processes.
- Elaborating various stages involved in the powder forming processes.

UNIT I  INTRODUCTION  9
Mechanical behavior of materials - Elastic and plastic deformations - Classification of forming processes - Temperature in metal working: Cold, Warm and hot working - Introduction to the theory of plastic deformation.

UNIT II  BULK FORMING  9
Introduction - Plastic deformation in forging, rolling, extrusion, rod/wire, tube drawing and swaging processes and their applications - Effect of friction, calculation of forces, work done, process parameters, equipment’s and defects - Design for manufacturing - Economics of bulk forming.

UNIT III  SHEET METAL FORMING  9

UNIT IV  SPECIAL FORMING  9
Orbital forging - Isothermal forging - Hot and cold Isostatic pressing - High speed extrusion - High speed forming machines - Rubber pad forming - Water hammer forming - Fine blanking - Incremental forming and comparing the above with conventional forming.

UNIT V  POWDER FORMING  9
Introduction - Powder production methods - Particle size characterization - Blending - Compacting - Sintering - Secondary and finishing operations - Advantages and applications of powder metallurgy - Design for manufacturing - Powder forging, rolling, extrusion, drawing - Economics of powder forging.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Illustrate deformation types and classification of forming processes.
2. Describe bulk forming processes and their applications.
3. Elaborate different sheet metal forming processes and their applications.
4. Compare and distinguish conventional and special forming processes.
5. Discuss powder forming processes and its applications

TEXT BOOKS:

REFERENCES:
Verlag Berlin Heidelberg., Germany, 2006.

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ML3501 FOUNDRY METALLURGY

COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Getting acquainted with the various patterns, moulding materials and furnaces used in foundries.
2. Choosing molding process for casting components.
3. Designing gating system for castings.

UNIT I PATTERN, MOULDING MATERIALS, FURNACES
Introduction to foundry process- Pattern, types- allowances- selection of pattern materials, Sand-Core for foundry applications – types, properties of prepared sand- Moulding and Cores additives-preparations-Types of furnaces –Crucible, Cupola, Oil fired furnaces, Electric furnaces, Arc and Induction types.

UNIT II MOULDING PROCESSES

UNIT III DESIGN OF GATING SYSTEM
Design of Gating Systems – Types – Pressure & Unpressurized systems - Sprue - runner - gates – problems in design and manufacture of thin and unequal Sections designing for directional solidification - Riser design - Chvorinov’s rule, Caines - Section Modulus - Naval Research Laboratory methods, feeding distances – Calculations and number of Risers required, chills and feeding aids – Exothermic And Insulating sleeves Design problems of L, T, V, X and Y junctions, Computer Applications in casting design – Software for casting design CAE – Stress, Liquid metal flow and solidification analysis.

UNIT IV  
FERROUS CAST ALLOYS

UNIT V  
NON-FERROUS CAST ALLOYS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Select a proper material for making a pattern, design patterns, and decide on the composition of sand and core and know about the different furnaces for available for melting metals.
2. Describe the various casting processes for casting a component.
3. Design suitable gating system for casting a component.
4. Use suitable casting techniques to produce sound ferrous castings.
5. Employ suitable casting techniques to produce sound nonferrous castings.

TEXT BOOKS
1. A.K.Chakrabarthi ‘Casting Technology and Cast Alloys ,Prentice Hall of India

REFERENCES

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ML3502 NON-FERROUS METALLURGY

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Understanding the structure, property relations of nonferrous alloys with special emphasis on engineering applications.
2. Gaining knowledge on the important alloys used for critical applications.
3. Having an insight on the phase diagrams of industrially relevant portions of some important alloys.
4. Acquiring knowledge on the selection of suitable non-ferrous alloy for a given application.
5. Being well versed with the properties and applications of precious metals.

UNIT I COPPER AND COPPER ALLOYS

UNIT II ALUMINIUM AND ITS ALLOYS

UNIT III MAGNESIUM AND TITANIUM ALLOYS
Methods of Production of Magnesium- properties and uses. Magnesium alloys and designation, Applications. Methods of Production of Titanium- unique characteristics of Ti metal- alpha, alpha+beta and beta titanium alloys- major types. Titanium aluminides – their properties and uses. Typical microstructure of magnesium and titanium alloys- Applications of Ti alloys in Aircraft, Chemical and Medical industries.

UNIT IV NICKEL AND ZINC ALLOYS

UNIT V LEAD, TIN AND PRECIOUS METALS
Methods of Production of Lead and Tin-Major characteristics and applications of lead and tin and their alloys and designation. Low melting nature of solder alloys. Gold, silver and platinum – nobility of these metals. Engineering properties and applications of these metals and their alloys. Typical microstructure of solder alloys.

COURSE OUTCOMES:
Upon completion of the course, the students will be able to:
1. Correlate the structure - property relations of various copper alloys with special emphasis on engineering applications.
2. Compare the differences between various aluminium alloys with respect to their composition, properties and applications.
3. Identify suitable magnesium and titanium alloys for applications which involves magnesium and titanium alloys.

TOTAL: 45 PERIODS
4. Classify the different types of Nickel and Zinc alloys and understand the implications of these compositions on the properties and applications of the various alloys.
5. Explain the importance of precious metals, their properties and applications as well as the properties and applications of Lead and Tin alloys.

TEXT BOOKS

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ML3512   METAL AND POWDER FORMING LABORATORY  L  T  P  C
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COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Acquiring knowledge on basic metal forming processes by experimental study and analysis
2. Constructing formability diagrams
3. Reducing thickness by sheet metal rolling
4. Reducing the metal powders size and characterisation of metal powders
5. Producing green compacts and sintering the compacts.

LIST OF EXPERIMENTS:
1. Formability of sheet metal by Ericsson cupping test
2. Construction of Formability limit diagram
3. Diameter reduction in Wire drawing
4. Thickness reduction in Sheet metal rolling
5. Study of Sheet metal forming using FEA analysis software
6. Powder size reduction by Ball Milling
7. Measurement of Flow rate, Apparent and Tap Density of Powders
8. Production of green compacts.
10. Effect of Sintering temperature on the density of the sintered compact

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion the course, the students will be able to
1. Demonstrate the formability behaviour of the metal forming process.
2. Use software tools for analysing the metal forming process.
3. Examine the formability of different materials
4. Characterize the powders in terms of tap density, apparent density, flow rate and particle size
5. Make a compact of desired size and shape and compare the properties of the sintered compact with that of the green compact

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ML3601 WELDING TECHNOLOGY L T P C

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Acquiring knowledge on the various Metal Joining Processes.
2. Analysing the effect of heat transfer in welding.
3. Understanding the concepts involved in ferrous welding metallurgy.
4. Understanding the basics of non-ferrous welding metallurgy.
5. Knowing the causes and remedies of various welding defects, weldability, testing of weldments, welding standards and codes.

UNIT I FUNDAMENTALS OF METAL JOINING

UNIT II WELDING METALLURGY PRINCIPLES
Thermal cycles in welding: basic heat transfer equations, temperature distributions and cooling curves, dependence of cooling rate on heat input, joint geometry, preheat and other factors. Comparison of welding processes based on these considerations.

UNIT III PHYSICAL METALLURGY OF WELDING
UNIT IV  WELDING OF ALLOY STEELS AND NON-FERROUS METALS

Welding of stainless steels, types of stainless steels, overview of joining ferritic and martensitic types, welding of austenitic stainless steels, Sensitisation, hot cracking, sigma phase and chromium carbide formation, ways of overcoming these difficulties, welding of cast iron. Welding of non-ferrous materials: Joining of aluminium, copper, nickel and titanium alloys, problems encountered and solutions

UNIT V  DEFECTS, WELDABILITY AND STANDARDS

Defects in welded joints: Defects such as arc strike, porosity, undercut, slag entrapment and hot cracking, causes and remedies in each case. Joining of dissimilar materials, weldability and testing of weldments. Introduction to International Standards and Codes

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Describe the various welding processes.
2. Examine the heat transfer associated with the welding process.
3. Describe the metallurgical changes in the ferrous weldments.
4. Appreciate the metallurgical changes in the alloy steels and non-ferrous weldments.
5. Identify the welding defects and provide the remedy according to the standards.

TEXT BOOKS
2. R.S. Parmar ‘Welding Engineering and Technology’ Khanna Publishers 2010

REFERENCES

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### BORDER & COASTAL AREAS

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

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

**AIRMANNISH**
- A 1: Airmanship

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

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

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

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

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

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

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

**TOTAL : 45 PERIODS**
COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Appraising the various sand testing methods.
2. Determining the effect of welding parameters on the weld bead by GTAW and GMAW processes.
3. Inspecting Carbon Steel and Stainless Steel welded specimens through microstructural analysis.
4. Examining Aluminium Alloy welded specimens through microstructural analysis.
5. Investigating Titanium Alloy welded specimens through microstructural analysis.

LIST OF EXPERIMENTS
1. Determination of Average Sand grain Fineness.
2. Determination of Permeability of Green sand.
3. Estimation of Active clay content in Sand
4. Loss of Ignition Test for Green sand Mould
5. Determination of Green compression and Shear Strength.
6. Determination of Dry compression Strength
7. Determination of Scratch hardness.
8. Determination of Compactability.
9. Metal casting by Green and sand and full mould process.
10. Arc striking practice.
11. Bead-on-plate welding
    Effect of welding parameters on weld bead by
    (i) GTA welding
    (ii) GMA Welding
    (iii) Submerged Arc Welding
12. Microstructural Observation of Weldments
    (i) Carbon Steel
    (ii) Stainless Steel
    (iii) Aluminium Alloy
    (iv) Titanium Alloy

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Estimate the properties of the system sand.
2. Demonstrate green and full molding process
3. To demonstrate the working of different welding process.
4. Evaluate the microstructures of weldments of ferrous materials.
5. Evaluate the microstructure of weldments of nonferrous materials

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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Understanding the importance of NDT in quality assurance.
2. Acquiring knowledge on the basic principles of various NDT techniques, its applications, limitations, codes and standards.
3. Equipping themselves for having proper competencies to locate a flaw in various materials, products.
4. Getting ready to use NDT techniques for in-situ applications too.
5. Selecting the right NDT technique for a given application

UNIT I  INTRODUCTION & VISUAL INSPECTION METHODS
NDT versus Mechanical testing, Need for NDT, Relative merits and limitations, various physical characteristics of materials and their applications in NDT.
Visual Inspection - Unaided, Aided - Borescopes - Videoscopes, Special features in Borescopes, Selection of borescopes, Optical sensors, Microscopes & replication Microscopy Technique and applications, Holography, Case study.

UNIT II  LIQUID PENETRANT TESTING & MAGNETIC PARTICLE TESTING
LPT - Principle, types, Procedures, Penetrants and their characteristics, Emulsifiers, Solvent Cleaners / Removers, Developments - properties and their forms, Equipments, Advantages and limitations, Inspection and Interpretation, Applications and case study.

UNIT III  THERMOGRAPHY & EDddy CURRENT TESTING
Thermography – Introduction, 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 and applications, Case study.
Eddy current Testing – Principle, properties of eddy currents, Eddy current sensing elements, probes, Instrumentation, Types of arrangement, Advantages & Limitations, Interpretation of Results & applications, Case study.

UNIT IV  ULTRASONIC TESTING & ACOUSTIC EMISSION TESTING
Ultrasonic Testing-Principle, Basic Equipment, Transducers, couplants, Ultrasonic wave, Variables in UT, Transmission and Pulse-echo method, Straight beam and angle beam, A-Scan, B-Scan & C-Scan, Phased Array Ultrasound & Time of Flight Diffraction, Advantages & Limitations, Interpretation of Results & Applications, Case study.

UNIT V  RADIOGRAPHY
COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Compare the differences between the various visual inspection techniques and apply the same to the components to be inspected.
2. Recognize the importance of Penetrant testing in NDT with the understanding of the procedures involved in the Penetration methods.
3. Interpret the images and the results obtained from the Thermo graphic technique and the Eddy current testing.
4. Evaluate and interpret the results obtained in the Ultrasonic inspection and Acoustic Emission technique.
5. Explain the techniques involved in the Radiographic testing and the various advancements in Radiography.

TEXT BOOKS:

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CME397 SURFACE ENGINEERING

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

UNIT – I SURFACES AND FRICTION

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

UNIT – III CORROSION

UNIT – IV SURFACE TREATMENTS

UNIT – V ENGINEERING MATERIALS

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

TEXT BOOKS:

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

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

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

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

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

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

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


TOTAL: 30 PERIODS

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:


5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022
COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Appraising the various Non-Destructive testing methods.
2. Determining the discontinuities by Visual inspection process.
3. Inspecting the surface cracks by Liquid penetrant testing technique.
4. Examining the Eddy current and radiography results.
5. Performing ultrasonic inspection process and identifying the defects.

LIST OF EXPERIMENTS
1. Leak testing of tubes.
2. Detection of surface defects by liquid penetrant testing.
3. Analysis of size and shape of the surface discontinuities by LPT.
4. Defect determination by Magnetic particle testing.
5. Defect Analysis of Radiographic image.
6. Flaw detection using normal beam probe in Ultrasonic testing.
7. Flaw detection using angle beam probe in Ultrasonic testing.
8. Determination of thickness of the component by UT technique.
10. Study of Eddy current inspection technique and interpretation of EDT results.

TOTAL: 60 PERIODS:

COURSE OUTCOMES:
Upon completion of the course, the students will be able to:
1. Detect the surface defects by Visual inspection and Liquid penetrant testing techniques.
2. Identify the defects in the components by MPT technique.
3. Interpret the results obtained from Eddy current testing and Radiography testing.
4. Detect the defects by ultrasonic inspection process.
5. Analyse the thermal images of engineering components.

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PO1-PO12 are program outcomes.
PSO1-PSO3 are program specific outcomes.
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for
1. Acquiring knowledge on the basic concepts of fracture mechanics
2. Gaining knowledge on strain energy principle and use of it for developing theories
3. Understanding and analysing the fatigue failure
4. Getting familiarized with the failure analysis on the components failing by creep, corrosion and wear failure
5. Acquiring knowledge on corrosion and wear failure of materials.

UNIT I BASIC CONCEPTS IN FRACTURE MECHANICS
Introduction to fracture - elastic deformation, plastic and elasto-plastic deformation, Brittle fracture: Griffiths theory, Ductile fracture, Inglis solution-LEFM-EPFM- Different modes of fracture- photo elastic fringes- characteristics-crack emanating from inner and outer boundaries of cylinder-

UNIT II MECHANICS OF FRACTURE- STATIC LOADING

UNIT III FAILURE ANALYSIS OF FATIGUE FRACTURE

UNIT IV FAILURE ANALYSIS OF CREEP RUPTURE
Fracture at elevated temperature: Time dependent mechanical behavior, stress rupture, Microstructural changes during creep, Mechanism of creep deformation and Creep deformation maps, Prediction of time to rupture, Creep-fatigue interaction. Some case studies in analysis of creep failures.

UNIT V FAILURE ANALYSIS OF CORROSION AND WEAR

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to
1. Design structure to prevent failure from the internal defect that unit within the structure
2. Derive the stress field solutions for fracture problems
3. Design structure to prevent fatigue and creep
4. Define different deformation and related theories
5. Analyse the corrosion and wear failure and system methods to prevent corrosion and wear

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ML3002 CREEP AND FATIGUE BEHAVIOUR OF 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. Acquiring knowledge on the framework of plastic deformation, its mechanism and the role of dislocations.
2. Recognizing the mechanism, metallurgical variables and methods of life prediction of materials under creep.
3. Getting an insight to the nature of stress, factors and life prediction under fatigue.
4. Understanding the micro-mechanics and micro structural aspects involved in fatigue.
5. Gaining knowledge to perform failure analysis.

UNIT – I INTRODUCTION
Mechanisms of plastic deformation- Slip and Twinning, Critically resolved stress, Strength of perfect crystal, Lattice resistance to dislocation movement, Elastic properties of dislocation, Dislocation interactions, Partial dislocation, Dislocation multiplication, Dislocation pile up, effect of stacking fault and strain hardening exponent on dislocation.

UNIT – II HIGH – TEMPERATURE DEFORMATION RESPONSE

UNIT – III CYCLIC STRESS AND STRAIN FATIGUE

UNIT – IV FATIGUE CRACK INITIATION PROPAGATION
UNIT – V  ANALYSIS OF ENGINEERING FAILURES

Typical defects, Microscopic surface examination, metallographic and fractographic examination, Fracture surface preservation – Cleaning and replication techniques and image interpretation, failure data retrieval, Component failure analysis : procedural steps for investigation of a failure for failure analysis, Preparation of failure analysis report.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Discuss the mechanisms of the role of dislocation and stacking fault on plastic deformation.
2. Assess the behavior of materials under high temperature, metallurgical factors and life prediction of high temperature materials.
3. Distinguish the characteristics, factors and method of life prediction in the stress and strain controlled fatigue.
4. Appraise the micro-mechanics and micro-structural aspects of fatigue.
5. Design and develop a procedure to perform failure analysis and generate a report.

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ML3003  ELECTRON MICROSCOPY

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for
1. Acquiring knowledge on the basic concepts of interaction of electron beam and material interaction
2. Gaining knowledge on Scanning electron microscopy
3. Understanding and analysing the transmission electron microscopic images
4. Getting familiarised with the advanced electron microscopic techniques
5. Acquiring knowledge on the electron diffraction patterns and stereo graphic projection
UNIT-I  ELECTRON BEAM AND MATERIAL INTERACTION  9
Electron gun – types – thermo-emission and field emission – electromagnetic and magnetic lens –
aberration – corrections – electron material interaction – elastic and inelastic – signals – escape
depth

UNIT-II  SCANNING ELECTRON MICROSCOPY  9
Imaging modes – resolution – depth of field and depth of focus – contrast – number contrast –
compositional contrast – Influence of process parameters on image fractography- applications

UNIT-III  TRANSMISSION ELECTRON MICROSCOPY  9
Instrumentation - Sample preparation – Mass thickness contrast – diffraction contrast- phase
contrast – High resolution TEM- Crystal defects – applications

UNIT-IV  ELECTRON DIFFRACTION  9
Reciprocal lattice- Stereographic projection - Selected Area Electron Diffraction - Zone axis,
indexing - Structure Factor - Typical patterns of BCC, FCC and HCP - Kikuchi pattern - SEM -
Orientation Imaging - Electron Backscattered Diffraction (EBSD).

UNIT-V  ADVANCED ELECTRON MICROSCOPY  9
Field ion microscopy (FIB), Low Energy Electron Diffraction (LEED), Reflection High Energy
Electron Diffraction (RHEED).

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to
1. Explain the interaction between electron beam and materials
2. Interpret the images obtained from scanning electron microscopy
3. Discuss on the working principle of transmission electron microscopy
4. Identify the electron diffraction patterns and interpret them
5. Describe the different advanced electron microscopic techniques

TEXT BOOKS
   Materials Science”, Publisher: Springer, USA, 2009.

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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for
1. Acquiring knowledge on the basic concepts of production of X-rays and their interaction with matter
2. Gaining knowledge on the basics of X-ray diffraction and stereographic projection
3. Understanding and analysing XRD results to identify the phases
4. Getting familiarized with the various methods for identification of the phases in the crystals
5. Acquiring knowledge on the residual stress measurement using X-ray diffraction method

UNIT - I  X-RAY GENERATION AND INTERACTION WITH MATERIALS

UNIT - II  X-RAY DIFFRACTION (XRD): BASICS
Bragg’s law, Diffraction methods – Laue, rotating crystal and powder methods- Stereographic projection – texture and orientation- Intensity of diffracted beams –structure factor calculations

UNIT - III  XRD FOR PHASE IDENTIFICATION - I
Crystallite size – Scherrer - Stokes and Wilson - Importance of Rietveld refinement in XRD (fundamental) Precise parameter measurement - Phase identification –ASTM catalogue of Materials identification – Grazing incidence XRD

UNIT - IV  XRD FOR PHASE QUANTIFICATION - II

UNIT - V  XRD RESIDUAL STRESS MEASUREMENT
Warrens Method, lattice strain calculation – double exposure method – powder diffraction and diffractometer - sin²ψ technique

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to
1. Explain the methods of X-ray production and their interaction with the matter
2. Discuss on the basics of X-ray diffraction and the intensity of diffracted beams
3. Determine the crystal size using the results obtained from XRD
4. Identify the phases that are present in the various alloys
5. Predict the amount of residual stresses associated with the materials

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**ML3005 ADVANCED METALLOGRAPHIC TECHNIQUES**

**COURSE OBJECTIVES:**
The main learning objective of this course is to prepare the students for
1. Acquiring knowledge on the basic concepts of metallographic techniques
2. Gaining knowledge on surface preparation techniques for microscopic examination
3. Understanding and analysing the microscopic images
4. Getting familiarized with the various field metallographic techniques
5. Acquiring knowledge on colour metallography and having awareness on the safety

**UNIT – I INTRODUCTION**

**UNIT – II SURFACE PREPARATION**
Metallographic Sectioning and Specimen Extraction, Mounting of Specimens, Mechanical Grinding and Polishing , Chemical and Electrolytic Polishing , Contrast Enhancement and Etching , Light Microscopy

**UNIT – III QUATITATIVE METALLOGRAPHY**

**UNIT – IV FIELD METALLOGRAPHY TECHNIQUES**
Basic Equipment and Supplies, Planning for Field Metallography, Specimen Preparation, polishing, replication, Applications, Case Studies.

**UNIT - V COLOUR METALLAGRAPHY AND SAFETY**
Optical Methods for Producing Color, Film Formation and Interference Techniques, Anodizing, Chemical Etching, Tint Etching, Vapor Deposition Methods to Produce Color, laboratory safety, Hazard Communication Standards.

**TOTAL : 45 PERIODS**
COURSE OUTCOMES:
Upon Completion of the course, the students will be able to
1. Prepare the samples for microscopic examination
2. Discuss the various methods adopted for surface preparation
3. Interpret the images obtained under microscope
4. Describe the different field metallographic techniques
5. Do colour metallography and also aware of the lab safety norms.

TEXT BOOKS

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CPR332  FINITE ELEMENT ANALYSIS  
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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Developing mathematical models for Boundary Value Problems and their numerical solution.
2. Applying concepts of Finite Element Analysis to solve one dimensional problem.
3. Determining field variables for two dimensional scalar variable problems.
4. Determining field variables for two dimensional vector variable problems.
5. Applying the need for Isoparametric transformation and the use of numerical integration.

UNIT I      INTRODUCTION  

UNIT II     ONE-DIMENSIONAL PROBLEMS  
UNIT III  TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS  9
Second Order 2D Equations involving Scalar Variable Functions – Variational formulation – Finite
Element formulation – Triangular elements and Quadrilateral elements- Shape functions and
element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non
circular shafts.

UNIT IV  TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS  9
Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Constitutive
matrices and Strain displacement matrices – Stiffness matrix – Stress calculations - Plate and shell
elements.

UNIT V  ISOPARAMETRIC FORMULATION AND ADVANCED TOPICS  9
Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements
– One and two dimensions – Serendipity elements – Numerical integration - Matrix solution
techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software-
Introduction to Non Linearity.

TOTAL  = 45 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:
1. Develop mathematical models for Boundary Value Problems and their numerical solution
2. Apply concepts of Finite Element Analysis to solve one dimensional problems
3. Determine field variables for two dimensional scalar variable problems
4. Determine field variables for two dimensional vector variable problems
5. Apply the need for Isoparametric transformation and the use of numerical integration

TEXT BOOKS:
   Heinemann,2018.

REFERENCES:
3. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and
5. Tirupathi R. Chandrupatla and Ashok D. Belegundu, “Introduction to Finite Elements in

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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for
1. Getting introduced to the different mathematical concepts related to modeling of materials
2. Acquiring knowledge on solving one dimensional problems related to heat transfer
3. Solving two dimensional problems related to heat transfer
4. Getting introduced to the different software packages and their capabilities in solving material processing problems
5. Understanding the computer applications in physical metallurgy

UNIT I    INTRODUCTION TO MODELING AND MATHEMATICAL CONCEPTS
Mathematical modeling, physical simulation, advantages and limitations - Review of differential equations, numerical methods, introduction to FEM, FDM- Governing differential equations of elastic, plastic deformation, fluid flow and heat transfer – basic steps in FEM

UNIT II    ONE DIMENSIONAL PROBLEMS
Classical Techniques in FEM – Weighted residual method – Galarkin and Ritz method – Coordinates and shape functions- Potential energy approach — Assembly of stiffness matrix and load vector – Finite element equations – Quadratic shape functions – Applications to elastic deformation of bar, plane trusses and beam – steady state heat transfer

UNIT III   TWO DIMENSIONAL AND AXISYMMETRIC CONTINUUM

UNIT IV    SOFTWARE PACKAGES
Introduction to standard software packages – General purpose FEA packages– Special purpose packages for simulation of rolling, forging and casting simulations. - Applications of FEA in simulation of sheet metal and bulk forming, solidification of casting and weldment, Concepts of coupled analysis

UNIT V    COMPUTER APPLICATIONS IN PHYSICAL METALLURGY
Use of computers for the construction of phase diagrams, Expert system for alloy design and selection of materials – computer applications in crystallography

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to
1. Apply numerical techniques to a variety of materials process including solidification, heat treatment, grain from the recovery stabilization
2. Solve one dimensional problems related to heat transfer
3. Solve two dimensional problems related to heat transfer
4. Able to evaluate the capabilities and limitation of commercial software
5. Explain the computer applications in physical metallurgy

TOTAL: 45 PERIODS

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

- Acquiring knowledge on the diffusion mechanisms and the various phase transformations that happen due to diffusion.
- Understanding the significance and importance of phase transformations and its influence on the mechanical behaviour.
- Gaining Knowledge on the diffusion less transformations that occurs in ferrous and non-ferrous materials.
- Understanding the concepts involved in the precipitation processes.
- Getting an insight on the concepts of recovery, grain growth and recrystallisation in detail.

UNIT I  DIFFUSION MECHANISMS  9

UNIT II  DIFFUSION CONTROLLED PHASE TRANSFORMATIONS  9

UNIT III  DIFFUSIONLESS PHASE TRANSFORMATIONS  9

UNIT IV  PRECIPITATION REACTIONS  9

UNIT V  RECOVERY, RECRYSTALLISATION AND GRAIN GROWTH  9
Cold working and hot working, recovery – polygonisation and dislocation movements in polygonisation, recrystallisation – effect of time, temperature, strain and other variables – Mechanism of nucleation and growth, grain growth – grain growth law, geometrical collisions, preferred orientation, secondary recrystallisation.

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

1. Explain the various diffusion mechanisms and the thermodynamic and kinetic principles.
2. Classify the various diffusion controlled transformations and infer the effect of various parameters on the kinetics and growth of nucleation.
3. Compare the differences between the diffusion controlled and diffusionless transformations and explain the diffusionless transformations in steels and non-ferrous alloys.
4. Interpret the thermal cycle on the alloys and the effect of time, temperature and composition during precipitation hardening.
5. Recall the concept of recovery, recrystallization and grain growth in cold worked and hot worked steels.
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CML331 FUNDAMENTALS OF NANO SCIENCE

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 different processing methods, properties of nanomaterials for the future engineering applications
2. Gaining knowledge on processing zero dimensional nanomaterials and using them in engineering applications
3. Acquiring knowledge on processing one dimensional nanomaterials and using them in engineering applications
4. Getting acquainted with processing two dimensional nanomaterials and using them in engineering applications
5. Exposing to characterization techniques used for nanomaterials.

UNIT I INTRODUCTION TO NANOMATERIALS
Amorphous, Crystalline, microcrystalline, quasicrystalline and nanocrystalline materials- historical development of nanomaterials – Nanomaterials classification (Gleiter’s Classification) – properly changes done to size effects, Hall – Petch, inverse Hall- Petch effects - polymeric nanostructures

UNIT II ZERO DIMENSIONAL NANOMATERIALS
UNIT III ONE DIMENSIONAL NANOMATERIALS


UNIT IV SUPER HARD COATINGS AND BULK NANOSTRUCTURED MATERIALS
Superhard coating – types – characteristics – thermal stability – case studies (nc-TiN/a-Si3N4 coating) – Applications.

Buck nanostructure formation – Equal Channel angular pressing(ECAP) – High pressure torsion(HPT), Accumulative roll bending – Reciprocating extrusion - compression, cyclic close die forging – Repetitive corrugation and straightening – Grain refinement mechanisms.

UNIT V CHARACTERIZATION OF NANOMATERIALS

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to
1. Explain the categories of nanomaterials and the effects due to which the properties changes
2. Describe the processes employed for processing zero dimensional nanomaterials and employ them in engineering applications
3. Select processes that can fabricate one dimensional nanomaterials
4. Prepare two dimensional nanomaterials and bulk nanostructures
5. Analyse the nanoindentation and AFM Data

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Gaining knowledge on the various types of tool materials and their characteristics and applications.
2. Distinguishing the various methods of testing tool steels.
3. Understanding thoroughly the various existing manufacturing processes, heat treatment and properties of advanced tool materials.
4. Identifying suitable heat treatments that can be adopted to the tool steels and its effect on the mechanical properties.
5. Discussing the need for coating the tool materials and its implications.

UNIT I  CLASSIFICATION AND MANUFACTURE OF TOOL STEELS
Classification – AISI system, selection of tool steels from the point of view of mechanical properties, Effect of alloying elements such as W, Mo, Ni, V, Ti etc., in Tool steels, Production techniques – problems in melting – powder metallurgy route, Refining methods like VAR, ESR– forming of tool steels.

UNIT II  HEAT TREATMENT OF TOOL STEELS AND DEFECTS
HEAT TREATMENT AND METALLURGY OF H, T, M, SPECIAL PURPOSE TOOL STEELS-Hot work tool steels, high speed tool steels, maraging tool steels, special purpose tool steels: constitution, classification of principal types, heat treatment process, specific requirements and applications.

UNIT III  PROPERTIES, TESTING AND FAILURE OF TOOL STEELS

UNIT IV  ADVANCED TOOL MATERIALS

UNIT V  SURFACE TREATMENTS AND COATINGS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the Students will be able to
1. Classify the various tool materials that are used for engineering applications and understand the influence of various alloying elements on the properties of tool materials
2. Select suitable heat treatment for the different tool materials inorder to improve the performance of tools.
3. Test the tool materials for various properties and analyse on the various possible failures that occur in tools.
4. Explain the need for advanced tool materials and the advantages of various special tool materials over conventional tool materials.
5. Infer the effect of coating on the tool materials and are exposed to the various possible coating techniques that are available for tool materials.
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ML3009 AUTOMOTIVE MATERIALS

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Having knowledge on the overview of material properties, use of materials selection chart and considerations for material selection
2. Acquiring knowledge about the basis of materials selection
3. Getting an insight about the factors that influence materials selection for engines and transmission system
4. Selecting suitable materials for automotive structures
5. Identifying appropriate material for electronics devices in the automobile industries

UNIT – I ENGINEERING MATERIALS AND THEIR PROPERTIES
Classes of engineering materials - the evolution of engineering materials, Definition of materials properties, Displaying material properties using materials selection charts, Forces for change in materials selection and design, Materials and the environment. Selection of materials for automotive, aerospace, marine and defence applications.

UNIT – II BASIS OF MATERIAL SELECTION

UNIT – III MATERIALS FOR ENGINES AND TRANSMISSION SYSTEMS
Materials selection for IC engines: Piston, piston rings, cylinder, Engine block, Connecting rod, Crank shaft, Fly wheels, Gear box, Gears, Splines, Clutches.
UNIT – IV MATERIALS FOR AUTOMOTIVE STRUCTURES 9
Materials selection for bearings, leaf springs, chassis & frames, Bumper, shock absorbers, Damping fluid, wind screens, panels, brake shoes, Disc, wheels, differentials, damping and antifriction fluids, Tyres and tubes.

UNIT – V ELECTRONIC MATERIALS FOR AUTOMOTIVE APPLICATIONS 9
Materials for electronic devices meant for engine control, ABS, Steering, Suspension, Sensors, temperature sensors for climate control, anti-collision, Anti-fog, Head lamps.

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Identify the criteria and forces that cause the changes in materials selection.
2. Investigate the influence of structural index, manufacturing process, design and functional requirements on selection strategies.
3. Recognize the temperature regime, nature of load and property requirements of materials for engines and transmission system.
4. Analyse the various stresses acting on the structural members of automobile under dynamic loading and select suitable material.
5. Adjudicate the apt material for electronic devices used in automobiles.

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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:

ML3010 CRYOGENIC TREATMENT OF MATERIALS L T P C 3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Familiarizing with cryogenic cycles and its related fluids.
2. Gaining knowledge on cry cooler and effects of materials
3. Acquiring knowledge on cryogenic treatment
4. Understanding the characteristics of cryo treated materials
5. Having knowledge on the applications of cryoprocessing of materials

UNIT I INTRODUCTION 9
UNIT II  CRYOCOOLER


UNIT III  CRYOGENIC PROCESSING


UNIT IV  MATERIALS ENGINEERING

Desirable qualities for materials used in cryogenic applications, History and applications of metallic / non-metallic materials, Understanding properties and fabrication processes of superconducting Nb$_3$Sn wires, High temperature superconductors. Characterization of cryogenically processed materials.

UNIT V  APPLICATIONS

Cryogenic processing of materials for Space applications, Superconductivity, Medical applications, Food Preservation-Individual Quick Freezing, Tool Industry, Automobiles etc

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the Course, the students will be able to
1. Perform cryogenic treatment of materials
2. Specify cryocooler requirements and performance
3. Select materials for cryogenic treatment
4. Characterise the cryo-treated materials
5. Discuss the properties and application after cryogenic treatment of materials

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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Gaining knowledge about different nuclear materials
2. Understanding the principle and construction of nuclear reactors
3. Identifying the materials for nuclear reactor and fuel
4. Getting awareness of the nuclear waste and prevention techniques
5. Knowing about irradiation effects in nuclear fuels.

UNIT I  FUNDAMENTALS OF NUCLEAR ENGINEERING  9
Atomic structure, atomic number, mass number, isotopes, nuclear energy and nuclear forces, binding energy, nuclear stability, radioactivity, nuclear reactions, nuclear fissions, nuclear fusion.

UNIT II  NUCLEAR REACTORS  9
Types of reactors- ordinary water moderated reactors, heavy water cooled and moderated reactors-design, construction and control of nuclear reactors-moderators-coolants-reflectors and structural materials, nuclear power stations in India, comparison of nuclear power plants with thermal power plants.

UNIT III  FUELS  9
Ores and beneficiation – Uranium and thorium ores, availability in India, solvent extraction and ore beneficiation. fuels of different types – metallic, alloy and dispersion fuels for research reactors, ceramic (oxide, carbide and nitride) fuels for thermal power reactor and fast reactors. Fabrication of oxide, mixed-oxide and mixed-carbide fuel for power reactors. Fabrication, characterization and property evaluation of advanced fuel type, processes encountered in fabrication, fuel property evaluation – thermal and physical properties

UNIT IV  NUCLEAR WASTE AND RADIATION PROTECTION  9
Introduction-unit of nuclear radiation-Types of waste –disposal –ICRP recommendations-radiation hazards and prevention –radiation dose units

UNIT V  IRRADIATION EFFECTS IN NUCLEAR FUELS  9
Irradiation Examination of Fuels, Irradiation behaviour of metallic uranium – irradiation growth, thermal cycling, swelling, adjusted uranium, blistering in uranium rods. Irradiation effects in ceramic oxide and mixed oxide fuels, definition and units of burnup, main causes of fuel element failure in power reactors and remedies to avoid failures. Behaviour of fuel under off normal and accident condition, criteria for fuel failure during LOCA: oxidation, deformation, stored energy.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the Course, the students will be able to
1. Select the right fuel to be used in Nuclear reactor
2. Discuss the Nucleator radiation and the controlling methods.
3. Describe the construction and working principle of nuclear reactors
4. Express the safety aspects required in the nuclear plants.
5. Explain the waste in the and its disposal methods.

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ML3012 COMPOSITE MATERIALS

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Gaining knowledge on different matrix and reinforcement materials and selection of them for making different composites.
2. Familiarizing with different manufacturing methods for making different polymer matrix composites components
3. Acquiring knowledge on various in-situ and ex-situ techniques for processing metal matrix composites and interface properties
4. Summarizing different techniques used to produce ceramic matrix composites and carbon-carbon composites
5. Developing constitutive equations for different laminates to evaluate the stress and strain in each lamina

UNIT I INTRODUCTION TO COMPOSITES

UNIT II POLYMER MATRIX COMPOSITES
UNIT III METAL MATRIX COMPOSITES

UNIT IV CERAMIC MATRIX COMPOSITES AND SPECIAL COMPOSITES

UNIT V MECHANICS OF COMPOSITES

TOTAL : 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. Identify suitable matrix and reinforcement materials, to develop different composite components.
2. Select suitable process to fabricate PMC structures/component.
3. Design and select suitable processes to develop MMCs.
4. Suggest suitable techniques to fabricate CMCs and C-C composites.
5. Develop and use the constitutive equation for the design of composite components.

TEXT BOOKS

REFERENCES
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. acquiring knowledge on raw materials for ceramic, natural ceramic and engineering ceramic
2. Understanding the characteristics and processing application of glass, refractories and
   engineering ceramics
3. Gaining knowledge on the advanced ceramics and their applications.
4. Identifying the proper refractory material for a given application
5. Getting acquainted with the various applications of ceramic materials

UNIT I  FUNDAMENTALS  9
Ceramic crystal structures. Phase diagram Al2O3--SiO2. Ceramic raw materials, Silicate and non
silicate ceramics. Composition, properties, Mineralogy, Phase analysis.

UNIT II  GLASS AND ITS PROCESSING  9
Introduction, classification, preparation-raw materials, mixing, charging, melting, processing.
Manufacture of glass products- flat ware, hollow ware. Cullets, optical glass, optical fibers.

UNIT III  REFRACTORIES AND ITS PROCESSING  9
Importance and requirements, classification-fire clay, alumino silicate, silica, magnesite, forsterite,
dolomite, chromite, chrome magnesite, zirconia, carbon and graphite-refractory failures.

UNIT IV  CERAMIC PROCESS  9
Ceramic fabrication processes-slip forming process, plastic forming process, dry forming process,
drying and finishing, firing.

UNIT V  ADVANCED CERAMICS  9
Oxides, carbides, nitrides, borides, silicides, sialon carbon fibres and Carbon composites.
Applications in structural, electrical and bioceramics. Ceramic coatings (thermal barriers),
nuclear(cermets), process (filter, catalyst).

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Understand the basic of ceramic materials and their characteristics.
2. Describe the processing route and techniques of ceramics
3. Discuss on the various refractory materials and compare them
4. Select the suitable ceramic material for a given application
5. Discuss about the different advanced ceramics and its applications.

TEXT BOOKS:
1. James S.Reed, "Principles of Ceramic processing" John Wiley and Sons NY 1988
   Wiley and Sons, New York,1976

REFERENCES:
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Knowing the different concepts in selecting smart materials
2. Comparing the different electro-rheological materials
3. Discuss on the various and piezoelectric materials
4. Distinguishing the different shape memory materials and their applications
5. Identify suitable materials for various applications such as actuators, sensors, etc.

UNIT I  INTRODUCTION

UNIT II  ELECTRO-RHEOLOGICAL AND PIEZOELECTRIC MATERIALS

UNIT III  MAGNETO-RHEOLOGICAL AND PIEZOELECTRIC MATERIALS
Basics, Principles and instrumentation and application of Magnetorheological fluids – Piezoelectric materials: polymers and ceramics, mechanism, properties and application. Introduction to electro-restrictive and magneto-restrictive materials

UNIT III  SHAPE MEMORY MATERIALS

UNIT III  APPLICATIONS OF SHAPE MEMORY ALLOYS
Continuum applications of SMA fasteners – SMA fibers – reaction vessels, nuclear reactors, chemical plant, etc. – micro robot actuated by SMA – SMA memorization process (Satellite Antenna Applications) SMA blood clot filter – Impediments to applications of SMA – Shape memory polymers– mechanism of shape memory-Primary moulding – secondary moulding– types and applications.

TOTAL:45 PERIODS
COURSE OUTCOMES:
Upon Completion of the Course, the students will be able to
1. Discuss the different Smart materials.
2. Describe the functions of Electro-Rheological Materials and their suitability for various applications.
3. Discuss the functions of Piezoelectric Materials and their suitability for various applications.
4. Explain the principle of shape memory effect and the transformations that occur in smart materials.
5. Select a suitable smart material for a given application

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CME364  ENERGY STORAGE DEVICES  L T P C
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COURSE OBJECTIVES
1. To study the various types of energy storage devices and technologies and their comparison.
2. To learn the techniques of various energy storage devices and their performances.
3. To learn the basics of batteries and hybrid systems for EVs and other mobile applications.
4. To learn about the renewable energy storage systems and management systems.
5. To have an insight into other energy storage devices, hydrogen, and fuel cells.

UNIT – I  INTRODUCTION TO ENERGY STORAGE  9

UNIT – II  ENERGY STORAGE SYSTEMS  9
UNIT – III  MOBILE AND HYBRID ENERGY STORAGE SYSTEMS  
Batteries for electric vehicles - Battery specifications for cars, heart pacemakers, computer standby supplies – V2G and G2V technologies – HESS.

UNIT – IV  RENEWABLE ENERGY STORAGE AND ENERGY MANAGEMENT  

UNIT – V  OTHER ENERGY DEVICES  

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to
1. Discuss the need and identify the suitable energy storage devices for applications.
2. Explain the working of various energy storage devices and their importance.
3. Explain the basic characteristics of batteries for mobile and hybrid systems.
4. Discuss the storage of renewable energies and management systems.
5. Explain the need for other energy devices and their scope for applications.

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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Learning the basics of hydrogen and its production and storage methods.
2. Gaining knowledge about the basics of fuel cells and their scope for energy related applications.
3. Understanding the different types of fuel cells and their working.
4. Acquiring knowledge on the thermodynamics and kinetics of fuel cell process.
5. Getting an insight into fuel cell applications and its economics.

UNIT – I HYDROGEN – PROPERTIES, PRODUCTION AND STORAGE 9

UNIT – II FUEL CELLS – BASICS 9

UNIT – III FUEL CELLS - CLASSIFICATION 9
Types of fuel cells – Construction and Working of PEMFC, DMFC, AFC, PAFC, SOFC, MCFC, BFC – relative merits and demerits – Applications.

UNIT – IV FUEL CELLS – KINETICS AND THERMODYNAMICS 9

UNIT – V FUEL CELLS – APPLICATIONS AND ECONOMICS 9
Fuel cell usage for domestic power systems, large scale power generation, automobile, space applications, economic and environmental analysis on usage of fuel cell, future trends of fuel cells

TOTAL:45 PERIODS

COURSE OUTCOMES:
Upon Completion of the Course, the students will be able to
1. Understand the hydrogen properties and know the Hydrogen generation and storage methods.
2. Recognize the principle operations of fuel cells and their components.
3. Comprehend the different types of fuel cells and their uses.
4. Understand the thermodynamics and kinetics behind the fuel cell processes.
5. Apply the fuel cells for domestic, automotive, space craft power generations and evaluate the techno-economics of fuel cells.

TEXT BOOKS:

REFERENCES:
ML3015 SEMICONDUCTORS AND OPTOELECTRONIC MATERIALS AND DEVICES  L T P C 3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Gaining knowledge on semiconductor materials, mechanisms and processing techniques
2. Understanding the concepts and working principles of optoelectronic devices
3. Getting acquainted with the basics of semiconductor understanding of fundamentals of optoelectronics
4. Acquiring knowledge on the Quantum effects and relevant properties due to their effect
5. Comparing the different processing techniques
6. Designing suitable optoelectronic devices for any given application

UNIT I  BASICS OF SEMICONDUCTORS  9
Energy bands and Charge carriers in Semiconductors: Direct and Indirect semiconductors, Density of states, Occupation probability, Fermi level and quasi Fermi levels, p-n junctions, Schottky junction and Ohmic contacts.

UNIT II  FUNDAMENTS OF OPTOELECTRONICS  9

UNIT III  QUANTUM EFFECT  9
Quantum confinement, Engineering classifications of nanostructures (1D, 2D, 3D confinement) - nanoparticles- quantum dots, nanowires-ultra-thin films ultilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, optical, Magnetic and Thermal properties. Semiconductor Hetrostructures.

UNIT IV  ADVANCED PROCESSING TECHNIQUES  9
Optoelectronic materials fabrication - Mechanical Milling, Colloidal routes, Self-assembly, CVD, MOCVD, Sputtering, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE and Lithography. Processing Environment - clean room technology: specifications and design, air and water purity, requirements for particular processes.

UNIT V  MODERN OPTOELECTRONIC DEVICES  9

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon Completion of the Course, the students will be able to
1. Relate the impacts of semiconductor material properties and the optical properties of semiconductor devices.
2. Discuss the fundamental properties of optoelectronic devices
3. Explain the quantum effect and the length scales of materials
4. Describe the various advanced processing techniques adopted for fabrication of optoelectronic materials.
5. Identify suitable material for any given application.

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ML3016       ADVANCED MATERIALS CHARACTERISATION       L T P C
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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Learning the basics of microscopic techniques and their working principle
2. Gaining knowledge about the various methods determining the surface composition
3. Understanding the surface analysis techniques by various ways
4. Acquiring knowledge on the mechanical characterisation techniques
5. Getting an insight into the electrical and magnetic characterisation methods

UNIT - I       MICROSCOPY 9
Phase contrast microscopy- Polarized Microscopy- Differential Interference Contrast microscopy,
Stereomicroscopy – Laser Scanning Confocal Microscope quantitative Near-field Scanning Optical Microscopy

UNIT - II       SURFACE CHEMICAL ANALYSIS 9
Electron spectroscopy for chemical analysis (ESCA), Ultraviolet Photo Electron Spectroscopy (UPS),
X ray Photoelectron Spectroscopy (XPS), Auger Electron Spectroscopy (AES), Electron Energy Analysers, Secondary ion mass spectrometry
UNIT - III  SURFACE ANALYSIS


UNIT - IV  MECHANICAL CHARACTERIZATION TECHNIQUES

Elastic and plastic deformation-mechanical properties of materials, models for interpretation of nanoindentation load-displacement curves, Nanoindentation data analysis methods-Hardness testing of thin films and coatings, Mechanical properties evaluation by universal testing machine (UTM), Dynamic mechanical analysis.

UNIT - V  ELECTRICAL AND MAGNETIC CHARACTERIZATION TECHNIQUES

Measurement of resistivity by 4-probe method, Hall measurement, Measurement of magnetic of properties of nanomaterial (Magnetic hysteresis and dielectric properties by LCR meter),Vibrating sample magnetometer.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to
1. Describe the various advanced microscopic techniques
2. Identify the surface chemical composition by interpreting the results from spectroscopic methods
3. Discuss on the different methods used to analyse the surface area and composition
4. Explain the various advanced mechanical characterization techniques
5. Enumerate and explain the various electrical and magnetic characterization methods

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

- Acquiring a comprehensive knowledge on the basics involved in thin films and development of thin films.
- Getting acquainted with the various methods of preparation of thin films.
- Explaining the methods of deposition monitoring and control and its importance.
- Gaining knowledge on the surface modification technologies of deposition of thin film for different application like optical emission, abrasion resistance, dielectric, electronic applications, energy conversion, etc.
- Knowing the applications of thin films in various fields.

UNIT I  
BASICS OF THIN FILMS

UNIT II  
PREPARATION OF THIN FILMS

UNIT III  
DEPOSITION MONITORING AND CONTROL
Microbalance, Crystal oscillator thickness monitor, optical monitor, Resistance Monitor. Thickness measurement: Multiple Beam Interferometer, Fizeau (Tolansky) technique - Fringes of equal chromatic order (FECO) method - Ellipsometry (qualitative only).

UNIT IV  
PROPERTIES OF THIN FILM

UNIT V  
APPLICATION OF THIN FILMS

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

- Explain the fundamental principles of Thin film technology.
- Compare the various techniques of preparation of thin films with respect to the processes, advantages, limitations and applications.
- Interpret the results obtained from Microbalance, Crystal oscillator thickness monitor, optical monitor, Resistance Monitor and Thickness measurements.
- Interpret the effect of size of thin films and ageing and annealing on the optical and conductive properties of thin films.
Identify suitable surface modification technologies of deposition of thin film for different application like optical emission, abrasion resistance, dielectric, electronic applications, energy conversion, etc.

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**ML3018**
**MEMS AND NANOTECHNOLOGY**

**COURSE OBJECTIVES:**
The main learning objectives of this course is to prepare the students for:
1. Acquiring knowledge about the materials used in MEMS.
2. Understanding the basics of nanoelectromechanical systems (NEMS)
3. Developing the skills to utilize MEMS devices in the real-time applications.
4. Familiarizing with microdevices.
5. Identifying suitable micro and nano electromechanical systems for a given application.

**UNIT – I**
**MATERIAL ASPECTS OF MEMS AND NEMS**

**UNIT – II**
**SENSORS**

**UNIT – III**
**ACTUATORS**
UNIT – IV MEMS AND NEMS APPLICATIONS - I
Applications in Computer industry – Making of ICs and Microprocessors – Data storage devices. Automobile – Safety and Stability Control. Health care

UNIT – V MEMS AND NEMS APPLICATIONS - II
Lab-on-a-Chip. Consumer Products; Micro reactor; Micro-bots; MOEMS; Molecular machines. Applications of NEMS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Select suitable material for MEMS and Microsystems,
2. Explain the scaling laws involved in miniaturization.
3. Apply the working principle of electrostatic based MEMS sensors and actuators in the design of MEMS devices.
4. Apply the working principle of thermal based MEMS sensors and actuators in the design of MEMS devices.
5. Design the elements of Micro-fluidic systems, and select suitable MEMS devices for Industrial applications.

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ML3019 MICRO AND NANO FABRICATION

COURSE OBJECTIVES:
The main learning objectives of this course is to prepare the students for:
1. Getting acquainted with the developments in microfabrication process engineering
2. Getting an insight about the microfabrication technologies.
3. Gaining a comprehensive knowledge on micromanufacturing methods.
4. Understanding the basics of the thin film deposition processes
5. Discuss on the scaling laws and their influences on process and design selection

UNIT – I INTRODUCTION
Review of early developments in Microfabrication Process Engineering, Introduction to Material Science for device fabrication
UNIT – II MANUFACTURING PROCESSES
Hot Processing and Ion implantation - Diffusion, Thermal Oxidation, Ion implantation, Rapid Thermal Processing. Pattern Transfer

UNIT – III LITHOGRAPHY
Photolithography, Extreme UV lithography, X-ray Lithography, Electron Beam lithography Focused ion beam Lithography, nanoimprint.

UNIT – IV THIN FILM DEPOSITION TECHNIQUES
Thin film deposition – Physical deposition: Evaporation and sputtering – Chemical Vapour Deposition – Epitaxial growth. Surface Micromachining of silicon

UNIT – V MICROMANUFACTURING PROCESSES

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Select suitable material for MEMS and Microsystems, and explain the scaling laws involved in miniaturization.
2. Explain the various micro-manufacturing processes.
3. Discuss on the various lithography techniques
4. Describe the working principles of various thin film deposition techniques
5. Explain the method of etching, surface and bulk micro manufacturing methods

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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Acquiring knowledge on fluid mechanics specific to materials processing
2. Outlining the different flow in pipes
3. Using heat transfer equations in solving casting related problems
5. Familiarizing with the concepts of radiation, mass transfer and diffusion.

UNIT I FLUID MECHANICS 9
Properties of fluids such as density, viscosity and specific weight. Fluid statics - Pressure at a point - Pressure variations in horizontal and vertical directions - Concept of gauge and absolute pressure. Use of manometer for pressure measurements. Introduction to Hydrostatic Forces.

Energy Balance in Fluid Flow: Types of flow - continuity equation - Application to one dimensional problems. Derivation of Bernoulli’s equation and Euler’s equation - Examples illustrating the use of energy equation in metallurgical processes.

UNIT II INTERNAL AND EXTERNAL FLOW 9
Classification of flow - Reynolds number - Laminar flow between parallel plates and circular pipes - Simple problems. Pressure in Fluid Flow: Head loss due to friction - Darcy - Weisbach equation - flow through pipes - use of Moody diagram - Minor losses - Simple problems.

UNIT III CONDUCTION HEAT TRANSFER 9
Steady state heat conduction - simple examples. Transient heat conduction - Systems with negligible internal resistance - Lump heat analysis - Response time of a temperature measuring instrument - System with negligible surface resistance - heat flow in an infinitely thin plate (Semi infinite body) - System with finite surface and internal resistance - Chart solutions of transient heat conduction problems – Examples on Heat Treatment

UNIT IV CONVECTIVE HEAT TRANSFER 9
Forced and free convention - Boundary layer concept - velocity and thermal boundary layers (no derivation) - Simple problems - Flow over flat plate - laminar and turbulent boundary layers (no derivation) - Simple problems – Boundary layer development in a circular duct (no derivation) - Flow over cylinders and spheres-Simple problem- applications in metallurgical processes.

UNIT V RADIATION HEAT TRANSFER 9

COURSE OUTCOMES:
Upon completion of this course the students will be able to
1. Apply the concepts of fluid mechanics, mass transport for minerals processing, solidifications etc.
2. Discuss the flow behaviour in pipes and use of this knowledge in casting
3. Use the conductive heat principles in materials processing
4. Utilise the convective heat transfer in materials processing
5. Illustrate the mass transfer principle in materials processing

TOTAL: 45 PERIODS
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ML3021 MATERIALS SELECTION AND DESIGN

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Having an overview of criteria, use of property chart and economics of materials selection.
2. Gaining knowledge about the manufacturing system, process selection and DFM.
3. Getting an insight to the manufacturing considerations in design.
4. Understanding the influence of the nature of load and material properties in design
5. Acquiring knowledge on the framework in materials design for various kinds of failures.

UNIT – I MATERIAL SELECTION IN DESIGN
Introduction, relation of materials selection to design, general criteria for selection, performance characteristics of materials, materials selection process, design process and materials selection, Types of design, material property chart, material performance indices, materials selection procedure, Structural index, economics of materials, recycling and materials selection

UNIT – II MATERIALS PROCESSING AND DESIGN
Role of Processing in Designing, classification of manufacturing processes, types of manufacturing systems, influence of material on process selection. Design for manufacturability, DFM guidelines, Design for assembly, DFA guidelines, computer methods for DFMA, Design for machining, casting, forging, welding and heat treatment and its DFM guidelines
UNIT – III MANUFACTURING CONSIDERATIONS IN DESIGN 9
Surface finish, texture, Standardization, Interchangeable manufacturing, Selective assembly, selection of materials based on mechanical properties -- Preferred numbers, Limits, fits and tolerances, Types of fits and tolerances. Geometric tolerance, types of form and position tolerances, tolerance and manufacturing methods, selection of fits.

UNIT – IV MATERIALS PROPERTIES AND DESIGN 9
Stress - Strain diagram, design for strength, rigidity, design under static loading, stress due to torsion and bending, variable loading, stress concentration, fluctuating stress, eccentric loading – stress concentration. Design examples with shaft design and spring design.

UNIT – V SAFETY CRITERIA IN DESIGN 9
Design for brittle fracture, plane strain fracture toughness, fatigue failure, Design criteria, fatigue parameters, infinite, safe life and damage tolerance design, fatigue life prediction, corrosion resistance, forms of corrosion, corrosion prevention, Design against wear, types of wear, wear prevention, Designing with plastics, design for stiffness, Time dependent part performance.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Identify suitable procedure for selection of material using material property chart.
2. Recognize the suitable manufacturing process with due considerations of design features of the component.
3. Elucidate the manufacturing considerations in design.
4. Analyse the influence of material properties and the nature of loading on design.
5. Develop a design procedure for safe design against various types of failures.

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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for
1. Acquiring knowledge on green energy technology.
2. Getting knowledge on different sources of renewable energies.
3. Getting introduced nanotechnology in green energy.
4. Obtaining knowledge on different green energy materials.
5. Having an overview about the green management concept and its applications.

UNIT I    GREEN ENERGY AND SUSTAINABLE DEVELOPMENT     9
Global warming; greenhouse gas emissions, impacts, mitigation and adaptation; future energy
Systems- clean/green energy technologies. Criteria for choosing appropriate green energy
Technologies, life cycle cost; the emerging trends – process/product innovation-, technological/
environmental aspects.

UNIT II    RENEWABLE ENERGY RESOURCES                    9
Current energy requirements - Review of conventional energy resources. Solar Energy and its
conversion methods, solar thermal collectors – photovoltaic; Wind energy – Ocean, Wave and Tidal
energy. Smart batteries – Fuel Cells and Types – Materials. Other Sources: Hydropower, Nuclear
fission and fusion-Geothermal energy.

UNIT III   GREEN NANOTECHNOLOGY                         9
Nanoparticles preparation techniques; Greener Nanosynthesis: Greener Synthetic Methods for
Functionalized Metal Nanoparticles, Greener Preparations of Semiconductor and Inorganic Oxide
Nanoparticles, green synthesis of Metal nanoparticles, Nanomaterials for Alternative Energy:
Nanomaterials for Fuel Cells and Hydrogen Generation and storage, Nanostructures for efficient
solar hydrogen production, Metal Nanoclusters in Hydrogen Storage Applications, Metal
Nanoparticles as Electro catalysts in Fuel Cells, Nanowires as Hydrogen Sensors, Nanomaterials in
Energy Storage Devices: MWNT for Li Ion Batteries, Nanomaterials in Electrodes, Hybrid
Nanotubes: Anode Material, Supercapacitor, Battery Electrodes

UNIT IV    PROCESSING OF GREEN ENERGY MATERIALS         9
Silicon processing methods - Fabrication methods: physical and chemical vapour deposition
techniques, photolithography, electroless and electrochemical deposition, etching, mask plating.
Newer Energy Materials: Carbon nano-tubes (CNTs) and multiwall carbon nanotubes (MWCNTs) -
methods of production, properties and its utility in energy devices.

UNIT V     GREEN MANAGEMENT                           9
Concept of green management; evolution; nature, scope, importance and types; developing a
theory; green management in India; relevance in twenty first century.

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Discuss on the green energy technology.
2. Explain the different sources of renewable energies.
3. Elaborate technological and economical aspects of conversion of renewable energies into
   useful forms.
4. Explain the energy sciences, its importance and utility.
5. Elaborate the green management concept and its applications.
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CMF339 UNCONVENTIONAL MACHINING PROCESSES L T P C 3 0 0 3

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

UNIT I INTRODUCTION 9
Need for non-traditional machining methods, classifications of modern machining processes, considerations in process selection, materials application, Ultrasonic machining: Elements of the process, mechanics of metal removal, process parameters, economic considerations, application and limitations, recent developments.

UNIT II ABRASIVE JET MACHINING 9
Abrasive jet machining, water jet machining and abrasive water jet machining: basic principles, equipment’s process variables, mechanics of metal removal, MRR, applications and limitations; Electro chemical processes: Fundamentals of electro chemical machining, electro chemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, tool design, surface finish and accuracy, economic aspect of ECM, simple problem for estimation of metal removal rate

UNIT III THERMAL METAL REMOVAL PROCESSES 9
General principle and applications of Electric discharge machining, electric discharge grinding, electric discharge wire cutting processes, power circuits in EDM, mechanism of metal removal in EDM, process parameters. Selection of tool electrodes and dielectric fluids, surface finish and accuracy.
UNIT IV   ELECTRON BEAM MACHINING  9
Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non thermal processes, general principle and applications of laser beam machining, thermal features, cutting speed and accuracy of cut.

UNIT V   PLASMA MACHINING  9
Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries; Chemical machining principle, maskants, etchants, applications.

TOTAL : 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

ML3023   LASER PROCESSING OF MATERIALS   L   T   P   C   3   0   0   3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for
1. Obtaining an overview of principle and types of laser
2. Acquiring knowledge about the fundamentals of heat and fluid flow during laser processing.
3. Getting an insight to the metallurgical aspects involved during laser processing.
4. Gaining on the methodology, parameters and imperfections laser welding and surface modification.
5. Getting an exposure to laser instrumentation, parameters and material considerations in laser cutting and drilling process.

UNIT – I   PRINCIPLES OF INDUSTRIAL LASERS  9
UNIT – II  THERMAL PROCESS- HEAT AND FLUID FLOW  
Heat flow in the work piece, Temperature distribution: thick plate with point heat source, thin plate with line heat source, peak temperature ,cooling rates and Gaussian heat source. Fluid flow in molten pool: continuity equation, Navier-Stokes equation and surface tension effects.

UNIT – III  LASER METALLURGY  
Process microstructure- fusion zone, zone of partial melting, HAZ. discontinuities- porosity, cracking, lack of fusion, incomplete penetration and undercut.

UNIT – IV  LASER WELDING AND SURFACE MODIFICATIONS  

UNIT – V  LASER MACHINING  

TOTAL: 45 PERIODS

COURSE OUTCOMES: 
Upon completion of this course, the students will be able to:
1. Identify suitable laser source required during laser processing.
2. Explain the heat and fluid flow during laser processing,
3. Analyze the microstructure and discontinuities in the materials subjected to laser processing.
4. Appraise the appropriate methodology, parameters and remedy for imperfections during laser surface modifications
5. Devise the instrumentation for laser cutting and drilling based on the nature of material.

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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Gaining a comprehensive knowledge on various aspects of Stainless steel making, metallurgy, Properties and its applications.
2. Acquiring knowledge on the classification of stainless steels and their properties.
3. Knowing the importance of use of stainless steels in various fields of technology.
4. Discussing the effect of how the composition and heat treatments affect the characteristics and corrosion behaviour of stainless steels.
5. Having a thorough knowledge on the numerous applications and importance of stainless steels.

UNIT I  HISTORY AND EVOLUTION OF STAINLESS STEEL  9

UNIT II  CLASSIFICATION OF STAINLESS STEELS  9

UNIT III  MELTING AND SECONDARY REFINING OF STAINLESS STEELS  9
Raw Materials selection, Melting Furnaces (EAF, EIF), melt treatment, Continuous casting, secondary refining –AOD, VOD, IOC converters processing, advantages and limitations.

UNIT IV  CORROSION BEHAVIOUR OF STAINLESS STEELS  9
Atmospheric, aqueous, stress corrosion, cracking and Hydrogen Embrittlement, High Temperature corrosion, Corrosion of Cast stainless steels, PREN Index, Corrosion rate estimations- ASTM Practices.

UNIT V  APPLICATIONS OF STAINLESS STEELS  9
Architecture and construction, Automotive and Marine systems, Petroleum, Chemical, Pulpand Paper Industries applications.  TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the Students will be able to:
1. Recall the essential elements responsible for the unique properties of stainless steels and basic metallurgical principles involved.
2. Classify the various types of stainless steels based on the microstructure and the effect of microstructure on the properties of stainless steels.
3. Explain the production methodology of stainless steel making and the influence of the process on the quality of the stainless steel.
4. Interpret the results of corrosion testing and PREN index and understand the influence of the various environmental factors on the corrosion of stainless steels.
5. Identify the suitable stainless steel material for a given application.

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ML3025 FUELS, FURNACES AND REFRACTORIES

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Obtaining knowledge on the different modes of heat transfer.
2. Acquiring knowledge on different types of fuels
3. Getting an insight to the different furnaces.
4. Familiarizing with the different refractories
5. Knowing the environmental aspects while handling furnaces.

UNIT I FUNDAMENTALS

UNIT II FUELS

UNIT III FURNACES
Firing, electric Resistance, Radiation, Induction. Temperature control - PID. Multi zone furnaces. Batch and tunnel furnaces.

UNIT IV REFRACTORIES
Heat resistant materials in steel making and non-ferrous production plants. Applications in the power, energy conversion, petroleum and chemical industries.

UNIT V ADVANCED ISSUES
Energy and Environment, Environmental optimization, recycling of thermal energy. Emissions control.

COURSE OUTCOMES
Upon Completion of the course, the students will be able to
1. Distinguish the fundamental aspects of heat transfer in furnaces.
2. Select different fuels for energy generation system.
3. Illustrate the different furnaces and its temperature control
4. Outline the use of Refractories in furnace and its application
5. Identify the environmental issues in using furnaces.
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CAS331 HIGH TEMPERATURE MATERIALS

OBJECTIVES
- To learn the concepts of damage mechanism.
- To acquire knowledge in of components at elevated temperatures
- To understand the concept of creep
- To design material for creep resistance
- To introduce to the theory of super alloys and other advanced materials

UNIT I CREEP
Factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperatures and strain rate.

UNIT II DESIGN FOR CREEP RESISTANCE
Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.

UNIT III FRACTURE
Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture due to micro void coalescence – diffusion controlled void growth; fracture maps for different alloys and oxides.

UNIT IV OXIDATION AND HOT CORROSION
Oxidation, Pilling, Bedworth ratio, kinetic laws of oxidation – defect structure and control of Oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of combat hot corrosion.

UNIT V SUPER ALLOYS AND OTHER MATERIALS
Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Intermetallics, high temperature ceramics.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
- Apply the concepts of damage mechanism.
- Describe the knowledge of components at elevated temperatures
- Explain the concept of creep
- Design materials to able to have creep resistance
- Explain the theory of super alloys and other advanced materials

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GE3751 PRINCIPLES OF MANAGEMENT

COURSE OBJECTIVES:
1. Sketch the Evolution of Management.
2. Extract the functions and principles of management.
3. Learn the application of the principles in an organization.
4. Study the various HR related activities.
5. Analyze the position of self and company goals towards business.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS
UNIT II     PLANNING  9

UNIT III    ORGANISING  9

UNIT IV     DIRECTING  9

UNIT V      CONTROLLING  9
System and process of controlling – Budgetary and non-Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

TOTAL : 45 PERIODS

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

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COURSE OBJECTIVES:
- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Describe Taguchi’s Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

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

UNIT II TQM PRINCIPLES

UNIT III TQM TOOLS & TECHNIQUES I

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

UNIT V QUALITY MANAGEMENT SYSTEM

TOTAL: 45 PERIODS

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

GE3753 ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING

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

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

UNIT II PRODUCTION AND COST ANALYSIS

UNIT III PRICING
Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice.
UNIT IV  FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT)  
Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.

UNIT V  CAPITAL BUDGETING (ELEMENTARY TREATMENT)  
Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.  
TOTAL: 45 PERIODS

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

TEXT BOOKS:

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

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GE3754  HUMAN RESOURCE MANAGEMENT  
OBJECTIVE:
- To provide knowledge about management issues related to staffing,
- To provide knowledge about management issues related to training,
- To provide knowledge about management issues related to performance
- To provide knowledge about management issues related to compensation
- To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.
UNIT I  INTRODUCTION TO HUMAN RESOURCE MANAGEMENT  

UNIT II  HUMAN RESOURCE PLANNING  

UNIT III  TRAINING AND EXECUTIVE DEVELOPMENT  
Types of training and Executive development methods – purpose – benefits.

UNIT IV  EMPLOYEE COMPENSATION  

UNIT V  PERFORMANCE EVALUATION AND CONTROL  

TOTAL: 45 PERIODS

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

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GE3755 KNOWLEDGE MANAGEMENT L T P C 3 0 0 3

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

UNIT I INTRODUCTION
Introduction: An Introduction to Knowledge Management - The foundations of knowledge management including cultural issues - technology applications organizational concepts and processes - management aspects - and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management.

UNIT II CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING

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

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

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

COURSE OUTCOMES:
Upon completion of the course, the student should be able to:
- CO1: Understand the process of acquire knowledge from experts
- CO2: Understand the learning organization.
- CO3: Use the knowledge management tools.
- CO4: Develop knowledge management Applications.
- CO5: Design and develop enterprise applications.

CO’s- PO’s & PSO’s MAPPING

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TOTAL: 45 PERIODS
TEXT BOOK:

REFERENCE:

GE3792 INDUSTRIAL MANAGEMENT L T P C
3 0 0 3

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

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

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

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

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

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

TOTAL : 45 PERIODS
COURSE OUTCOMES:
At the end of the course the students would be able to
CO1 Explain basic concepts of management; approaches to management; contributors to
management studies; various forms of business organization and trade unions function
in professional organizations.
CO2 Discuss the planning; organizing and staffing functions of management in professional
organization.
CO3 Apply the leading; controlling and decision making functions of management in professional
organization.
CO4 Discuss the organizational theory in professional organization.
CO5 Apply principles of productivity and modern concepts in management in professional
organization.

TEXT BOOKS:
Delhi, 2009.

REFERENCES:
2009.

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MANDATORY COURSES I

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

COURSE OUTLINE

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

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

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

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

UNIT V GENDER AND REPRESENTATION
Advertising and popular visual media.

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

TOTAL : 45 PERIODS

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

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

1. COURSE CONTENTS
Introduction to Elements of Literature

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

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

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

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

3. READINGS:

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

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

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

TOTAL: 45 PERIODS

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

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
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - - , Inter relations between Disasters and Sustainable development Goals
UNIT II  DISASTER RISK REDUCTION (DRR)  9
Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

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

UNIT IV  TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT  9

UNIT V  DISASTER MANAGEMENT: CASE STUDIES  9
Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill - TOTAL : 45 PERIODS

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

REFERENCES

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

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MANDATORY COURSES II

MX3085 WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA, SIDDHA 3 0 0 0

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

UNIT I HEALTH AND ITS IMPORTANCE 2+4

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


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

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

UNIT II DIET 4+6

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

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

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

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

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 4+4
AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.

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

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

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

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


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

UNIT V YOGA 2+12
Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL : 45 PERIODS

TEXT BOOKS:
1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners _ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California
REFERENCES:
1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts
   The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001
   1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
   2. Simple lifestyle modifications to maintain health
      https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20ook.
   3. Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html
   7. BMI https://www.hsp.harvard.edu/nutritionsource/healthy-weight/
      https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations
   8. Yoga https://www.healthifyme.com/blog/types-of-yoga/
      https://yogamedicine.com/guide-types-yoga-styles/
      Ayurveda: https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda
   10. CAM https://www.hindawi.com/journals/ecam/2013/376327/
   11. Preventive herbs: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/

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

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 verses evidence, concept of historical inevitability, Historical Positivism.
Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

UNIT- II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA
Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.
UNIT- III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA
Technology in pre-historic period
Beginning of agriculture and its impact on technology
Science and Technology during Vedic and Later Vedic times
Science and technology from 1st century AD to C-1200.

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

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

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

TOTAL : 45 PERIODS

MX3087 POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY

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

OBJECTIVES:
- This course will begin with a short overview of human needs and desires and how different political-economic systems try to fulfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.

COURSE TOPICS:
Considerations for humane society, holistic thought, human being’s desires, harmony in self, harmony in relationships, society, and nature, societal systems. (9 lectures, 1 hour each)

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

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. (5 lectures)
(Refs: Adam smith, J S Mill)

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

Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.
(Ref: Marx, Lenin, Mao, M N Roy) (5 lectures)

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

(Refs: M K Gandhi, Schumacher, Kumarappa)

Essential elements of Indian civilization. (3 lectures)

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

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

Conclusion (2 lectures)

Total lectures: 39

Preferred Textbooks: See Reference Books

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

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OUTCOME:

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

MX3088 STATE, NATION BUILDING AND POLITICS IN INDIA

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

TOPICS:
Understanding the need and role of State and politics.

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

Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government-unitary-federal, Presidential-Parliamentary,
The idea of India.
1857 and the national awakening.

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

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

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

SUGGESTED READING:

TOTAL : 45 PERIODS

MX3089 INDUSTRIAL SAFETY

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
occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998-
Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT III  SAFETY ACTIVITIES
Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety
Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action
Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

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

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

Course outcomes on completion of this course the student will be able:
- Understand the basic concept of safety.
- Obtain knowledge of Statutory Regulations and standards.
- Know about the safety Activities of the Working Place.
- Analyze on the impact of Occupational Exposures and their Remedies
- Obtain knowledge of Risk Assessment Techniques.

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

REFERENCES
5. Society of Safety Engineers, USA

ONLINE RESOURCES
ISO 45001:2018 occupational health and safety (OH&S) International Organization for
Standardization https://www.iso.org/standard/63787.html
Indian Standard code of practice on occupational safety and health audit
Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006
https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf
OPEN ELECTIVE I AND II

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

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

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH


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

UNIT IV  SUPERVISED LEARNING  6

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

TOTAL : 30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

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

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

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

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

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

TOTAL: 60 PERIODS

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

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

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

UNIT I INTRODUCTION TO INTERNET OF THINGS 5

UNIT II COMPONENTS IN INTERNET OF THINGS 5
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 6

UNIT IV OPEN PLATFORMS AND PROGRAMMING 7

UNIT V IOT APPLICATIONS 7
Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture

PRACTICAL EXERCISES: 30 PERIODS
1. Introduction to Arduino platform and programming
2. Interfacing Arduino to Zigbee module
3. Interfacing Arduino to GSM module
4. Interfacing Arduino to Bluetooth Module
5. Introduction to Raspberry PI platform and python programming
6. Interfacing sensors to Raspberry PI
7. Communicate between Arduino and Raspberry PI using any wireless medium
8. Setup a cloud platform to log the data
9. Log Data using Raspberry PI and upload to the cloud platform
10. Design an IOT based system
OUTCOMES:
CO 1: Explain the concept of IoT.
CO 2: Understand the communication models and various protocols for IoT.
CO 3: Design portable IoT using Arduino/Raspberry Pi/open platform
CO 4: Apply data analytics and use cloud offerings related to IoT.
CO 5: Analyze applications of IoT in real time scenario.

TOTAL: 60 PERIODS

TEXTBOOKS

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

OC353 DATA SCIENCE FUNDAMENTALS

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.

30 PERIODS

PRACTICAL EXERCISES:

LAB EXERCISES
1. Download, install and explore the features of Python for data analytics.
2. Working with Numpy arrays
3. Working with Pandas data frames
4. Basic plots using Matplotlib
5. Statistical and Probability measures
   a) Frequency distributions
   b) Mean, Mode, Standard Deviation
   c) Variability
   d) Normal curves
   e) Correlation and scatter plots
   f) Correlation coefficient
   g) Regression

6. Use the standard benchmark data set for performing the following:
   a) Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
   b) Bivariate Analysis: Linear and logistic regression modelling.
7. Apply supervised learning algorithms and unsupervised learning algorithms on any data set.
8. Apply and explore various plotting functions on any data set.

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

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

TOTAL: 60 PERIODS

TEXT BOOKS

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

UNIT I            INTRODUCTION

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 tracklers and sensors incorporating full haptic interactivity.
8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
10. Develop simple MR enabled gaming applications.

TOTAL:60 PERIODS
OUTCOMES:
On completion of the course, the students will be able to:
CO1: Understand the basic concepts of AR and VR
CO2: Understand the tools and technologies related to AR/VR
CO3: Know the working principle of AR/VR related Sensor devices
CO4: Design of various models using modeling techniques
CO5: Develop AR/VR applications in different domains

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

OPEN ELECTIVE III

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

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

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

UNIT I

UNIT II

UNIT III
UNIT IV

UNIT V

TOTAL: 45 PERIODS

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

CO-PO & PSO MAPPING

| CO | PO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO | 1 | 2 | 3 |
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| Avg.|    | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 3 | 2.4 | 3 | - | - | - |

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

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

Teaching Methods:
Instructional methods will involve discussions, taking mock tests on various question papers – Objective, multiple-choice and descriptive. Peer evaluation, self-check on improvement and peer feedback - Practice sessions on speaking assessments, interview and discussion – Using multimedia.

Evaluative Pattern:
Internal Tests – 50%
End Semester Exam - 50%

TEXTBOOKS:
REFERENCES:

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

OMG352 NGOS AND SUSTAINABLE DEVELOPMENT L T P C
3 0 0 3

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

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

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

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

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

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

REFERENCES:
4. Saima Saeed: Screening the Public Sphere: Media and Democracy in India,2013
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  9
Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status - Potential of various renewable energy sources - Global energy status - Per capita energy consumption - Future energy plans.

UNIT – II  SOLAR ENERGY  9

UNIT – III  WIND ENERGY  9

UNIT – IV  BIO-ENERGY  9

UNIT – V  OCEAN AND GEOTHERMAL ENERGY  9

TOTAL: 45 PERIODS

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

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

OME354 APPLIED DESIGN THINKING

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

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

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

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

UNIT IV CONCEPT GENERATION
Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts
UNIT V SYSTEM THINKING
System Thinking, Understanding Systems, Examples and Understandings, Complex Systems

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

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

TEXT BOOKS
1. Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
3. Proposition Design: How to Create Products and Services Customers Want, Wiley

REFERENCES
1. https://www.ideou.com/pages/design-thinking#process
4. https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e
6. https://blog.forgeforward.in/star-tup-failure-is-like-true-lie-7812cdfe9b85

MF3003 REVERSE ENGINEERING LT P C 3 0 0 3

COURSE OBJECTIVES:

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

UNIT I INTRODUCTION & GEOMETRIC FORM 9 Hours
UNIT II  MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION  9 Hours

UNIT III  DATA PROCESSING  9 Hours

UNIT IV  3D SCANNING AND MODELLING  9 Hours

UNIT V  INDUSTRIAL APPLICATIONS  9 Hours

TOTAL : 45 PERIODS

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

- Apply the fundamental concepts and principles of reverse engineering in product design and development.
- Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
- Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.
- Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
- Analyze the various legal aspect.
- Applications of reverse engineering in product design and development.

TEXT BOOKS:

REFERENCES:
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

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

**REFERENCES:**

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1 – Slight, 2 – Moderate, 3 – Substantial

**AU3791 ELECTRIC AND HYBRID VEHICLES**

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

**UNIT I DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES**

**UNIT II ENERGY SOURCES**

**UNIT III MOTORS AND DRIVES**
Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.
UNIT IV  POWER CONVERTERS AND CONTROLLERS  9
Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC -
Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM
motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes

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

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

TEXT BOOKS:

REFERENCES:
Sons,2003

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OAS352  SPACE ENGINEERING  L T P C
3 0 0 3

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

UNIT I  STANDARD ATMOSPHERE  6
History of aviation – standard atmosphere - pressure, temperature and density altitude.
UNIT II AERODYNAMICS 10
Aerodynamic forces – Lift generation Viscosity and its implications - Shear stress in a velocity profile - Lagrangian and Eulerian flow field - Concept of a streamline – Aircraft terminology and geometry - Aircraft types - Lift and drag coefficients using NACA data.

UNIT III PERFORMANCE AND PROPULSION 9
Viscous and pressure drag - flow separation - aerodynamic drag - thrust calculations -thrust/power available and thrust/power required.

UNIT IV AIRCRAFT STABILITY AND STRUCTURAL THEORY 10

UNIT V SPACE APPLICATIONS 10
History of space research - spacecraft trajectories and basic orbital manoeuvres - six orbital elements - Kepler’s laws of orbits - Newton’s law of gravitation.

TOTAL: 45 PERIODS

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 L T P C
3 0 0 3

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

UNIT I INTRODUCTION 9
UNIT II  FUNCTIONS OF MANAGEMENT

UNIT III  ORGANIZATIONAL BEHAVIOUR

UNIT IV  GROUPDYNAMICS

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

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

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COURSE OBJECTIVES

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

UNIT I INTRODUCTION


UNIT II CONTROL CHARTS

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

UNIT III SPECIAL CONTROL PROCEDURES

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

UNIT IV STATISTICAL PROCESS CONTROL

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

UNIT V ACCEPTANCE SAMPLING

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able to:

CO1: Control the quality of processes using control charts for variables in manufacturing industries.

CO2: Control the occurrence of defective product and the defects in manufacturing companies.

CO3: Control the occurrence of defects in services.

CO4: Analyzing and understanding the process capability study.

CO5: Developing the acceptance sampling procedures for incoming raw material.

CO’s- PO’s & PSO’s MAPPING

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PSO’s: 1, 2, 3
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.

TOTAL : 45 PERIODS
TEXT BOOKS

REFERENCES:

CO’$ PO’s & PSO’s MAPPING

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OML351 INTRODUCTION TO NON-DESTRUCTIVE TESTING

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

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

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

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

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OMR351 MECHATRONICS L T P C
3 0 0 3

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

UNIT – I INTRODUCTION AND SENSORS

UNIT – II 8085 MICROPROCESSOR

UNIT – III PROGRAMMABLE PERIPHERAL INTERFACE

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

UNIT – V ACTUATORS AND MECHATRONICS SYSTEM DESIGN

TOTAL: 45 PERIODS

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

## REFERENCES:

## 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
9

### UNIT – II  ROBOT KINEMATICS
9
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.

Mapping of COs with POs and PSOs

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TEXT BOOKS:
REFERENCES:

OAE352 FUNDAMENTALS OF AERONAUTICAL ENGINEERING L T P C
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OBJECTIVES:
- To acquire the knowledge on the Historical evaluation of Airplanes
- To learn the different component systems and functions
- To know the concepts of basic properties and principles behind the flight
- To learn the basics of different structures & construction
- To learn the various types of power plants used in aircrafts

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

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

UNIT III BASICS OF AERODYNAMICS 9

UNIT IV BASICS OF AIRCRAFT STRUCTURES 9

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

TOTAL : 45 PERIODS

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

REFERENCE

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

UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION

UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL

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

UNIT IV SENSING TECHNIQUES

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

TOTAL:45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to
CO 1 Understand the concepts and laws related to remote sensing
CO 2 Understand the interaction of electromagnetic radiation with atmosphere and earth material
CO 3 Acquire knowledge about satellite orbits and different types of satellites
CO 4 Understand the different types of remote sensors
CO 5 Gain knowledge about the concepts of interpretation of satellite imagery

TEXTBOOKS:

REFERENCES:

CO-PO MAPPING

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<td>Design solutions</td>
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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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<tr>
<th>PO/PSO</th>
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<th>CO2</th>
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<th>CO4</th>
<th>CO5</th>
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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

TOTAL: 45 PERIODS
OUTCOMES
CO1: An understanding of water quality criteria and standards, and their relation to public health
CO2: The ability to design the water conveyance system
CO3: The knowledge in various unit operations and processes in water treatment
CO4: An ability to understand the various systems for advanced water treatment
CO5: An insight into the structure of drinking water distribution system

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.

OEE352 ELECTRIC VEHICLE TECHNOLOGY  L T P C
                    3 0 0 3

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

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

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

UNIT IV HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS

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

TOTAL: 45 PERIODS

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

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REFERENCES:
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 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 Petruzzula, Programmable Logic Controllers, Tata Mc-Graw Hill Edition
2. John W. Webb, Ronald A. Reis, Programmable Logic Controllers Principles and Applications, PHI publication
REFERENCES:
2. J. R. Hackworth and F. D. Hackworth, Programmable Logic Controllers Principles and Applications, Pearson publication

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

<table>
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OCH351 NANO TECHNOLOGY L T P C 3 0 0 3

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

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

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

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

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

TOTAL : 45 PERIODS

OUTCOMES:

CO1 Understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications.

CO2 Able to acquire knowledge about the different types of nano material synthesis

CO3 Describes about the shape, size, structure of composite nano materials and their interference

CO4 Understand the different characterization techniques for nanomaterials

CO5 Develop a deeper knowledge in the application of nanomaterials in different fields.

TEXT BOOKS


2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications” Imperial College Press, 2004


REFERENCES


COURSE ARTICULATION MATRIX

<table>
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<tr>
<th>Course Outcomes</th>
<th>Statement</th>
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OBJECTIVE:
• The course emphasis on the molecular safe assembly and materials for polymer electronics

UNIT I INTRODUCTION

UNIT II MOLECULAR SELF ASSEMBLY

UNIT III BIO-INSPIRED MATERIALS

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

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

TOTAL: 45 PERIODS

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

TEXT BOOK:

REFERENCE:

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

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

UNIT II TRADITIONAL METHODS OF FOOD PROCESSING 9

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

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

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

COURSE OUTCOMES:
CO1To understand the historical and traditional perspective of foods and food habits
CO2To understand the wide diversity and common features of traditional Indian foods and meal patterns.

TEXT BOOKS:

OFD353 INTRODUCTION TO FOOD PROCESSING L T P C 3 0 0 3
OBJECTIVE:
• The course aims to introduce the students to the area of Food Processing. This is necessary for effective understanding of a detailed study of food processing and technology subjects. This course will enable students to appreciate the importance of food processing with respect to the producer, manufacturer and consumer.

UNIT I PROCESSING OF FOOD AND ITS IMPORTANCE 9
Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.
UNIT II METHODS OF FOOD HANDLING AND STORAGE
Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.

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

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

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

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

TEXT BOOKS/REFERENCES:

OPY352 IPR FOR PHARMA INDUSTRY L T P C 3 0 0 3
COURSE OBJECTIVES:
• To provide the basic fundamental knowledge of different forms of Intellectual Property Rights in national and international level.
• To provide the significance of the Intellectual Property Rights about the patents, copyrights, industrial design, plant and geographical indications.
• This paper is to study significance of the amended patent act on pharma industry.

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

UNIT II  FLAME PROOF & WATERPROOF  9
Concept of Flame proof & flame retardancy, Flame retardant finishes for cotton, Concept of waterproof and water repellent Finishes, Durable & Semi durable and Temporary finishes, Concept of Antimicrobial finish.

UNIT III  SOIL RELEASE AND ANTISTATIC FINISHES  9
Soil Release Finishing: Mechanism of soil retention & soil release. Anti pilling Finishing: chemical and mechanical methods to produce anti pilling, Concept of UV Protection finishes- Concept of antistatic finishes.

UNIT IV  MECHANICAL FINISHES  9

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

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, chronu cycle graph, travel chart
Motion Study: Principle of motion economy, Two handed process chart, micro motion analysis – therbligs, SIMO chart.

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

UNIT V WORK STUDY APPLICATION 9
Application of work study techniques in cutting, stitching and packing in garment industry. Workaids in sewing, Pitch diagram, Line balancing, Capacity planning, scientific method of training.

TOTAL: 45 PERIODS
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

**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

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

UNIT I ORIGIN, FORMATION AND REFINING OF CRUDE OIL 9

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

UNIT III REFORMING AND HYDROTREATING 9

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

UNIT V PRODUCTION OF PETROCHEMICALS 9
Production of Petrochemicals like Dimethyl Terephthalate(DMT), Ethylene Glycol, Synthetic glycerine, Linear Alkyl Benzene (LAB), Acrylonitrile, Methyl Methacrylate (MMA), Vinyl Acetate Monomer, Phthalic Anhydride, Maleic Anhydride, Phenol, Acetone, Methanol, Formaldehyde, Acetaldehyde, Pentaerythritol and production of Carbon Black.

TOTAL: 45 PERIODS

OUTCOMES:
On the completion of the course students are expected to

**CO1**: Understand the classification, composition and testing methods of crude petroleum and its products. Learn the mechanism of refining process.

**CO2**: Understand the insights of primary treatment processes to produce the precursors.

**CO3**: Study the secondary treatment processes cracking, vis-breaking and coking to produce more petroleum products.

**CO4**: Appreciate the need of treatment techniques for the removal of sulphur and other impurities from petroleum products.

**CO5**: Understand the societal impact of petrochemicals and learn their manufacturing processes.

**CO6**: Learn the importance of optimization of process parameters for the high yield of petroleum products.

**TEXT BOOKS**:

**REFERENCES**:

**CPE334 ENERGY CONSERVATION AND MANAGEMENT**  
**OBJECTIVES**:  
At the end of the course, the student is expected to  
- understand and analyse the energy data of industries  
- carryout energy accounting and balancing  
- conduct energy audit and suggest methodologies for energy savings and  
- utilise the available resources in optimal ways

**UNIT I INTRODUCTION**  

**UNIT II ELECTRICAL SYSTEMS**  

**UNIT III THERMAL SYSTEMS**  

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

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

COURSE OBJECTIVES
- Understand the fundamentals of plastics processing, such as the relationships between material structural properties and required processing parameters, and so on
- To gain practical knowledge on the polymer selection and its processing
- Understanding the major plastic material processing techniques (Extrusion, Injection molding, Compression and Transfer molding, Blow molding, Thermoforming and casting)
- To understand suitable additives for plastics compounding
- To Propose troubleshooting mechanisms for defects found in plastics products manufactured by various processing techniques
UNIT I  INTRODUCTION TO PLASTICS PROCESSING  9

UNIT II  EXTRUSION  9

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

UNIT IV  COMPRESSION AND TRANSFER MOLDING  9
Compression moulding – Basic principles of compression and transfer moulding-Meaning of terms- Bulk factor and flow properties, moulding materials, process variables and process cycle, Inter relation between flow properties-Curing time-Mould temperature and Pressure requirements. Preforms and preheating- Techniques of preheating. Machines used-Types of compression mould- positive, semi-positive and flash. Common moulding faults and their correction- Finishing of mouldings. Transfer moulding: working principle, equipment, Press capacity-Integral moulds and auxiliary ram moulds, moulding cycle, moulding tolerances, pot transfer, plunger transfer and screw transfer moulding techniques, advantages over compression moulding

UNIT V  BLOW MOLDING, THERMOFORMING AND CASTING  9

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

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

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

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

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

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 9

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

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 9

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: Determine if a given system is linear/causal/stable
CO2: Determine the frequency components present in a deterministic signal
CO3: Characterize continuous LTI systems in the time domain and frequency domain
CO4: Characterize discrete LTI systems in the time domain and frequency domain
CO5: Compute the output of an LTI system in the time and frequency domains

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OEC352 FUNDAMENTALS OF ELECTRONIC DEVICES AND CIRCUITS L T P C 3 0 0 3

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

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

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

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

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

TOTAL: 45 PERIODS

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

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

UNIT I BASICS OF PRODUCT DEVELOPMENT 9

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

UNIT III DESIGN AND TESTING 9

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

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

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:

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CBM333 ASSISTIVE TECHNOLOGY

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

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

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

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

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

Transcutaneous electrical nerve stimulator, bio-feedback, assistive devices in drug delivery

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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OMA352  
OPERATIONS RESEARCH

OBJECTIVES:
This course will help the students to
- Determine the optimum solution for Linear programming problems.
- Study the Transportation and assignment models and various techniques to solve them.
- Acquire the knowledge of optimality, formulation and computation of integer programming problems.
- Acquire the knowledge of optimality, formulation and computation of dynamic programming problems.
- Determine the optimum solution for non-linear programming problems.
UNIT I  LINEAR PROGRAMMING  

UNIT II  TRANSPORTATION AND ASSIGNMENT PROBLEMS  

UNIT III INTEGER PROGRAMMING  

UNIT IV DYNAMIC PROGRAMMING PROBLEMS  

UNIT V NON-LINEAR PROGRAMMING PROBLEMS  

TOTAL:45 PERIODS

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

TEXT BOOKS: 

REFERENCES: 
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 \hspace{1cm} 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 \hspace{1cm} FINITE FIELDS AND POLYNOMIALS
Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.

UNIT III \hspace{1cm} 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 \hspace{1cm} 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 \hspace{1cm} CLASSICAL THEOREMS AND MUTIPlicative 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
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COURSE OBJECTIVES:
- To test the consistency and solve system of linear equations.
- To find the basis and dimension of vector space.
- To obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
- To find orthonormal basis of inner product space and find least square approximation.
- To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

UNIT I MATRICES AND SYSTEM OF LINEAR EQUATIONS

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

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

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

UNIT V EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION

TOTAL: 45 PERIODS
COURSE OUTCOMES:
After the completion of the course the student will be able to
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.

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

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

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

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

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS

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

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

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

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

UNIT III       AMINO ACIDS AND PROTEIN.          9

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

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

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

OBT354 FUNDAMENTALS OF CELL AND MOLECULAR BIOLOGY L T P C
3 0 0 3

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

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

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


UNIT IV CELL CYCLE

Cell cycle- Cell division by mitosis and meosis, Comparison of meosis and mitosis, regulation of cell cycle, cell lysis, Cytokinesis, Cell signaling, Cell communication, Cell adhesion and Cell junction, cell cycle checkpoints.

UNIT V CENTRAL DOGMA


TOTAL: 45 PERIODS

OUTCOMES:

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

TEXTBOOKS:


REFERENCES:

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

UNIT I

UNIT II

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

UNIT IV

UNIT V

OUTCOMES
By the end of the course, learners will be able to
- Write effective project reports.
- Use statistical tools with confidence.
- Explain the purpose and 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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- Note: The average value of this course to be used for program articulation matrix.

REFERENCES:
OMA355 ADvanced Numerical Methods

UNIT I ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEM


UNIT II INTERPOLATION

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

UNIT III NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS


UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS

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

UNIT V FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS


TOTAL : 45 PERIODS

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 9

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

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

UNIT IV SYSTEM RELIABILITY 9

UNIT V MAINTAINABILITY AND AVAILABILITY 9
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 analyze reliability of the systems for various probability distributions.

TEXT BOOKS

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OMG354 PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS L T P C
3 0 0 3

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

UNIT I INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT 9
Functions of Production Management - Relationship between production and other functions – Production management and operations management, Characteristics of modern production and operation management, organisation of production function, recent trends in production /operations management - production as an organisational function, decision making in production Operations research

UNIT II PRODUCTION & OPERATION SYSTEMS 9
Production Systems- principles – Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning- Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry
UNIT III PRODUCTION & OPERATIONS PLANNING
Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis - Production Process Planning: Characteristic of production process systems – Steps for production process - Production Planning Control Functions – Planning phase - Action phase - Control phase - Aggregate production planning

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS

UNIT V CONTROLLING PRODUCTION & OPERATIONS MANAGEMENT

TOTAL 45 : PERIODS

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

REFERENCES

OCE354 BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT L T P C
3 0 0 3

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

UNIT I OVERVIEW OF IWRM

UNIT II WATER USE SECTORS: IMPACTS AND SOLUTION
Water users: People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management.
UNIT III  WATER ECONOMICS
Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management - PPP experiences through case studies.

UNIT IV  RECENT TRENDS IN WATER MANAGEMENT
River basin management - Ecosystem Regeneration – 5 Rs - WASH - Sustainable livelihood - Water management in the context of climate change.

UNIT V  IMPLEMENTATION OF IWRM
Barriers to implementing IWRM - Policy and legal framework - Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.

OUTCOMES
On completion of the course, the student will be able to apply appropriate management techniques towards managing the water resources.

CO1  Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.

CO2  Discuss on the different water uses; how it is impacted and ways to tackle these impacts.

CO3  Explain the economic aspects of water and choose the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.

CO4  Illustrate the recent trends in water management.

CO5  Understand the implementation hitches and the institutional frameworks.

TEXT BOOKS

REFERENCES
2. IWRM Guidelines at River Basin Level (UNESCO, 2008).

OMG355  MULTIVARIATE DATA ANALYSIS

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  9
Conceptualization of research model with variables, collection of data — Approaches for dealing with missing data — Testing the assumptions of multivariate analysis.

UNIT III  MULTIPLE LINEAR REGRESSION ANALYSIS, FACTOR ANALYSIS  9
Multiple Linear Regression Analysis – Inferences from the estimated regression function – Validation of the model. - Approaches to factor analysis – interpretation of results.

UNIT IV  LATENT VARIABLE TECHNIQUES  9
Confirmatory Factor Analysis, Structural equation modelling, Mediation models, Moderation models, Longitudinal studies.

UNIT V  ADVANCED MULTIVARIATE TECHNIQUES  9
Multiple Discriminant Analysis, Logistic Regression, Cluster Analysis, Conjoint Analysis, multidimensional scaling.

TOTAL: 45 PERIODS

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

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

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

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

UNIT III  CORE CONCEPTS IN LEAN

UNIT IV  LEAN TOOLS AND TECHNIQUES

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

TOTAL: 45 PERIODS

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

UNIT I INTRODUCTION

UNIT II VAT POLYMERIZATION AND MATERIAL EXTRUSION

UNIT III POWDER BED FUSION AND BINDER JETTING

UNIT IV MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION

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

TOTAL: 45 PERIODS

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

REFERENCES:

OME356 NEW PRODUCT DEVELOPMENT

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

UNIT – I FUNDAMENTALS OF NPD

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

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

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

TOTAL :45 PERIODS

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

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

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

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OBJECTIVES:
The course aims to
  ● Outline Fundamental concepts in UI & UX
  ● Introduce the principles of Design and Building an mobile app
  ● Illustrate the use of CAD in product design
  ● Outline the choice and use of prototyping tools
  ● Understanding design of electronic circuits and fabrication of electronic devices

UNIT I  UI/UX  9

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

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

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

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

TOTAL: 45 PERIODS

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

REFERENCES:

OMF354 COST MANAGEMENT OF ENGINEERING PROJECTS

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

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

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

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

UNIT – IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL

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

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

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

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

UNIT III BATTERY MODELLING
UNIT IV  BATTERY STATE ESTIMATION

UNIT V  BMS ARCHITECTURE AND REAL TIME COMPONENTS
Battery Management System- need, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex Ray-CANedge1 package.ARBIN Battery Tester. BMS Development with Modeling software and Model-Based Design.

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Acquire knowledge of different Li-ion Batteries performance.
2. Design a Battery Pack and make related calculations.
3. Demonstrate a Battery Model or Simulation.
5. Approach different BMS architectures during real world usage.

TEXT BOOKS

REFERENCE BOOKS
1. Developing Battery Management Systems with Simulink and Model-Based Design-whitepaper
2. Panasonic NCR18650B DataSheet
3. bq76PL536A-Q1-IC DataSheet
4. CC2662R-Q1-IC DataSheet

UNIT I  INTRODUCTION TO MEASUREMENTS AND SENSORS

UNIT II  VARIABLE RESISTANCE AND INDUCTANCE SENSORS
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT

UNIT III  VARIABLE AND OTHER SPECIAL SENSORS
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.
UNIT IV AUTOMOTIVE ACTUATORS

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

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

TEXT BOOKS:

REFERENCES:

OAS353 SPACE VEHICLES

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.

TOTAL: 45 PERIODS

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

- Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.
- Apply knowledge in selecting the appropriate rocket propulsion systems.
- Interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.
- Analyze aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.
- Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.

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

UNIT III HUMAN RESOURCES MANAGEMENT

Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Wage and Salary Administration, Promotion, Transfer, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating – Capability Maturity Model (CMM) Levels.

UNIT IV PROJECT MANAGEMENT

Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

UNIT V STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES


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

CO1: Plan an organizational structure for a given context in the organization to carryout production operations through Work-study.

CO2: Survey the markets, customers and competition better and price the given products appropriately.

CO3: Ensure quality for a given product or service.

CO4: Plan, schedule and control projects through PERT and CPM.

CO5: Evaluate strategy for a business or service organisation.

TOTAL: 45 PERIODS

TEXTBOOKS:

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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COURSE OBJECTIVES:
- To understand the concept of production planning and control act work study,
- To apply the concept of product planning,
- To analyze the production scheduling,
- To apply the Inventory Control concepts.
- To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I  INTRODUCTION
Objectives and benefits of planning and control-Functions of production control-Types of production job- batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration-Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT II  WORK STUDY
Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III  PRODUCT PLANNING AND PROCESS PLANNING
Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

UNIT IV PRODUCTION SCHEDULING

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC
Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course,
CO1:The students can able to prepare production planning and control act work study,
CO2:The students can able to prepare product planning,
CO3:The students can able to prepare production scheduling,
CO4:The students can able to prepare Inventory Control.
CO5:They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

TEXT BOOKS:
REFERENCES
7. Samson Eilon, “Elements of Production Planning and Control”, Universal Book Corp.n.1984

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OIE353 OPERATIONS MANAGEMENT

COURSE OBJECTIVE:
- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm’s competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
- Relate the interdependence of the operations function with the other key functional areas of a firm.
- Teach analytical skills and problem-solving tools to the analysis of the operations problems.
- Apply scheduling and Lean Concepts for improving System Performance.

UNIT I INTRODUCTION TO OPERATIONS MANAGEMENT
Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy - Strategic fit, framework; Supply Chain Management

UNIT II FORECASTING, CAPACITY AND FACILITY DESIGN
UNIT III DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS

UNIT IV MATERIALS MANAGEMENT

UNIT V SCHEDULING AND PROJECT MANAGEMENT
Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson’s Algorithm – Gantt charts; personnel scheduling in services.

COURSE OUTCOMES:
CO1: The students will appreciate the role of Production and Operations management in enabling and enhancing a firm’s competitive advantages in the dynamic business environment.
CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.
CO3: The students will be able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.
CO4: The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.
CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance.

CO’s- PO’s & PSO’s MAPPING

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TEXT BOOKS

REFERENCES
COURSE OBJECTIVES:
1. Demonstrate an understanding of how occupational hygiene standards are set and used in work health and safety.
2. Compare and contrast the roles of environmental and biological monitoring in work health and safety.
3. Outline strategies for identifying, assessing and controlling risks associated with airborne gases, vapours and particulates.
4. Discuss how personal protective equipment can be used to reduce risks associated with workplace exposures.
5. Provide high-level advice on managing and controlling noise and noise-related hazards.

UNIT I INTRODUCTION AND SCOPE

UNIT II MONITORING FOR SAFETY, HEALTH & ENVIRONMENT
Occupational Health and Environmental Safety Management System, ILO and EPA Standards. Industrial Hygiene: Definition of Industrial Hygiene, Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.

UNIT III OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION

UNIT IV OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT

UNIT V INDUSTRIAL HAZARDS

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Students able to
CO1: Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems
CO2: Specify designs that avoid occupation related injuries
CO3: Define and apply the principles of work design, motion economy, and work environment design.
CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.
CO5: Acknowledge the impact of workplace design and environment on productivity

TEXT BOOKS:

REFERENCES:
2. Frank P Lees - Loss of prevention in Process Industries, Vol. 1 and 2,

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OSF353 CHEMICAL PROCESS SAFETY L T P C 3 0 0 3

COURSE OBJECTIVES
- Teach the principles of safety applicable to the design, and operation of chemical process plants.
- Ensure that potential hazards are identified and mitigation measures are in place to prevent unwanted release of energy.
- Learn about the hazardous chemicals into locations that could expose employees and others to serious harm.
- Focuses on preventing incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals.
- Ensure that the general design of the plant is capable of complying with the dose limits in force and with the radioactive releases.
UNIT I  SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES  
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:
OML352  ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS  \( \text{L T P C} \)
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**COURSE OBJECTIVES:**
The main learning objective of this course is to prepare the students for:
- Understanding the importance of various materials used in electrical, electronics and magnetic applications
- Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
- Gaining knowledge on the selection of suitable materials for the given application
- Knowing the fundamental concepts in Semiconducting materials
- Getting equipped with the materials used in optical and optoelectronic applications.

**UNIT I  DIELECTRIC MATERIALS**
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

**UNIT II  MAGNETIC MATERIALS**
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriiction, 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
- Understand various types of dielectric materials, their properties in various conditions.
- Evaluate magnetic materials and their behavior.
- Evaluate semiconductor materials and technologies.
- Select suitable materials for electrical engineering applications.
- Identify right material for optical and optoelectronic applications

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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 knowledge on fluid power principles and working of hydraulic pumps
2. To obtain the knowledge in hydraulic actuators and control components
3. To understand the basics in hydraulic circuits and systems
4. To obtain the knowledge in pneumatic and electro pneumatic systems
5. To apply the concepts to solve the trouble shooting

UNIT I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS 9

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

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

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1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS

REFERENCES

OMR353      SENSORS

L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics.
2. To understand basic working principle, construction, Application and characteristics of displacement, speed and ranging sensors.
3. To understand and analyze the working principle, construction, application and characteristics of force, magnetic and heading sensors.
4. To learn and analyze the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors.
5. To familiarize students with different signal conditioning circuits design and data acquisition system.

UNIT I SENSORS

UNIT II DISPLACEMENT, PROXIMITY AND RANGING SENSORS
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.

Mapping of COs with POs and PSOs

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<tr>
<th>COs/POs &amp; PSOs</th>
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TEXT BOOKS

REFERENCES:
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  9

UNIT – IV  LOCALIZATION  9

UNIT – V  PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS  9

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Evaluate the appropriate mobile robots for the desired application.
CO2: Create the kinematics for given wheeled and legged robot.
CO3: Analyse the sensors for the intelligence of mobile robotics.
CO4: Create the localization strategies and mapping technique for mobile robot.
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.

TEXT BOOKS

REFERENCES:
COOOURSE OBJECTIVES:

1. To impart knowledge on basics of propulsion system and ship dynamic movements
2. To educate them on basic layout and propulsion equipment’s
3. To impart basic knowledge on performance of the ship
4. To impart basic knowledge on Ship propeller and its types
5. To impart knowledge on ship rudder and its types

UNIT I    BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS  9
law of floatation - Basics principle of propulsion- Earlier methods of propulsion- ship propulsion machinery- boiler, Marine steam engine, diesel engine, ship power transmission system, ship dynamic structure, Marine propulsion equipment - shaft tunnel, Intermediate shaft and bearing, stern tube, stern tube sealing etc. degree of freedom, Modern propelling methods- water jet propulsion, screw propulsion.

UNIT II    SHIPS MOVEMENTS AND SHIP STABILIZATION  9
Thrust augmented devices, Ship hull, modern ship propulsion design, bow thruster – Advantages, various methods to stabilize the ship- passive and active stabilizer, fin stabilizer, bilge keel - stabilizing and securing ship in port- effect of tides on ship – effect of river water and sea water sailing vessel, Load line and load line of marking- draught markings.

UNIT III SHIPS SPEED AND ITS PERFORMANCE  9
Ship propulsion factors, factors affecting ships speed, various velocities of ship, hull drag, effects of fouling on ships hull, ship wake, relation between powers, Fuel consumption of ship, cavitations - effects of cavitation’s, ship turning radius.

UNIT IV BASICS OF PROPELLER  9

UNIT V BASICS OF RUDDER  9
Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings- Rudder pintle - Rudder types- Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits of various types of rudders, Propeller and rudder interaction, Rudder stopper, movement of rudders, Basic construction of Rudder

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
CO1: Explain the basics of propulsion system and ship dynamic movements
CO2: Familiarize with various components assisting ship stabilization.
CO3: Demonstrate the performance of the ship.
CO4: Classify the Propeller and its types, Materials etc.
CO5: Categories the Rudder and its types, design criteria of rudder.

TEXT BOOKS:
1. GP. Ghose, "Basic Ship propulsion",2015
REFERENCES BOOKS:

MAPPING OF COS AND POS:

<table>
<thead>
<tr>
<th>CO</th>
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OMV351 MARINE MERCHANT VESSELS

OBJECTIVES:
At the end of the course, students are expected to acquire
1. Knowledge on basics of Hydrostatics
2. Familiarization on types of merchant ships
3. Knowledge on Shipbuilding Materials
4. Knowledge on marine propeller and rudder
5. Awareness on governing bodies in shipping industry

UNIT I INTRODUCTION TO HYDROSTATICS

UNIT II TYPES OF SHIP
General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers- Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gas carriers - Chemical tankers - Passenger ships

UNIT III SHIPBUILDING MATERIALS
Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys, Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced Composites

UNIT IV MARINE PROPELLER AND RUDDER
Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its effects on propeller

UNIT V GOVERNING BODIES FOR SHIPPING INDUSTRY
Role of IMO (International Maritime Organization), SOLAS (International Convention for the Safety of Life at Sea), MARPOL (International Convention for the Prevention of Pollution from Ships ), MLC (Maritime Labour Convention), STCW 2010 (International Convention on Standards of Training, Certification and Watch keeping for Seafarers), Classification societies Administration authorities

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, students would
1. Acquire Knowledge on floatation of ships
2. Acquire Knowledge on features of various ships
3. Acquire Knowledge of Shipbuilding Materials
4. Acquire Knowledge to identify the different types of marine propeller and rudder
5. Understand the Roles and responsibilities of governing bodies
TEXT BOOKS:
2. Dr.DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006

REFERENCES:
2. MARPOL Consolidated Edition, Bhandakar Publications, 2018

OMV352 ELEMENTS OF MARINE ENGINEERING

OBJECTIVES:
At the end of the course, students are expected to
1. Understand the role of Marine machinery systems
2. Be familiar with Marine propulsion machinery system
3. Acquaint with Marine Auxiliary machinery system
4. Have acquired basics of Marine Auxiliary boiler system
5. Be aware of ship propellers and steering system

UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS
Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems

UNIT II MARINE PROPULSION MACHINERY SYSTEM
Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system

UNIT III MARINE AUXILIARY MACHINERY SYSTEM
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications

UNIT IV MARINE BOILER SYSTEM
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories

UNIT V SHIP PROPELLERS AND STEERING MECHANISM
Importance of Propeller and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, students should able to,
1. Distinguish the role of various marine machinery systems
2. Relate the components of marine propulsion machinery system
3. Explain the importance of marine auxiliary machinery system
4. Acquire knowledge of marine boiler system
5. Understand the importance of ship propellers and steering system

TEXT BOOKS:

REFERENCES:
1. Alan L.Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006
2. A.S.Tambwekar, “Naval Architecture and Ship Construction”, The Institute of Marine Engineers (India), Mumbai, 2015

CRA332 DRONE TECHNOLOGIES

<table>
<thead>
<tr>
<th>COURSE OBJECTIVES:</th>
</tr>
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<tbody>
<tr>
<td>1. To understand the basics of drone concepts</td>
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<tr>
<td>2. To learn and understand the fundamentals of design, fabrication and programming of drone</td>
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<td>3. To impart the knowledge of an flying and operation of drone</td>
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<tr>
<td>4. To know about the various applications of drone</td>
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<td>5. To understand the safety risks and guidelines of fly safely</td>
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</table>

UNIT I INTRODUCTION TO DRONE TECHNOLOGY
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

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

UNIT III DRONE FLYING AND OPERATION
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity - Removable storage devices- Linked mobile devices and applications

UNIT IV DRONE COMMERCIAL APPLICATIONS
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

UNIT V FUTURE DRONES AND SAFETY
The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

TOTAL: 45 PERIODS
COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Know about a various type of drone technology, drone fabrication and programming.
CO2: Execute the suitable operating procedures for functioning a drone
CO3: Select appropriate sensors and actuators for Drones
CO4: Develop a drone mechanism for specific applications
CO4: Create the programs for various drones

CO-PO MAPPING:

<table>
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1 – Slight, 2 – Moderate, 3 – Substantial

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
Scanner - Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input –

UNIT IV DATA QUALITY AND STANDARDS
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards – Interoperability - OGC - Spatial Data Infrastructure

UNIT V DATA MANAGEMENT AND OUTPUT
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.

COURSE OUTCOMES:
On completion of the course, the student is expected to
CO1 Have basic idea about the fundamentals of GIS.
CO2 Understand the types of data models.
CO3 Get knowledge about data input and topology
CO4 Gain knowledge on data quality and standards
CO5 Understand data management functions and data output

TEXT BOOKS:

REFERENCES:

CO – PO – PSO MAPPING: GEOGRAPHIC INFORMATION SYSTEM

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| PO1  | Engineering Knowledge                       | 3  3  3  3  3  3 | 3     |
| PO2  | Problem Analysis                            | 3  3  3  3  3  3 | 3     |
| PO3  | Design/Development of Solutions             | 3  3  3  3  3  3 | 3     |
| PO4  | Conduct Investigations of Complex Problems | 3  3  3  3  3  3 | 3     |
| PO5  | Modern Tool Usage                           | 3  3  3  3  3  3 | 3     |
| PO6  | The Engineer and Society                    | 3  3  3  3  3  3 | 3     |
| PO7  | Environment and Sustainability              | 3  3  3  3  3  3 | 3     |
| PO8  | Ethics                                      | 3  3  3  3  3  3 | 3     |
| PO9  | Individual and Team Work                    | 3  3  3  3  3  3 | 3     |
| PO10 | Communication                               | 3  3  3  3  3  3 | 3     |
| PO11 | Project Management and Finance              | 3  3  3  3  3  3 | 3     |
| PO12 | Life-long Learning                          | 3  3  3  3  3  3 | 3     |
| PSO1 | Knowledge of Geoinformatics discipline      | 3  3  3  3  3  3 | 3     |
| PSO2 | Critical analysis of Geoinformatics         | 3  3  3  3  3  3 | 3     |
| PSO3 | Conceptualization and evaluation of Design  | 3  3  3  3  3  3 | 3     |

TOTAL:45 PERIODS
OBJECTIVES

- To introduce the importance of Agri-business management, its characteristics and principles
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.

UNIT I ENTREPRENEURIAL ENVIRONMENT IN INDIAN CONTEXT 9
Entrepreneur Development (ED): Concept of entrepreneur and entrepreneurship assessing overall business environment in Indian economy- Entrepreneurial and managerial characteristics- Entrepreneurship development programmers (EDP)-Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment.

UNIT II AGRIENTREPRENEURSHIP IN GLOBAL ARENA: LEGAL PERSPECTIVE 9
Importance of agribusiness in Indian economy - International trade-WTO agreements- Provisions related to agreements in agricultural and food commodities - Agreements on Agriculture (AOA)-Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS).

UNIT III ENTREPRENEURSHIP MANAGEMENT: FINANCIAL PERSPECTIVE 9

UNIT IV ENTREPRENEURIAL OPPORTUNITIES: ECONOMIC GROWTH PERSPECTIVE 9
Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country- Overview of Indian social, political system and their implications for decision making by individual entrepreneurs- Economic system and its implication for decision making by individual entrepreneurs.

UNIT V ENTREPRENEURIAL PROMOTION MEASURES AND GOVERNMENT SUPPORT 9
Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis-Government schemes and incentives for promotions of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract framing (CF) and Joint Venture (JV), public-private partnerships (PPP) - overview of agricultural engineering industry, characteristics of Indian farm machinery industry.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
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:

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<tr>
<th>PO/PSO</th>
<th>CO1</th>
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<td>PSO3 To inculcate entrepreneurial skills through strong Industry-Institution linkage.</td>
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OBJECTIVE:
The identification of different aspects of biological diversity and conservation techniques.

UNIT I   INTRODUCTION  9
Concept of Species, Variation; Introduction to Major Plant Groups; Evolutionary relationships between Plant Groups; Nomenclature and History of plant taxonomy; Systems of Classification and their Application; Study of Plant Groups; Study of Identification Characters; Study of important families of Angiosperms; Plant Diversity Application.

UNIT II   INTRODUCTION TO ANIMAL DIVERSITY AND TAXONOMY  9
Principles and Rules of Taxonomy; ICZN Rules, Animal Study Techniques; Concepts of Taxon, Categories, Holotype, Paratype, Topotype etc; Classification of Animal kingdom, Invertebrates, Vertebrates, Evolutionary relationships between Animal Groups.

UNIT III   MICROBIAL DIVERSITY  9
Microbes and Earth History, Magnitude, Occurrence and Distribution. Concept of Species, Criteria for Classification, Outline Classification of Microorganisms (Bacteria, Viruses and Protozoa); Criteria for Classification and Identification of Fungi; Chemical and Biochemical Methods of Microbial Diversity Analysis

UNIT IV   MEGA DIVERSITY  9
Biodiversity Hot-spots, Floristic and Faunal Regions in India and World; IUCN Red List; Factors affecting Diversity, Impact of Exotic Species and Human Disturbance on Diversity, Dispersal, Diversity-Stability Relationship; Socio-economic Issues of Biodiversity; Sustainable Utilization of Bioresources; National Movements and International Convention/Treaties on Biodiversity.

UNIT V   CONSERVATIONS OF BIODIVERSITY  9
In-Situ Conservation- National parks, Wildlife sanctuaries, Biosphere reserves; Ex-situ conservation- Gene bank, Cryopreservation, Tissue culture bank; Long term captive breeding, Botanical gardens, Animal Translocation, Zoological Gardens; Concept of Keystone Species, Endangered Species, Threatened Species, Rare Species, Extinct Species

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

OUTCOMES:
Upon successful completion of this course, students will:
CO1: An insight into the structure and function of diversity for ecosystem stability.
CO2: Understand the concept of animal diversity and taxonomy
CO3: Understand socio-economic issues pertaining to biodiversity
CO4: An understanding of biodiversity in community resource management.
CO5: Student can apply fundamental knowledge of biodiversity conservation to solve problems associated with infrastructure development.
CO’s- PO’s & PSO’s MAPPING

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

OEE353 INTRODUCTION TO CONTROL SYSTEMS L T P C
3 0 0 3

OBJECTIVES

- To impart knowledge on various representations of systems.
- To familiarize time response analysis of LTI systems and steady state error.
- To analyze the frequency responses and stability of the systems
- To analyze the stability of linear systems in frequency domain and time domain
- To develop linear models mainly state variable model and transfer function model

UNIT I MATHEMATICAL MODELS OF PHYSICAL SYSTEMS 9
Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction–Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS & ROOTLOCUSTECHNIQUE 9

UNIT III FREQUENCY RESPONSE ANALYSIS 9
Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV STABILITY CONCEPTS & ANALYSIS 9

UNIT V STATE VARIABLE ANALYSIS 9
Concept of state – State Variable & State Model – State models for linear & continuous time systems–Solution of state & output equation–controllability & observability.

TOTAL: 45 PERIODS

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.
TEXT BOOKS:

REFERENCES:
2. Control System Dynamics" by Robert Clark, Cambridge University Press, 1996 USA.

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OEI354 INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS LT P C 3 0 03

COURSE OBJECTIVES:
1. To educate on design of signal conditioning circuits for various applications.
2. To introduce signal transmission techniques and their design.
3. Study of components used in data acquisition systems interface techniques
4. To educate on the components used in distributed control systems
5. To introduce the communication buses used in automation industries.

UNIT I INTRODUCTION

UNIT II AUTOMATION COMPONENTS
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT III COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS
Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.
UNIT V DISTRIBUTED CONTROL SYSTEM

Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Market survey of the recent PLCs and comparison of their features.
2. Summarize the PLC standards
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)

COURSE OUTCOMES:

Students able to

CO1 Design a signal conditioning circuits for various application (L3).
CO2 Acquire a detail knowledge on data acquisition system interface and DCS system (L2).
CO3 Understand the basics and Importance of communication buses in applied automation Engineering (L2).
CO4 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.(L3)
CO5 Able to develop a PLC logic for a specific application on real world problem. (L5)

TEXT BOOKS:


REFERENCES:


List of Open Source Software/ Learning website:

1. https://archive.nptel.ac.in/courses/108/105/108105062/
2. https://nptel.ac.in/courses/108105063

CO’s- PO’s & PSO’s MAPPING

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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  
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT V  ENERGY CONSERVATION  
Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.

OUTCOMES:
On completion of the course, the students will be able to
CO1: Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.
CO2: Students will excel as professionals in the various fields of energy engineering.
CO3: Compare different renewable energy technologies and choose the most appropriate based on local conditions.
CO4: Explain the technological basis for harnessing renewable energy sources.
CO5: Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.

TEXT BOOKS:

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<td>Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.</td>
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<td>Students will excel as professionals in the various fields of energy engineering</td>
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<td>Compare different renewable energy technologies and choose the most appropriate based on local conditions.</td>
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<td>CO4</td>
<td>Explain the technological basis for harnessing renewable energy sources.</td>
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<td>CO5</td>
<td>Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

OBJECTIVE:
- To enable the students to analyze properties of a surfaces and correlate them to structure, chemistry, and physics and surface modification technique.

UNIT I SURFACE STRUCTURE AND EXPERIMENTAL PROBES
Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, absorbate structure, Band and Vibrational structure, Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy

UNIT II ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT SURFACES
Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods

UNIT III LIQUID INTERFACES
Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells

UNIT IV HETEROGENEOUS CATALYSIS
Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, Fisher-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

OUTCOME:
- Upon completion of this course, the students can understand, predict and design surface properties based on surface structure. Students would understand the physics and chemistry behind surface phenomena

TEXT BOOK:

REFERENCE:
OBJECTIVES:
The course aims to
- Acquaint and equip the students with different techniques of measurement of engineering properties.
- Make the students understand the nature of food constituents in the design of processing equipment

UNIT I
Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.

UNIT II
Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foammat dryers

UNIT III
Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger’s, Kick’s and Bond’s equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping)

UNIT IV
Mixing: theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for low or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids.

UNIT V
Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine, Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids, Membrane separation: General considerations, materials for membrane construction, ultra-filtration, microfiltration, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by 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.

TEXT BOOKS:
OFD355 FOOD SAFETY AND QUALITY REGULATIONS

OBJECTIVES:

- To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
- To help become skilled in systems for food safety surveillance
- To be aware of the regulatory and statutory bodies in India and the world
- To ensure processed food meets global standards

UNIT I
Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labeling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection, ISO 22000 – Importance and Implementation

UNIT II
Food quality: Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities.

UNIT III
Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system. Food inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system to monitor food safety, risk communication

UNIT IV
Indian and global regulations: FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)

UNIT V
Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.

COURSE OUTCOMES:

CO1 Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments
CO2 Awareness on regulatory and statutory bodies in India and the world

REFERENCES:

1. Handbook of food toxicology by S. S. Deshpande, 2002
2. The food safety information handbook by Cynthia A. Robert, 2009
OBJECTIVES:

- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease.

UNIT I INTRODUCTION AND SIGNIFICANCE

Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoochemicals and microbes in food, plants, animals and microbes.

UNIT II PHYTOCHEMICALS AS NUTRACEUTICALS

Phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, lycopene, chitin, carotenoids. Manufacturing practice of selected nutraceuticals such as lycopene, isoflavonoids, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals - stability, analytical and labelling issues.

UNIT III ASSESSMENT OF ANTIOXIDANT ACTIVITY

In vitro and in vivo methods for the assessment of antioxidant activity, Comparison of different in vitro methods to evaluate the antioxidant, antioxidant mechanism, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

UNIT IV ROLE IN HEALTH AND DISEASE

The health benefit of - Soy protein, Spirulina, Tea, Olive oil, plant sterols, Broccoli, omega3 fatty acid and eicosanoids. Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and symbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

UNIT V SAFETY ISSUES

Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues International and national.

TOTAL: 45 PERIODS

TEXT BOOKS:

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>
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<th>CO</th>
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<td>Acquire knowledge about the nutraceuticals and functional foods, their classification and benefits.</td>
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<td>Acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes</td>
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<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 in vitro and in vivo 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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OTT354 BASICS OF DYEING AND PRINTING

OBJECTIVE:
- To enable the students to learn about the basics of Pretreatment, dyeing, printing and machinery in textile processing.

UNIT I INTRODUCTION
Impurities present in different fibres, Inspection of grey goods and lot preparation. Shearing.

UNIT II PRE TREATMENT
UNIT III  DYEING

UNIT IV  PRINTING
Definition of printing – Difference between printing and dying- Classification thickeners – Requirements to be good thickener, printing paste Preparation - different styles of printing.

UNIT V  MACHINERIES

OUTCOMES:
Upon completion of the course, the students will be able to Understand the
CO1: Basics of grey fabric
CO2: Basics of pre treatment
CO3: Concept of Dyeing
CO4: Concept of Printing
CO5: Machinery in processing industry

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:

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FT3201 FIBRE SCIENCE

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 Cellulotic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel ,Tencel

UNIT III SYNTHETIC FIBRES

Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass ,carbon .Introduction to spin finishes and texturization

UNIT IV SPECIALITY FIBRES

Properties and end uses of high tenacity and high modulus fibres, high temperature and flame retardant fibres, Chemical resistant fibres

UNIT V FUNCTIONAL SPECIALITY FIBRES

Properties and end uses: Fibres for medical application – Biodegradable fibres based on PLA ,Super absorbent fibres elastomeric fibres, ultra-fine fibres, electrospun nano fibres, metallic fibres – Gold and Silver coated.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the student would be able to

- Understand the process sequence of various fibres
- Understand the properties of various fibres

TEXT BOOKS:

REFERENCES:

OTT355 GARMENr 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 GARMENr PRESSING, PACKING AND CARE LABELING 9
Garment pressing – categories and equipment, packing; care 280abelling 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 280abelling

TEXT BOOKS:
2. Gerry Cooklin, “Introduction to Clothing Manufacture” Blackwell Science Ltd., 1995. 64
REFERENCES:

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OPE353 INDUSTRIAL SAFETY

OBJECTIVES:
- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen’s Compensation and other laws) enacted for the protection of employees health at work settings
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I INTRODUCTION
Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.

UNIT II OCCUPATIONAL HEALTH AND HYGIENE

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS

UNIT IV HAZARDS AND RISK MANAGEMENT
UNIT V  ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT


TOTAL: 45 PERIODS

OUTCOMES:
After completion of this course, the student is expected to be able to:

- Describe, with example, the common work-related diseases and accidents in occupational setting
- Name essential members of the Occupational Health team
- What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee

OPE354  UNIT OPERATIONS IN PETRO CHEMICAL INDUSTRIES  L T P C

3 0 0 3

OBJECTIVES:
- To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.

UNIT I  FLUID MECHANICS CONCEPTS
Fluid definition and classification of fluids, types of fluids, Rheological behaviour of fluids & Newton’s Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems).Basic equations of fluid flow - Continuity equation, Euler’s equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits - Hagen Poiseuille equation (no derivation). Flow through stagnant fluids – theory of Settling and Sedimentation – Equipment (cyclones, thickeners) Conceptual numericals.

UNIT II  FLOW MEASUREMENTS & MECHANICAL OPERATIONS

UNIT III  CONDUCTIVE & CONVECTIVE HEAT TRANSFER
Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).

UNIT IV  BASICS OF MASS TRANSFER
UNIT V — MASS TRANSFER OPERATIONS
Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction). Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method. Drying- drying operations, batch and continuous drying. Conceptual numerical.

TOTAL: 45 PERIODS

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

- State and describe the nature and properties of the fluids.
- Study the different flow measuring instruments, the principles of various size reductions, conveying equipment’s, sedimentation and mixing tanks.
- Comprehend the laws governing the heat and mass transfer operations to solve the problems.
- Design the heat transfer equipment suitable for specific requirement.

TEXTBOOKS:
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008

REFERENCE BOOKS
2. Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996

OPT352 PLASTIC MATERIALS FOR ENGINEERS

COURSE OBJECTIVES
- Understand the advantages, disadvantages and general classification of plastic materials
- To know the manufacturing, sources, and applications of engineering thermoplastics
- Understand the basics as well as the advanced applications of various plastic materials in the industry
- To understand the preparation methods of thermosetting materials
- Select suitable specialty plastics for different end applications

UNIT I — INTRODUCTION TO PLASTIC MATERIALS
Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermosetting behavior, amorphous polymers, crystalline polymers and cross-linked structures. General purpose thermoplastics/ Commodity plastics: manufacture, structure, properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene, polyvinyl chloride-compounding, formulation, polypropylene (PP)

UNIT II — ENGINEERING THERMOPLASTICS AND APPLICATIONS
Engineering thermoplastics — Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides, PMMA, polyphenylene oxide, thermoplastic polyurethane (PU)
UNIT III  THERMOSETTING PLASTICS
Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.

UNIT IV  MISCELLANEOUS PLASTICS FOR END APPLICATIONS
Miscellaneous plastics- Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbazole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers- their synthesis, properties and applications

UNIT V  PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS
Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers- poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- To study the importance, advantages and classification of plastic materials
- Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics
- To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins
- Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU
- To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

REFERENCES

OPT353  PROPERTIES AND TESTING OF PLASTICS  L T P C  3 0 0 3

COURSE OBJECTIVES
- To understand the relevance of standards and specifications as well as the specimen preparation for polymer testing.
- To study the mechanical properties and testing of polymer materials and their structural property relationships.
- To understand the thermal properties of polymers and their testing methods.
- To gain knowledge on the electrical and optical properties of polymers and their testing methods.
- To study about the environmental effects and prevent polymer degradation.
UNIT I  INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS  

UNIT II  MECHANICAL PROPERTIES  
Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact strength, resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic fatigue, ageing properties. Basic concepts of stress and strain, short term tests: Viscoelastic behavior (simple models: Kelvin model for creep and stress relaxation, Maxwell-Voigt model, strain recovery and dynamic response), Effect of structure and composition on mechanical properties, Behavior of reinforced polymers

UNIT III  THERMAL RHEOLOGICAL PROPERTIES  
Thermal properties: Transition temperatures, specific heat, thermal conductivity, co-efficient of thermal expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness temperature, thermal stability and flammability. Product testing: Plastic films, sheeting, pipes, laminates, foams, containers, cables and tubes.

UNIT IV  ELECTRICAL AND OPTICAL PROPERTIES  
Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and power factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric co-efficient, dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive index, haze, gloss, clarity, birefringence.

UNIT V  ENVIRONMENTAL AND CHEMICAL RESISTANCE  

TOTAL : 45 PERIODS

COURSE OUTCOMES
- Understand the relevance of standards and specifications.
- Summarize the various test methods for evaluating the mechanical properties of the polymers.
- To know the thermal, electrical & optical properties of polymers.
- Identify various techniques used for characterizing polymers.
- Distinguish the processability tests used for thermoplastics, thermosets and elastomers.

REFERENCES:
OBJECTIVES:
- Understand the fundamentals of IC technology components and their characteristics.
- Understand combinational logic circuits and design principles.
- Understand sequential logic circuits and clocking strategies.
- Understand Interconnects and Memory Architecture.
- Understand the design of arithmetic building blocks.

UNIT I MOS TRANSISTOR PRINCIPLES
MOS logic families (NMOS and CMOS), Ideal and Non Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor DC transfer Characteristics ,small signal analysis of MOSFET.

UNIT II COMBINATIONAL LOGIC CIRCUITS

UNIT III SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES

UNIT IV INTERCONNECT, MEMORY ARCHITECTURE
Interconnect Parameters – Capacitance, Resistance, and Inductance, Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks.

UNIT V DESIGN OF ARITHMETIC BUILDING BLOCKS
Arithmetic Building Blocks: Data Paths, Adders-Ripple Carry Adder, Carry-Bypass Adder, Carry Select Adder, Carry-Look Ahead Adder, Multipliers, Barrel Shifter, power and speed tradeoffs.

TOTAL: 45 PERIODS

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.

TEXT BOOKS:

REFERENCES:
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

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

UNIT III  WIRELESS HEALTH SYSTEMS

UNIT IV  SMART TEXTILE

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

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

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES:

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

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CBM356 MEDICAL INFORMATICS  L T P C  3 0 0 3

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

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
1. Explain the structure and functional capabilities of Hospital Information System.
2. Describe the need of computers in medical imaging and automated clinical laboratory.
3. Articulate the functioning of information storage and retrieval in computerized patient record system.
4. Apply the suitable decision support system for automated clinical diagnosis.
5. Discuss the application of virtual reality and telehealth technology in medical industry.

TEXT BOOKS:

REFERENCES:

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OBT355  BIOTECHNOLOGY FOR WASTE MANAGEMENT  L T P C

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
Production of lactic acid, succinic acid, citric acid – Biopolymer synthesis – Production of Amylases - Lignocellulolytic enzymes - Pectinolytic enzymes - Proteases – Lipases

UNIT V BIOCOMPOSTING OF ORGANIC WASTES
Overview of composting process - Benefits of composting, Role of microorganisms in composting - Factors affecting the composting process - Waste Materials for Composting, Fundamentals of composting process - Composting technologies, Composting systems – Nonreactor Composting, Reactor composting - Compost Quality

TOTAL: 45 PERIODS

COURSE OUTCOMES
After completion of this course, the students should be able
1. To learn the various methods biological treatment
2. To know the details of waste biomass and its value addition
3. To develop the bioconversion processes to convert wastes to energy
4. To synthesize the chemicals and enzyme from wastes
5. To produce the biocompost from wastes
6. To apply the theoretical knowledge for the development of value added products

TEXT BOOKS

REFERENCE BOOKS

OBT356 LIFESTYLE DISEASES L T P C
3 0 0 3

UNIT I INTRODUCTION
Lifestyle diseases – Definition ; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use ; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise.

UNIT II CANCER
Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment

UNIT III CARDIOVASCULAR DISEASES
Coronary atherosclerosis – Coronary artery disease; Causes -Fat and lipids, Alcohol abuse -- Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation
UNIT IV  DIABETES AND OBESITY  9
Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI

UNIT V  RESPIRATORY DISEASES  9
Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

OBT357  BIOTECHNOLOGY IN HEALTH CARE  L T P C 3 0 0 3

COURSE OBJECTIVES
The aim of this course is to
1. Create higher standard of knowledge on healthcare system and services
2. Prioritize advanced technologies for the diagnosis and treatment of various diseases

UNIT I  PUBLIC HEALTH  9

UNIT II  CLINICAL DISEASES  9
Communicable diseases: Chickenpox / Shingles, COVID-19, Tuberculosis, Hepatitis B, Hepatitis C, HIV / AIDS, Influenza, Swine flu. Non Communicable diseases: Diabetes mellitus, atherosclerosis, fatty liver, Obesity, Cancer

UNIT III  VACCINOLOGY  9
History of Vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems. Instruments related to monitoring of temperature, sterilization, environment.

UNIT IV  OUTPATIENT & IN PATIENT SERVICES  9
Radiotherapy, Nuclear medicine, surgical units, OT Medical units, G & Obs. units Pediatric, neonatal units, Critical care units, Physical medicine & Rehabilitation, Neurology, Gastroenterology, Endoscopy, Pulmonology, Cardiology.

UNIT V  BASICS OF IMAGING MODALITIES  9

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

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 MANAGEMENT
Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization - Time Value of money - Risk and return concepts.

UNIT II  SOURCES OF FINANCE
Long term sources of Finance - Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc

UNIT III  INVESTMENT DECISIONS

UNIT IV  FINANCING AND DIVIDEND DECISION

UNIT V  WORKING CAPITAL DECISION

TOTAL : 45 PERIODS
TEXT BOOKS

REFERENCES
2. Prasanna Chandra, Financial Management,

CMG332 FUNDAMENTALS OF INVESTMENT L T P C
3 0 0 3

OBJECTIVES:
1. Describe the investment environment in which investment decisions are taken.
2. Explain how to Value bonds and equities
3. Explain the various approaches to value securities
4. Describe how to create efficient portfolios through diversification
5. Discuss the mechanism of investor protection in India.

UNIT I THE INVESTMENT ENVIRONMENT
The investment decision process, Types of Investments – Commodities, Real Estate and FinancialAssets, the Indian securities market, the market participants and trading of securities, securitymarket indices, sources of financial information, Concept of return and risk, Impact of Taxes andInflation on return.

UNIT II FIXED INCOME SECURITIES
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.

UNIT III APPROACHES TO EQUITY ANALYSIS
Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT IV PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India.

UNIT V INVESTOR PROTECTION
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors’ awareness and activism.

TOTAL: 45 PERIODS

REFERENCES:
OBJECTIVES

- Understand the Banking system in India
- Grasp how banks raise their sources and how they deploy it
- Understand the development in banking technology
- Understand the financial services in India
- Understand the insurance Industry in India

UNIT I  INTRODUCTION TO INDIAN BANKING SYSTEM  9
Overview of Banking system – Structure – Functions – Banking system in India - Key Regulations in Indian Banking sector – RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT II  MANAGING BANK FUNDS/ PRODUCTS  9

UNIT III  DEVELOPMENT IN BANKING TECHNOLOGY  9

UNIT IV  FINANCIAL SERVICES  9

UNIT V  INSURANCE  9

TOTAL : 45 PERIODS

REFERENCES:

CMG334 INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS  L T P C
3 0 0 3

UNIT I  INTRODUCTION TO BLOCKCHAIN  9
Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization - Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.
UNIT II INTRODUCTION TO CRYPTOCURRENCY


UNIT III ETHEREUM

Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network

UNIT IV WEB3 AND HYPERLEDGE


UNIT V EMERGING TRENDS


REFERENCE

2. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018
UNIT V  REGULATORY ISSUES

TOTAL : 45 PERIODS

REFERENCES:
5. IIBF, Digital Banking, Taxmann Publication, 2016

CMG336  INTRODUCTION TO FINTECH

OBJECTIVES:
1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I  INTRODUCTION
Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II  PAYMENT INDUSTRY
FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III  INSURANCE INDUSTRY

UNIT IV  FINTECH AROUND THE GLOBE
UNIT IV  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 businesses.
- To empower the learners to run a Technology driven business efficiently and effectively

UNIT I  INTRODUCTION TO ENTREPRENEURSHIP
Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development.

UNIT II  BUSINESS OWNERSHIP & ENVIRONMENT

UNIT III  FUNDAMENTALS OF TECHNOPRENEURSHIP
Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends

TOTAL:45 PERIODS

References:
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
6. Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018
UNIT IV  APPLICATIONS OF TECHNOPRENEURSHIP  9
Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship --- Success Stories of Technopreneurs - Case Studies

UNIT 5  EMERGING TRENDS IN ENTREPRENEURSHIP  9

OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of Entrepreneurship
CO 2 Understand the business ownership patterns and environment
CO 3 Understand the Job opportunities in Industries relating to Technopreneurship
CO 4 Learn about applications of tehnopreneurship and successful technopreneurs
CO 5 Acquaint with the recent and emerging trends in entrepreneurship

TEXT BOOKS:

REFERENCES :
7. Basics of Technoprenuership: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP
8. Journal articles pertaining to Entrepreneurship

CMG338  TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS  L T P C  3 0 0 3

COURSE OBJECTIVES:
- To develop and strengthen the Leadership qualities and motivation of learners.
- To impart the Leadership skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of Team Building in managing Technology oriented businesses.
- To empower the learners to build robust teams for running and leading a business efficiently and effectively.
UNIT I  INTRODUCTION TO MANAGING TEAMS  9
Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) - Multicultural Teams.

UNIT II  MANAGING AND DEVELOPING EFFECTIVE TEAMS  9
Team-based Organisations- Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.

UNIT III  INTRODUCTION TO LEADERSHIP  9
Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership - Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment.

UNIT IV  LEADERSHIP IN ORGANISATIONS  9

UNIT V  LEADERSHIP EFFECTIVENESS  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of managing teams for business.
CO 2 Understand developing effective teams for business management.
CO 3 Understand the fundamentals of leadership for running a business.
CO 4 Learn about the importance of leadership for business development.
CO 5 Acquaint with emerging trends in leadership effectiveness for entrepreneurs.

REFERENCES:
CMG339  CREATIVITY & INNOVATION IN ENTREPRENEURSHIP  L T P C  
3 0 0 3

COURSE OBJECTIVES

- To develop the creativity skills among the learners
- To impart the knowledge of creative intelligence essential for entrepreneurs
- To know the applications of innovation in entrepreneurship.
- To develop innovative business models for business.

UNIT I  CREATIVITY

Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- Creative Personality and Motivation.

UNIT II  CREATIVE INTELLIGENCE

Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training- Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III  INNOVATION


UNIT IV  INNOVATION AND ENTREPRENEURSHIP


UNIT V  INNOVATIVE BUSINESS MODELS


COURSE OUTCOMES:

Upon completion of this course, the student should be able to:
CO 1 Learn the basics of creativity for developing Entrepreneurship
CO 2 Understand the importance of creative intelligence for business growth
CO 3 Understand the advances through Innovation in Industries
CO 4 Learn about applications of innovation in building successful ventures
CO 5 Acquaint with developing innovative business models to run the business efficiently and effectively

SUGGESTED READINGS:

1. Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand
COURSE OBJECTIVES:

- To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
- To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
- To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.

UNIT I  INTRODUCTION TO MARKETING MANAGEMENT


UNIT II  MARKETING ENVIRONMENT


UNIT III  PRODUCT AND PRICING MANAGEMENT


UNIT IV  PROMOTION AND DISTRIBUTION MANAGEMENT


UNIT V  CONTEMPORARY ISSUES IN MARKETING MANAGEMENT


COURSE OUTCOMES:

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

CO1 Have the awareness of marketing management process
CO 2 Understand the marketing environment
CO 3 Acquaint about product and pricing strategies
CO 4 Knowledge of promotion and distribution in marketing management.
CO 5 Comprehend the contemporary marketing scenarios and offer solutions to marketing issues.

REFERENCES:

OBJECTIVES:
1. To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
2. To create an awareness of the roles, functions and functioning of human resource department.
3. To understand the methods and techniques followed by Human Resource Management practitioners.

UNIT I    INTRODUCTION TO HRM

UNIT II  HUMAN RESOURCE PLANNING
HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends

UNIT III  RECRUITMENT AND SELECTION
Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources - eRecruitment - Selection Process- Selection techniques - eSelection- Interview Types - Employee Engagement.

UNIT IV TRAINING AND EMPLOYEE DEVELOPMENT

UNIT V  CONTROLLING HUMAN RESOURCES

COURSE OUTCOMES:
Upon completion of this course the learners will be able:
CO 1 To understand the Evolution of HRM and Challenges faced by HR Managers
CO 2 To learn about the HR Planning Methods and practices.
CO 3 To acquaint about the Recruitment and Selection Techniques followed in Industries.
CO 4 To known about the methods of Training and Employee Development.
CO 5 To comprehend the techniques of controlling human resources in organisations.

REFERENCES:
COURSE OBJECTIVES:

- To develop the basics of business venture financing.
- To impart the knowledge essential for entrepreneurs for financing new ventures.
- To acquaint the learners with the sources of debt and equity financing.
- To empower the learners towards fund raising for new ventures effectively.

UNIT I  ESSENTIALS OF NEW BUSINESS VENTURE


UNIT II  INTRODUCTION TO VENTURE FINANCING


UNIT III  SOURCES OF DEBT FINANCING


UNIT IV  SOURCES OF EQUITY FINANCING

Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.

UNIT V  METHODS OF FUND RAISING FOR NEW VENTURES


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.
UNIT-I
1. Constitutional Development Since 1909 to 1947
3. Constituent Assembly

UNIT-II
1. Fundamental Rights
2. Fundamental Duties
3. Directive Principles of State Policy

UNIT-III
1. President
2. Parliament
3. Supreme Court

UNIT-IV
1. Governor
2. State Legislature
3. High Court

UNIT-V
1. Secularism
2. Social Justice
3. Minority Safeguards

REFERENCES:
3. Johari J.C.: Indian Politics, Vishal Publications Ltd, New Delhi
4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi

TOTAL: 45 PERIODS

UNIT-I
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

UNIT-II
1. Generalist Vs Specialist
2. Civil Servants' Relationship with Political Executive
3. Integrity in Administration.

UNIT-III
1. Recruitment: Direct Recruitment and Recruitment from Within
2. Training: Kinds of Training
3. Promotion
**UNIT-IV**
1. All India Services
2. Service Conditions
3. State Public Service Commission

**UNIT-V**
1. Employer Employee Relations
2. Wage and Salary Administration
3. Allowances and Benefits

**REFERENCES:**
1. Stahl Glean O: Public Personnel Administration
4. Dwivedi O.P and Jain R.B: India’s Administrative state.
7. Davar R.S. Personnel Management & Industrial Relations

**CMG346**

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**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

**TOTAL: 45 PERIODS**

**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  (9)
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  (9)
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  (9)
Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992

UNIT IV  (9)
Coalition politics in India, Integrity and Vigilance in Indian Administration

UNIT V  (9)
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  (9)

UNIT-II  (9)
Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System’s Approach – Dror’s Optimal Model

UNIT-III  (9)

UNIT-IV  (9)
Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.

UNIT-V  (9)
Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.

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

OUTCOMES:
- To facilitate objective solutions in business decision making.
- To understand and solve business problems
- To apply statistical techniques to data sets, and correctly interpret the results.
- To develop skill-set that is in demand in both the research and business environments
- To enable the students to apply the statistical techniques in a work setting.

REFERENCES:
OBJECTIVES:
- To know how to derive meaning form huge volume of data and information.
- To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION
Data mining, Text mining, Web mining, Data ware house.

UNIT II DATA MINING PROCESS
Datamining process – KDD, CRISP-DM, SEMMA
Prediction performance measures

UNIT III PREDICTION TECHNIQUES
Data visualization, Time series – ARIMA, Winter Holts,

UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES
Classification, Association, Clustering.

UNIT V MACHINE LEARNING AND AI
Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization

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

TOTAL: 45 PERIODS

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
OBJECTIVES:
- To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
- To know the different types of HR metrics and understand their respective impact and application.
- To understand the impact and use of HR metrics and their connection with HR analytics.
- To understand common workforce issues and resolving them using people analytics.

UNIT I INTRODUCTION TO HR ANALYTICS
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:
OBJECTIVE:
To showcase the opportunities that exist today to leverage the power of the web and social media.

UNIT I MARKETING ANALYTICS
Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT II COMMUNITY BUILDING AND MANAGEMENT
History and Evolution of Social Media - Understanding Science of Social Media - Goals for using Social Media - Social Media Audience and Influencers - Digital PR - Promoting Social Media Pages - Linking Social Media Accounts - The Viral Impact of Social Media.

UNIT III SOCIAL MEDIA POLICIES AND MEASUREMENTS
Social Media Policies - Etiquette, Privacy - ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV WEB ANALYTICS
Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT V SEARCH ANALYTICS
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

TOTAL: 45 PERIODS

OUTCOME:
- The Learners will understand social media, web and social media analytics and their potential impact.

REFERENCES:
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004

OBJECTIVE:
To treat the subject in depth by emphasizing on the advanced quantitative models and methods in operations and supply chain management and its practical aspects and the latest developments in the field.

UNIT I INTRODUCTION
Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains.
UNIT II  WAREHOUSING DECISIONS  9
P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.

UNIT III  INVENTORY MANAGEMENT  9
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV  TRANSPORTATION NETWORK MODELS  9

UNIT V  MCDM MODELS  9
Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the analytical network process (ANP), TOPSIS.

TOTAL: 45 PERIODS

OUTCOME:
• To enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.

REFERENCES:

CMG354  FINANCIAL ANALYTICS  L T P C
3 0 0 3

OBJECTIVE:
• This course introduces a core set of modern analytical tools that specifically target finance applications.

UNIT I  CORPORATE FINANCE ANALYSIS  9
Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.

UNIT II  FINANCIAL MARKET ANALYSIS  9
Estimation and prediction of risk and return (bond investment and stock investment) –Time series-examining nature of data, Value at risk, ARMA, ARCH and GARCH.

UNIT III  PORTFOLIO ANALYSIS  9
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.
UNIT IV  TECHNICAL ANALYSIS

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
UNIT III SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES


UNIT IV SUSTAINABLE CONSTRUCTION MATERIALS


UNIT V SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS


TOTAL: 45 PERIODS

OUTCOME:
On completion of the course, the student is expected to be able to
CO1 Understand the environment sustainability goals at global and Indian scenario.
CO2 Understand risks in development of projects and suggest mitigation measures.
CO3 Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
CO4 Explain Life Cycle Analysis and life cycle cost of construction materials.
CO5 Explain the new technologies for maintenance of infrastructure projects.

REFERENCES:
5. New Building Materials and Construction World magazine
7. Munier N, "Introduction to Sustainability", Springer2005

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

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CES332 SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT

OBJECTIVES:

• To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.

UNIT I AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS

Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT

Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT III WATER MANAGEMENT

Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT IV ENERGY AND WASTE MANAGEMENT

Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS
Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS

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

CO1 Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture
CO2 Discuss the sustainable ways in managing soil health, nutrients, pests and diseases
CO3 Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources
CO4 Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas
CO5 Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

REFERENCES:
1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020

CO – PO Mapping - SUSTAINABLE AGRICULTURE PRACTICES

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CES333
SUSTAINABLE BIOMATERIALS
L T P C
3 0 0 3

OBJECTIVES
- To impart knowledge of biomaterials and their properties
- To learn about Fundamentals aspects of Biopolymers and their applications
- To learn about bioceramics and biopolymers
- To introduce the students about metals as biomaterials and their usage as implants
- To make the students understand the significance of bionanomaterials and its applications.
UNIT I  INTRODUCTION TO BIOMATERIALS

UNIT II  BIO POLYMERS
Molecular structure of polymers -Molecular weight - Types of polymerization techniques–Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials - Polyethylene -Polymethylmethacrylate (PMMA-Polyactic acid (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT III  BIO CERAMICS AND BIOCOMPOSITES
General properties- Bio ceramics -Silicate glass - Alumina (Al2O3) - Zirconia (ZrO2)- Carbon- Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites-Polymer Matrix Composite(PMC)- Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)– glass ceramics - Orthopedic implants-Tissue engineering scaffolds

UNIT IV  METALS AS BIOMATERIALS
Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys-Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals

UNIT V NANOBIOMATERIALS

OUTCOMES
• Students will gain familiarity with Biomaterials and they will understand their importance.
• Students will get an overview of different biopolymers and their properties
• Students gain knowledge on some of the important Bioceramics and Biocomposite materials
• Students gain knowledge on metals as biomaterials
• Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

REFERENCES
6. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018

CES334 MATERIALS FOR ENERGY SUSTAINABILITY L T P C
3 0 0 3

OBJECTIVES
- To familiarize the students about the challenges and demands of energy sustainability
- To provide fundamental knowledge about electrochemical devices and the materials used.
- To introduce the students to various types of fuel cell
- To enable students to appreciate novel materials and their usage in photovoltaic application
- To introduce students to the basic principles of various types Supercapacitors and the materials used.

UNIT I SUSTAINABLE ENERGY SOURCES 9
Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy

UNIT II ELECTROCHEMICAL DEVICES 9
Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O₂ battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO₂, LiFePO₄, LiMn₂O₄) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)

UNIT III FUEL CELLS 9

UNIT IV PHOTOVOLTAICS 9
UNIT V SUPERCAPACITORS

Supercapacitor – types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL : 45 PERIODS

OUTCOMES

- Students will acquire knowledge about energy sustainability.
- Students understand the principles of different electrochemical devices.
- Students learn about the working of fuel cells and their application.
- Students will learn about various Photovoltaic applications and the materials used.
- The students gain knowledge on different types of supercapacitors and the performance of various materials

REFERENCES

5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh

CES335 GREEN TECHNOLOGY

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

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
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
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
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
Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: To understand the principles of green engineering and technology
CO2: To learn about pollution using hazardous chemicals and solvents
CO3: To modify processes and products to make them green and safe.
CO4: To design processes and products using green technology
CO5 – To understand advanced technology in green synthesis

TEXT BOOKS

REFERENCE BOOKS
1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

CES336   ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS   L T P C   3 0 0 3

OBJECTIVES:
• to understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
• To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.

UNIT I   ENVIRONMENTAL MONITORING AND STANDARDS
UNIT II  MONITORING OF ENVIRONMENTAL PARAMETERS  9

UNIT III  ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING  9
Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods -Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT IV  ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISKASSESSMENT  9

UNIT V  AUTOMATED DATA ACQUISITION AND PROCESSING  9
Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks -Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

TOTAL: 45 PERIODS

COURSE OUTCOMES
After completion of this course, the students will know

| CO1 | Basic concepts of environmental standards and monitoring. |
| CO2 | the ambient air quality and water quality standards; |
| CO3 | the various instrumental methods and their principles for environmental monitoring |
| CO4 | The significance of environmental standards in monitoring quality and sustainability of the environment. |
| CO5 | the various ways of raising environmental awareness among the people. |
| CO6 | Know the standard research methods that are used worldwide for monitoring the environment. |

TEXTBOOKS
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and soilld wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc

REFERENCES
1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.
## COURSE ARTICULATION MATRIX

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## CES337 INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT

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<td>1. To create awareness on the energy scenario of India with respect to world</td>
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<td>2. To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation</td>
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<td>3. Familiarisation on the concept of sustainable development and its benefits</td>
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<td>4. Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development</td>
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<td>5. Acquainting with energy policies and energy planning for sustainable development</td>
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### UNIT I ENERGY SCENARIO
Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security

### UNIT II ENERGY AND ENVIRONMENT
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

### UNIT III SUSTAINABLE DEVELOPMENT

### UNIT IV RENEWABLE ENERGY TECHNOLOGY

### UNIT V ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT

**TOTAL : 45 PERIODS**
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

COURSE OBJECTIVES:
1. To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
2. To create awareness on energy audit and its impacts
3. To acquaint the techniques adopted for performance evaluation of thermal utilities
4. To familiarise on the procedures adopted for performance evaluation of electrical utilities
5. To learn the concept of sustainable development and the implication of energy usage

UNIT I ENERGY AND ENVIRONMENT
Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT II ENERGY AUDITING
Need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES
Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression
UNIT IV    ENERGY CONSERVATION IN ELECTRICAL UTILITIES
Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

UNIT V    SUSTAINABLE DEVELOPMENT

TOTAL: 45 PERIODS

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