ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY
REGULATIONS 2021

B.TECH. PLASTICS TECHNOLOGY

CHOICE BASED CREDIT SYSTEM

1. PROGRAMME OUTCOMES (POs): Engineering Graduates will be able to:

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

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

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

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

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

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

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

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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

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

### 2. PROGRAM SPECIFIC OUTCOMES (PSOs):

On completion of B.Tech Plastics Technology, the graduates will

1. Apply the fundamental knowledge acquired from basic sciences, engineering sciences and computational platforms to design and develop plastics products.
2. Take up challenging positions in design, development and manufacturing of sustainable plastics products with environmental concern.
3. Become an entrepreneur with sound knowledge in core and management related courses.
### 3. MAPPING OF COURSE OUTCOMES AND PROGRAMME OUTCOMES

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**THEORY**

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3. MA3151 | Matrices and Calculus | BSC | 3 | 1 | 0 | 4 | 4 |
4. PH3151 | Engineering Physics | BSC | 3 | 0 | 0 | 3 | 3 |
5. CY3151 | Engineering Chemistry | BSC | 3 | 0 | 0 | 3 | 3 |
6. GE3151 | Problem Solving and Python Programming | ESC | 3 | 0 | 0 | 3 | 3 |
7. GE3152 | தமிழ் மதிப்பியல் /Heritage of Tamils | HSMC | 1 | 0 | 0 | 1 | 1 |

**PRACTICALS**

8. GE3171 | Problem Solving and Python Programming Laboratory | ESC | 0 | 0 | 4 | 4 | 2 |
9. BS3171 | Physics and Chemistry Laboratory | BSC | 0 | 0 | 4 | 2 |
10. GE3172 | English Laboratory $ | EEC | 0 | 0 | 2 | 1 |

**TOTAL** 16 1 10 27 22

$ Skill Based Course

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#### SEMESTER II

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**PRACTICALS**

9. GE3271 | Engineering Practices Laboratory | ESC | 0 | 0 | 4 | 4 | 2 |
10. BE3272 | Basic Electrical, Electronics and Instrumentation Engineering Laboratory | ESC | 0 | 0 | 4 | 2 |
11. GE3272 | Communication Laboratory / Foreign Language $ | EEC | 0 | 0 | 4 | 2 |

**TOTAL** 17 1 16 34 26

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

$ 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.

*Four weeks industrial training/internship carries two credits. Industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester.
### SEMESTER V

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* Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC-I)
* Four weeks industrial training/internship carries two credits. Industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester

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*Open Elective – I shall be chosen from the emerging technologies.
*#Four weeks industrial training/internship carries two credits. Industrial training/internship during VI Semester Summer Vacation will be evaluated in VII semester
* 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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*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

##Four weeks industrial training/internship carries two credits. Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester

###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.

*15 weeks of continuous Internship in an organization carries 10 credits.

**ELECTIVE – MANAGEMENT COURSES**

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**TOTAL CREDITS: 166**
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* Mandatory Courses are offered as Non-Credit Courses

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

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<td>Advanced Extrusion Processing</td>
<td>Product Design and Cost Estimation</td>
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<td>Additive Manufacturing</td>
<td>Advanced Injection Moulding</td>
<td>Engineering Statistics and Quality Control</td>
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<td>Biodegradable Polymers</td>
<td>Fiber technology</td>
<td>Advanced Blow Moulding</td>
<td>Circular Economy and Extended Producer Responsibility</td>
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<tr>
<td>Polymers in Biomedical Engineering</td>
<td>Plastics Packaging Technology</td>
<td>Polyurethane Technology</td>
<td>Pollution, Regulatory Norms and Control Equipment</td>
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<td>Adhesives, Paints and Coatings</td>
<td>Rubber Technology</td>
<td>Instrumentation and Process Control</td>
<td>Fintech and Block Chain</td>
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<td>Polymers in Transportation</td>
<td>Design and Manufacture of Composites</td>
<td>Automation in Polymer Processing</td>
<td>Entrepreneurship Development</td>
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<tr>
<td>Biopolymers and Green Composite</td>
<td>Finite Element Methods</td>
<td>Foam Technology</td>
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**Registration of Professional Elective Courses from Verticals:**

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

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

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

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Enrollment for B.E. / B. Tech. (Honours) / Minor degree (Optional)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech. (Honours) 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 ADDITIONS TO ALL THE VERTICALS OF OTHER PROGRAMMES)**

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

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<td>Introduction to Fintech</td>
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### VERTICAL 2: ENTREPRENEURSHIP

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### VERTICAL 4: BUSINESS DATA ANALYTICS

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INDUCTION PROGRAMME

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

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

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

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

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

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

(i) Physical Activity
This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

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

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

(iv) Literary Activity
Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.
(v) Proficiency Modules
This would address some lacunas that students might have, for example, English, computer familiarity etc.

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

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

(viii) Familiarization to Dept./Branch & Innovations
They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

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

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

REFERENCES:
Guide to Induction program from AICTE

HS3152 PROFESSIONAL ENGLISH I
OBJECTIVES :
- To improve the communicative competence of learners
- To learn to use basic grammatic structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners’ ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.
UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION
What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C’s of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

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

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

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

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

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

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 interpret information presented in tables, charts and other graphic forms
- To write definitions, descriptions, narrations and essays on various topics

TOTAL : 45 PERIODS
TEXT BOOKS:
1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
   Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

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

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

MA3151 MATRICES AND CALCULUS

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

TOTAL: 60 PERIODS

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

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

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PH3151 ENGINEERING PHYSICS

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

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

TOTAL: 45 PERIODS

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

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

REFERENCES:
5. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag,

CO’s-PO’s & PSO’s MAPPING

| CO’s | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 1  | 2  | 3  |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
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| 2    | 3  | 3  | 2  | 1  | 2  | 1  | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| 3    | 3  | 3  | 2  | 2  | 2  | 1  | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| 4    | 3  | 3  | 1  | 1  | 2  | 1  | -  | -  | -  | -  | -  | -  | -  | -  | -  |
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1-Low,2-Medium,3-High,”-”-no correlation
Note: the average value of this course to be used for program articulation matrix.
COURSE OBJECTIVES:
- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I  WATER AND ITS TREATMENT

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

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

UNIT IV  FUELS AND COMBUSTION

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

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

CO1 : To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO2 : To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO3 : To apply the knowledge of phase rule and composites for material selection requirements.

CO4 : To recommend suitable fuels for engineering processes and applications.

CO5 : To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

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GE3151 PROBLEM SOLVING AND PYTHON PROGRAMMING

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

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

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

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COs- PO's & PSO's MAPPING

AGENDA I

CO1 - PO1: مبانی علم

AGENDA II

CO2 - PO2: تحلیل کامپیوتر

AGENDA III

CO3 - PO3: برنامه نویسی

AGENDA IV

CO4 - PO4: کتابخانه

AGENDA V

CO5 - PO5: کاربرد

AGENDA VI

CO6 - PO6: ارزیابی

AGENDA VII

CO7 - PO7: گزارش

AGENDA VIII

CO8 - PO8: تحقیق

AGENDA IX

CO9 - PO9: پرداختن

AGENDA X

CO10 - PO10: بررسی

AGENDA XI

CO11 - PO11: آزمایش

AGENDA XII

CO12 - PO12: تدوین

AGENDA XIII

CO13 - PO13: ساختار

AGENDA XIV

CO14 - PO14: ترکیب

AGENDA XV

CO15 - PO15: آموزش

AGENDA XVI

CO16 - PO16: معرفی

AGENDA XVII

CO17 - PO17: تبادل

AGENDA XVIII

CO18 - PO18: کارشناسی

AGENDA XIX

CO19 - PO19: تکنولوژی

AGENDA XX

CO20 - PO20: مدیریت

AGENDA XXI

CO21 - PO21: سازمان

AGENDA XXII

CO22 - PO22: پرداختن

AGENDA XXIII

CO23 - PO23: تحقیق
TEXT-CUM-REFERENCE BOOKS

1. Social Life of the 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. Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr. K. D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
5. 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)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

TOTAL : 15 PERIODS
UNIT I
LANGUAGE AND LITERATURE

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

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

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

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

TOTAL: 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. தமிழ் கல்வியமைப்பு – மக்கள் கல்வியமைப்பு – சதுரக. பிளயூ (திமிர்கியின்: குருத்து படிக் படிக் குருத்து மத்தியம் குருத்து குருத்து).
2. கல்லறைத்தியல் – வெளியியல் திமி முனைந்தல் (திமிர்கியின்).
3. நீரியல் – மத்தியம் குருத்துக்குருத்து மத்தியம் குருத்து குருத்து குருத்து (திமிர்கியின் குருத்து குருத்து).
4. பொருளக்கணம் – அருகில் கல்வியமைப்பு (திமிர்கியின் குருத்து குருத்து).
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)
GE3171 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

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)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)
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

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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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.

LIST OF EXPERIMENTS
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.

COURSE OUTCOMES:
Upon completion of the course, the students should be able to
CO1 : Understand the functioning of various physics laboratory equipment.
CO2 : Use graphical models to analyze laboratory data.
CO3 : Use mathematical models as a medium for quantitative reasoning and describing physical reality.
CO4 : Access, process and analyze scientific information.
CO5 : Solve problems individually and collaboratively.

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

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

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

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

1. Preparation of Na₂CO₃ as a primary standard and estimation of acidity of a water sample using the primary standard
2. Determination of types and amount of alkalinity in water sample.
   - Split the first experiment into two
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler’s method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
13. Preparation of nanoparticles (TiO₂/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

TOTAL : 30 PERIODS

OUT COMES:
- 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.

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GE3172 ENGLISH LABORATORY

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

UNIT I

INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION

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

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

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

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

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

TOTAL : 30 PERIODS

LEARNING OUTCOMES:
At the end of the course, learners will be able
- To listen to and comprehend general as well as complex academic texts 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.

39
OBJECTIVES:

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

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

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

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

UNIT IV  REPORTING OF EVENTS AND RESEARCH  6

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

TOTAL: 30 PERIODS

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

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

TEXT BOOKS:
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes 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.

MA3251 STATISTICS AND NUMERICAL METHODS

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

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

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

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

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

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

TOTAL: 60 PERIODS

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:
COURSE OBJECTIVES:

- To make the students to understand the basics of phase diagrams and various materials preparation techniques
- To equip the students to have a knowledge on different types of electron theory, basics of quantum mechanics and about superconductors
- To introduce the physics of semiconducting materials and applications of semiconductors in device fabrication
- To familiarize the students with the theory and applications of magnetic and dielectric materials
- To provide the students a sound platform towards learning about advanced materials and their applications.

UNIT I  PREPARATION OF MATERIALS  9

UNIT II  ELECTRICAL PROPERTIES OF MATERIALS  9

UNIT III  SEMICONDUCTING PROPERTIES MATERIALS  9

UNIT IV  DIELECTRIC AND MAGNETIC MATERIALS  9
Dielectric, Paraelectric and ferroelectric materials - Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of Clausius Mosotti equation – dielectric loss –
different types of dielectric breakdown – classification of insulating materials and their applications

UNIT V NEW MATERIALS AND APPLICATIONS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the students should be able to
CO1 : acquire knowledge of phase diagram, and thin film and nanomaterial preparation techniques
CO2 : familiarize with conducting materials, basic quantum mechanics, and properties and applications of superconductors.
CO3 : gain knowledge on semiconducting materials based on energy level diagrams, its types, temperature effect. Also, fabrication methods for semiconductor devices will be understood.
CO4 : realize with theories and applications of dielectric and ferromagnetic materials
CO5 : familiarize with ceramics, composites, metallic glasses, shape memory alloys, biomaterials and their important applications.

TEXT BOOKS:

REFERENCES:

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1-Low,2-Medium,3-High,”-“no correlation
Note: the average value of this course to be used for program articulation matrix.
OBJECTIVES:
- To introduce the basics of electric circuits and analysis
- To impart knowledge in domestic wiring
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To introduce the functional elements and working of sensors and transducers.

UNIT I  ELECTRICAL CIRCUITS
9
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm’s Law - Kirchhoff’s Laws – 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), Three phase supply – star and delta connection – power in three-phase systems.

UNIT II  MAGNETIC CIRCUITS AND ELECTRICAL INSTALLATIONS
9
Magnetic circuits-definitions-MMF, flux, reluctance, magnetic field intensity, flux density, fringing, self and mutual inductances-simple problems.
Domestic wiring , types of wires and cables, earthing ,protective devices- switch fuse unit- Miniature circuit breaker-moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid.

UNIT III  ELECTRICAL MACHINES
9

UNIT IV  ANALOG ELECTRONICS
9

UNIT V  SENSORS AND TRANSDUCERS
9
Sensors, solenoids, pneumatic controls with electrical actuator, mechatronics, types of valves and its applications, electro-pneumatic systems, proximity sensors, limit switches, piezoelectric, hall effect, photo sensors,Strain gauge, LVDT, differential pressure transducer,optical and digital transducers, Smart sensors, Thermal Imagers.

TOTAL:45 PERIODS

COURSE OUTCOMES:
After completing this course, the students will be able to
CO1: Compute the electric circuit parameters for simple problems
CO2: Explain the concepts of domestic wiring and protective devices
CO3: Explain the working principle and applications of electrical machines
CO4: Analyze the characteristics of analog electronic devices
CO5: Explain the types and operating principles of sensors and transducers
TEXT BOOKS:
3. S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
4. James A Svoboda, Richard C. Dorf, Dorf’s Introduction to Electric Circuits, Wiley, 2018

REFERENCES:
5. H.S. Kalsi, Electronic Instrumentation, Tata McGraw-Hill, New Delhi, 2010

CO’s, PO’s & PSO’s MAPPING

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CY3201 PHYSICAL AND ORGANIC CHEMISTRY

OBJECTIVES:
- To understand concepts of chemical thermodynamics and partial molar quantities
- To impart thorough knowledge on rubber and plastics
- To make the student conversant with adsorption and oxidation process
- To provide comprehensive information and exposure to synthesis of monomers
- To learn and understand the structure and reactivity in organic compounds

UNIT I CHEMICAL THERMODYNAMICS
Introduction to thermodynamics – Need for second law of thermodynamics, third law of thermodynamics and its validity - Entropy and probability - Maxwell relations - Gibbs – Helmholtz equation - Van’t Hoff’s equation - Chemical potential - Partial molar quantities, methods of calculation Ideal and non-ideal solutions Thermodynamic criteria of polymer solubility, solubility parameter.

UNIT II RUBBER AND PLASTICS
Introduction to rubber - latex - processing latex - mastication - compounding of rubber - vulcanizations of rubber - engineering polymers thermoforming - degradation stability and environment- synthetic rubbers preparation and applications of SBR - butyl rubber - nitrile rubber - neoprene and silicone rubber- plastic materials - classification of plastics (or resins) - moulding constituents of a plastic – fabrication techniques used for thermoplastic resin (moulding process)-important thermoplastic resins- natural resins - celluloses – polyethylene – PVC.

UNIT III REACTION MECHANISMS
Free radical substitutions, Electrophilic addition, Aromatic Electrophilic substitutions, Nucleophilic...
additions, condensation reactions, nucleophilic substitutions in aliphatic compounds, cycloadditions, Rearrangements Beckmann, Curtius, Hofmann, cope and oxy-cope, Fries rearrangement reactions (Mechanism not required).

UNIT IV MONOMERS IN POLYMER TECHNOLOGY 9
Preparation, properties and uses of monomers: ethylene, propylene, isobutylene, butadiene, styrene, methyl methacrylate, diisocyanates, glycols, polyols, epichlorohydrin, Tetrafluoro ethylene, acrylonitrile, vinyl chloride, vinyl acetate, Caprolactam.

UNIT V STRUCTURE AND REACTIVITY IN ORGANIC COMPOUNDS 9
Bonding in Organic Compounds: alkane, alkene and alkyne - Structure-property relationships Electronic effects: inductive, mesomeric, electromeric and hyperconjugation. Free radicals, carbocations, carbanions, elementary ideas about stereo chemistry RS- nomenclature and EZ- nomenclature

OUTCOMES:
- Will be able to understand chemical thermodynamics and the influence of chemical potential
- Will be familiar in rubber and plastics
- Will be conversant in the reaction mechanisms in organic chemistry
- Will have the ability to synthesize the monomers for the use of man kind
- Can investigate on the structure and reactivity of organic compounds

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES:

GE3251 ENGINEERING GRAPHICS

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

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

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

TEXT BOOKS:
REFERENCES:

Publication of Bureau of Indian Standards:

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

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Low (1); Medium (2); High (3)
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. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. 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)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) — Reference Book.
UNIT I  WEAVING AND CERAMIC TECHNOLOGY  3
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

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

UNIT III  MANUFACTURING TECHNOLOGY  3

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

UNIT V  SCIENTIFIC TAMIL & TAMIL COMPUTING  3

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. குமில்சூர் பல்லகீர்கோவில் - மந்திரம் பல்லக்காரார் - தூ. தூ. பொருட்ப்பாடு (தொலெரிப்பு: குமில்சூர் பல்லகீர்கோவில் மந்திரம் பல்லக்காரார் குழுநிலை குழுநிலை).
2. குமில்சூர் பல்லக்காரார் - மந்திரம் பல்லகீர்கோவில் - தூ. தூ. பொருட்ப்பாடு (தொலெரிப்பு: பல்லகீர்கோவில்).
3. பாலமைந்து - குருவைக் குருவைக் குருவைக் குருவைக் - தூ. தூ. பொருட்ப்பாடு (தொலெரிப்பு: பொருட்ப்பாடு).
4. பாலமைந்து - குருவைக் குருவைக் குருவைக் (தொலெரிப்பு: குருவைக் குருவை).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
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### NCC Credit Course Level 1*

**NX3251**  (ARMY WING) NCC Credit Course Level - I  

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**TOTAL : 30 PERIODS**

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### NCC Credit Course Level 1*

**NX3252**  (NAVAL WING) NCC Credit Course Level - I  

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**TOTAL : 30 PERIODS**
PD 1  Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving  2
PD 2  Communication Skills  3
PD 3  Group Discussion: Stress & Emotions  2

**LEADERSHIP**  5
L 1  Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code  3
L 2  Case Studies: Shivaji, Jhasi Ki Rani  2

**SOCIAL SERVICE AND COMMUNITY DEVELOPMENT**  8
SS 1  Basics, Rural Development Programmes, NGOs, Contribution of Youth  3
SS 4  Protection of Children and Women Safety  1
SS 5  Road / Rail Travel Safety  1
SS 6  New Initiatives  2
SS 7  Cyber and Mobile Security Awareness  1

TOTAL : 30 PERIODS

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**NCC Credit Course Level 1**

**NX3253**  
(AIR FORCE WING) NCC Credit Course Level - I  

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TOTAL : 30 PERIODS
COURSE OBJECTIVES:
- 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 commonhousehold wood work.
- Wiring various electrical joints in common household electrical wire work.
- Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
- Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I  CIVIL ENGINEERING PRACTICES  15

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

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

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

PART II  ELECTRICAL ENGINEERING PRACTICES  15

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

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III  MECHANICAL ENGINEERING PRACTICES  15

WELDING WORK:
- 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 airconditioner.

SHEET METAL WORK:
   a) Making of a square tray

FOUNDRY WORK:
   a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

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

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

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

TOTAL : 60 PERIODS

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

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Low (1) ; Medium (2) ; High (3)
COURSE OBJECTIVES:
- To train the students in conducting load tests electrical machines
- To gain practical experience in experimentally obtaining the characteristics of electronic devices and rectifiers
- To train the students to measure three phase power and displacement

LIST OF EXPERIMENTS
1. Verification of ohms and Kirchhoff’s Laws.
2. Three Phase Power Measurement
3. Load test on DC Shunt Motor.
4. Load test on Self Excited DC Generator
5. Load test on Single phase Transformer
6. Load Test on Induction Motor
7. Characteristics of PN and Zener Diodes
8. Characteristics of BJT, SCR and MOSFET
9. Design and analysis of Half wave and Full Wave rectifiers
10. Measurement of displacement of LVDT

COURSE OUTCOMES:
After completing this course, the students will be able to
CO1: Use experimental methods to verify the Ohm’s law and Kirchhoff’s Law and to measure three phase power
CO2: Analyze experimentally the load characteristics of electrical machines
CO3: Analyze the characteristics of basic electronic devices
CO4: Use LVDT to measure displacement

CO’s, PO’s & PSO’s MAPPING

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TOTAL: 60 PERIODS

OBJECTIVES
- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To be able to communicate effectively through formal and informal writing.
- To be able to use appropriate language structures to write emails, reports and essays.
- To give instructions and recommendations that are clear and relevant to the context.
UNIT I
Speaking: Role Play Exercises Based on Workplace Contexts, - talking about competition-
discussing progress toward goals-talking about experiences- talking about events in life-
discussing past events-Writing: writing emails ( formal & semi-formal).

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

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

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

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

TOTAL: 60 PERIODS

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.

CO-PO & PSO MAPPING

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| Avg.| 2.4| 2.8| 3  | 3  | 1.8| 3  | 3  | 3  | 3  | 3  | 3  | 3  | -  | -  | -  |

- 1-low, 2-medium, 3-high, '-'- no correlation
- Note: The average value of this course to be used for program articulation matrix.
MA3391 PROBABILITY AND STATISTICS

OBJECTIVES

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- 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 classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I PROBABILITY AND RANDOM VARIABLES

Axioms of probability – Conditional probability – Baye’s theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions – Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III ESTIMATION THEORY


UNIT IV NON-PARAMETRIC TESTS

Introduction - The Sign test - The Signed - Rank test - Rank - sum tests - The U test - The H test - Tests based on Runs - Test of randomness - The Kolmogorov Tests.

UNIT V STATISTICAL QUALITY CONTROL

Control charts for measurements ( and R charts ) – Control charts for attributes ( p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL: 60 PERIODS

OUTCOMES:

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

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- 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 and statistical quality control.
- Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXT BOOKS

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OBJECTIVES:
To facilitate the students
- To learn the fundamental operation involved in chemical engineering
- To attain the knowledge in the subject of fluid flow
- To gain the ideas in the field of heat transfer operation
- To learn the mass diffusion in polymers by the study or mass transfer operations
- To acquire knowledge about various unit operations

UNIT I FLUID FLOW

UNIT II MECHANICAL OPERATIONS
Properties of solids - Sieve analysis; Laws of crushing, Crushers and grinders. Principle of separation and selection and details of equipment for screening, cyclones and hydro cyclones (Basic principles and equipment description only. Mathematical consideration not required)

UNIT III HEAT TRANSFER
Modes of heat transfer: Heat transfer by conduction - Fourier's law, conduction across composite walls. Heat transfer by natural & forced convection. Co current, counter current, shell & tube heat exchangers (Basic principles and equipment description only. Mathematical consideration not required)

UNIT IV MASS TRANSFER
Principles of diffusion, theory of diffusion, Two film theory and mass transfer coefficients Humidification - operation, humidity chart, equipment’s - cooling towers and spray chambers Drying - Principles and definitions. Rate of batch drying- Equipment for drying (Basic principles and equipment description only. Mathematical consideration not required)

UNIT V UNIT OPERATIONS
Absorption - Principle and equipment (packed towers and plate columns). Distillation - flash distillation, and Binary distillation. Industrial equipment for distillation Adsorption - Principle and equipment for adsorption. (Basic principles and equipment description only. Mathematical consideration not required)

OUTCOMES
Upon completion of the course, the student will be able to:
- Attain the knowledge in fluid flow behaviors and mechanical separation.
- Understand the conduction and convection modes of heat transfer.
- Understand the concept of distillation equipment in the process industries.
- Understand the fundamentals of chemical engineering
- Gain knowledge in various Unit Operations for Polymer processing

TEXT BOOKS:
REFERENCES:

MAPPING OF CO’S WITH PO’S

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PT3302 PLASTICS MATERIALS I

OBJECTIVES:
To enable the students
- To learn about the general methods of preparation of individual class of plastics Materials
- To study about the general properties, processing behavior and applications of different Class of plastics materials
- To understand about the structure- property relation of different class of plastics materials.
- To familiar about properties and end application of different plastics materials
- To gain knowledge of thermoplastics for industrial applications.

UNIT I INTRODUCTION
Basic chemistry of polymers-nomenclature of polymers sources for raw materials. Methods of manufacturing –properties and applications of Natural Polymers - Shellac resin and natural rubber-Cellulosics-Cellulose nitrate, cellulose acetate, cellulose acetate butyrate, Ethyl cellulose and others.

UNIT II COMMODITY THERMOPLASTICS-I
Preparation- properties - and applications of Polyolefin-Polyethylene- LDPE -LLDPE- HDPE, HMWHDEPE- UHMWHDEPE-Cross-linked polyethylene- Chlorinated polyethylene –Polypropylene – Homo & Co polymer

62
UNIT III COMMODITY THERMOPLASTICS- II
Preparation - properties - and applications of Vinyl plastics - Polyvinyl chloride, C-PVC, Polyvinyl Acetate, Polyvinylidene chloride, polyvinyl alcohol. Polystyrene

UNIT IV GENERAL PURPOSE THERMOSETS
Preparation - properties - and applications of: Phenol formaldehyde (PF), Amino plastics: Urea50formaldehyde (UF) - Melamine formaldehyde (MF), unsaturated polyesters, Alkyd resins

UNIT V ENGINEERING PLASTICS & ITS APPLICATIONS - I
Preparation- properties - and applications: Styrene copolymers–High Impact Polystyrene (HIPS), Acrylonitrile Butadiene Styrene (ABS), Styrene acrylonitrile (SAN), Acrylic plastics–Polymethyl Methacrylate, Polyacrylonitrile , Ethylene Vinyl Acetate (EVA).

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the student will be able to:
• Familiarize in natural polymer properties and its applications
• Acquire skills in selecting additives for plastic materials for specific applications
• Gain knowledge of manufacturing, properties and applications of poly olefins.
• Gain knowledge of manufacturing, properties and applications of vinyl halogenated olefin based plastic materials
• Gain knowledge of manufacturing, properties and applications of special purpose plastics

TEXT BOOKS:

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1-low, 2-medium, 3-high, ‘-‘- no correlation
OBJECTIVES:
To make the student conversant with
- The basic concepts of polymers, classification of polymers, copolymer types and tactility.
- The kinetics & mechanism of different types addition polymerization and free radical copolymerization
- The kinetics & mechanism of two types of condensation polymerization and ring-opening polymerization
- Various types of polymerization techniques
- The molecular weight and its distribution and different methods of molecular weight determination.

UNIT I BASIC CONCEPTS OF POLYMERS 9

UNIT II ADDITIONPOLYMERISATION 9

UNIT III CONDENSATIONPOLYMERISATION 9

UNIT IV POLYMERISATIONTECHNIQUES 9

UNIT V MOLECULARWEIGHTANDITSDISTRIBUTION 9
Molecular weight of polymer – number, weight and viscosity average molecular weights – molecular weight distribution (problems) – molecular weight determination: end-group analysis, colligative properties, osmometry, light scattering, gel permeation chromatography and viscometry.

TOTAL: 45 PERIODS

OUTCOMES:
Upon Completion of the Course the students will be able to
- Classify polymers based on various criteria and also name the polymers using proper nomenclature.
- Derive the rate equations and explain the mechanism of addition polymerisation reactions.
- Derive the rate equations and explain the mechanism of condensation polymerisation reactions.
- Describe the various polymerisation techniques.
- Elaborate on methods of molecular weight determination and calculate molecular weight of polymers.
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PT3304 POLYMER PHYSICS L T P C 3 0 0 3

OBJECTIVES:
To enable the students to understand the
- Physical and conformational properties of polymeric materials.
- Molecular arrangement in polymers and their orientation under the influence of stress.
- Solubility behavior of polymers.

UNIT I FUNDAMENTALS OF POLYMER PHYSICS 9
Potential energy and conformational energy of molecules - conformations and configurations, Tacticity, isomeric states and isomerism in polymers, stereoisomerism, geometric isomerism - Random coils and average end to end distance - (Derivation only)

UNIT II THERMODYNAMIC PROPERTIES 9
Laws of Thermodynamics - Freely jointed and freely rotating chain models - Entropy and enthalpy Energy driven and entropy driven elasticity - Thermo elasticity -Thermodynamic treatment - entropic and energetic contributions (Derivation only).
UNIT III  POLYMER CRYSTAL FORMATION  9

UNIT IV  CHAIN ORIENTATION  9

UNIT V  POLYMER SOLUTIONS  9
Polymer solutions - Terms and definitions, types of solutions - Hildebrand approach, Flory Huggins theory - Thermodynamic view of miscibility, upper critical solution temperature (UCST), lower critical solution temperature (LCST) - solubility parameter, determination of solubility parameter of polymers - theta conditions.

TOTAL: 45 PERIODS

OUTCOMES:
Upon Completion of the Course the students will be able to
• Understand molecular arrangement in polymers.
• Demonstrate the orientation processes in polymer.
• Demonstrate knowledge in solubility behavior of polymers

TEXT BOOKS:

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PT3305  SOLID MECHANICS OF TECHNOLOGISTS  L T P C  3 0 0 3

OBJECTIVES:
• To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.
• To apply the mathematical knowledge to calculate the deformation behavior of beams.
• To understand the effect of torsion on shafts and springs.
• To analyze a complete two dimensional state of stress.
UNIT I  STATICS OF PARTICLES  

UNIT II  EQUILIBRIUM OF RIGID BODIES  
Free body diagram – Types of supports – Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon’s theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III  DEFLECTION OF BEAMS  

UNIT IV  TORISON  
Torsion of Circular and Hollow Shafts – Stresses and Deflection in Circular Solid and Hollow Shafts – strain energy due to torsion – Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – Springs in series and parallel.

UNIT V  THIN CYLINDERS AND THEORIES OF FAILURE  
Thin cylinders – Stresses in thin cylindrical shell due to internal pressure – circumferential and longitudinal stresses - Theories of failure - maximum Principal stress - maximum Principal strain - Shear stress - Total strain energy - Energy distortion theories.

OUTCOMES:
On successful completion of this course, the student will be able to
- Illustrate the vectorial and scalar representation of forces and moments
- Analyse the rigid body in equilibrium
- Apply the mathematical knowledge in determining the deformation behavior of beams
- Thoroughly understand the effect of torsion on shafts and springs.
- Analyze a complex two dimensional state of stress and to analyze the failure mode.

TEXT BOOK

REFERENCES BOOK
PT3311 CHEMICAL ENGINEERING LABORATORY

OBJECTIVE:
- To practically train on various techniques for reducing and separating of particles, flow properties of fluids.

LIST OF EXPERIMENTS:
1. To determine the pipe friction using Flow through rough and smooth pipes.
2. To determine the efficiency of pump using Centrifugal pump.
3. To determine the coefficient of discharge of orifice meter.
4. To find the efficiency of Air compressor.
5. To Calibrate the rotameter.
6. To find the Pressure drop in packed bed.
7. To study the concept of Fluidization by using fluidized bed.
8. To determine the coefficient of discharge of Venturi meter.
9. To find the Thermal conductivity of solids.
10. To find overall heat transfer coefficient of the Heat exchanger.
11. To find the Stefan-Boltzman constant.
12. To find the new surface area created by Jaw crusher.
13. To find the critical speed of Ball Mill.
14. To find the Screening efficiency.
15. To separate the component by Simple distillation.
16. To separate the component by using steam distillation.
17. To find the Particle size and Surface area of filler particles.

(Any nine Experiments) TOTAL: 60 PERIODS

OUTCOMES:
Upon completing of this course, the students will be able to:
- Apply the different technique for size reduction.
- Attain skill in operating fluid pressure apparatus.

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PT3312 POLYMER CHEMISTRY LABORATORY L T P C 0 0 4 2

COURSEOBJECTIVES:
- To develop an understanding on various methods of polymerization and its structure property relationship.
- To equip with the fundamental knowledge of mechanism of polymerization and various process parameters affecting the polymerisation technique

PRACTICALS
List of Experiments:
1. Preparation of phenol-formaldehyde (Novolac) resin.
2. Preparation of phenol-formaldehyde (Resol) resin.
3. Preparation of urea-formaldehyde resin.
4. Preparation of bisphenol–A epoxy resin.
5. Preparation of unsaturated polyester resin.
6. Preparation of polyester using diethylene glycol & adipic acid.
8. Emulsion polymerization of styrene.
10. Solution polymerization of vinyl acetate.
11. Suspension polymerization of methylmethacrylate.
12. Copolymerization of styrene and methylmethacrylate

(Any nine Experiments) TOTAL: 60 PERIODS

OUTCOMES:
Upon Completion of the Course the students will be able to
- Develop new polymers and chemically modify the existing polymers based on specific property requirements
- Apply suitable technique for synthesizing polymers for advance applications

TEXTBOOKS:
GE3361 PROFESSIONAL DEVELOPMENT

**OBJECTIVES:**

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

**MS WORD:**

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

**MS EXCEL:**

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

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

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.

OBJECTIVES:
To enable the students to
• Understand various draw backs of polymer materials and suitable remedies.
• understand various additives used in polymers
• understand the mechanism of degradation of polymers and chemistry of stabilizing additives
• understand various compounding methodologies for plastics materials
• Learn the house keeping and maintenance of compounding machinery.

UNIT I FILLERS/ REINFORCEMENTS, STABILIZERS, PIGMENTS 9
Fillers and Reinforcement–Antioxidants-Thermal Stabilisers, Ultraviolet stabilizer– Impact Modifiers/ toughening agents. Colourants-Fire retardants-Coupling agents-blowing-agents

UNIT II ADDITIVES FOR PROCESSING 9
Plasticizers- Anti static agents-Anti blocking agents-Slip and anti slip agents-processing aids - Lubricants- mould releasing agents Additives for recycling.

UNIT III FUNDAMENTALS OF COMPOUNDING 9
UNIT IV  COMPOUNDING MECHANISMS
Compounding Machineries specifications - temperature control system – operating characteristics and working details of continuous mixers - Single Screw extruder - Twin Screw extruder-housekeeping and maintenance of compounding machines.

UNIT V  CASE STUDIES
Case studies on preference of one plastics to other and co-relation of properties of conventional materials and blends and alloys - case studies on application of blends and alloys.

TOTAL: 45 PERIODS

OUTCOMES:
Upon Completion of the Course the students will be able to
- Understanding various types of additives for plastics and their merits and demerits.
- Analyse various compounding methods used in the manufacturing of compounded thermoplastics and thermosets.

TEXT BOOKS:

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

PT3402  FLUID MECHANICS AND POLYMER RHEOLOGY  L T P C
3 0 0 3

OBJECTIVES:
To enable the students to understand the basic concepts of rheology
- To analyze the flow behavior of polymer melts
- To understand the basics of fluid mechanism and to analyze behavior of Newtonian fluids.
- To familiarize with instruments such as orifice meter, Venturi meter and Pitot tube.

UNIT I  FLUID PROPERTIES
Units and dimensions-Properties of fluids-mass density, specific weight, specific volume, specific gravity, viscosity, surface tension and capillarity-Terminologies of fluid flow-
Laminar and turbulent flow of Newtonian fluids—Power law—Reynolds number and its significance

UNIT II FLUID FRICTION AND FLOW MEASUREMENT 9
Bernoulli’s equation—kinetic energy correction factor; head loss; friction factor; major and Minor losses—Flow measurement: Introduction; Orifice meter; Venturi meter; concept of area meters: rotameter; Local velocity measurement: Pitot tube.

UNIT III POLYMER RHEOLOGY 9
Introduction and Basic concepts of Rheology, classification of fluids, Newtonian and non Newtonian fluids, shear stress, shear strain and shear rate, shear modulus, bulk modulus, Zero shear viscosity, Dependence of viscosity with temp, shear stress, Viscoelasticity - effect of rate of strain, temperature and time on mechanical behaviour of polymeric materials.

UNIT IV RHEOLOGICAL MODELS 9

UNIT V MEASUREMENT OF POLYMER MELT VISCOSITY 9

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, students
- Will have thorough knowledge on the basic concepts of rheology.
- Will able to analyze the mechanical behavior of polymers under applied load.
- Will have the knowledge on experimental techniques for measuring the rheological properties.
- WILL understand the basics of fluid mechanics and to analyze the behavior of Newtonian fluids.
- Will have knowledge of the instruments such as orifice meter, venturi meter & pitot tube.

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

PT3403 PLASTICS MATERIALS II

OBJECTIVES:
To enable the students to

- Learn about the general methods of preparation of individual class of plastic materials
- Understand the general properties, processing behavior of plastics materials.
- Gain knowledge in applications of different class of plastics materials.
- Make the student familiar about specialty polymers properties and end application.
- To understand the role of polymer blends & alloys in current scenario.

UNIT I ENGINEERING PLASTICS & ITS APPLICATIONS – II 9
Preparation- properties - and applications: Polyamides-Nylons 6, (6,6), (6,10), 11, 12, Polyesters–Polyethylene terephthalate, polybutylene terephthalate, Polycarbonate, Polylactic acids.

UNIT II HIGH PERFORMANCE PLASTICS - I 9
Preparation -properties-and applications: Aromatic ether-Polyphenylene oxide (PPO), Aromatic thioether - Polyphenylenesulphide (PPS), Polysulfone, Aromatic polyamides

UNIT III HIGH PERFORMANCE PLASTICS - II 9
Preparation- properties-and applications: Polyimides (PI) Polyamideimide (PAI), Polymidazoles, Fluropolymers—Polyvinyl fluoride (PVF), Polyvinylidene fluoride (PVDF), Polytetrafluoroethylene (PTFE), Polychlorotrifluoroethylene (PCTFE).

UNIT IV WATER SOLUBLE POLYMERS AND BIO DEGRADABLE POLYMERS 9
Preparation- properties and applications of Biodegradable polymers-poly ε-caprolactone - polylactic acid- Bacterial polylactide,–polyvinylpyrrolidone–polyacrylic acid and its homolog’s – polyacrylamide –polyethylene oxide – polyethylene amine-Polyvinyl alcohol

UNIT IV ENGINEERING AND SPECIALITY THERMOSETS 9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students

- Will have the knowledge of manufacturing methods, properties of special purpose polymers applied in special application
- Will have knowledge of manufacturing methods and correlate the high performance polymer properties for special purpose
- Will Acquire skills in selection of conducting polymer to suitable application
• Will have the knowledge of manufacturing methods, properties and applications of ionic polymers
• Will have the knowledge of manufacturing methods, properties and applications of water soluble and bio degradable polymers

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PT3404 PLASTICS MOULD AND DIES TECHNOLOGY L T P C

OBJECTIVES:
To impart knowledge on
• Various Molds types, Mold making and Material of mold selection.
• Elements of the mould and manufacturing processes.
• Application of additive manufacturing in mould development
• Advanced measuring instruments for inspection of mold

UNIT I BASIC MOULD TYPES, TOOL MAKING PROCESSES AND MATERIALS 9
Introduction to Moulds - Classification - Working Principle and Construction - Types and making
processes – Materials for mould making - Injection moulding machine, Compression mould, Continuous extrusion mould and Blow moulding – General mould types – Other tools for plastics, Cut off Equipments – Metal Cutting process – Metal displacement process – Casting Process– Step in Mould Finishing & References –Steel & Steel forging – Machinability – Heat treatment – Annealing Stainless Steel Steels for machined moulds- Tool steel castings

UNIT II INJECTION MOLDS
9

UNIT III BLOW MOLDING AND EXTRUCTION MOLDS
9

UNIT IV COMPRESSION MOULDS
9

UNIT V MAINTENANCE OF MOULDS & DIES
9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students would have knowledge on

- Molds Tools and mould manufacturing
- Types of molds
- Advanced measuring equipment for inspection of mold

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PT3405 PLASTICS PROCESSING L T P C 3 0 0 3

OBJECTIVES:
To enable the students
- To understand various processing techniques of plastic materials.
- To learn the fundamentals of compression molding and transfer molding of thermoset plastics.
- To learn the basic processing of thermoplastics by injection molding, extrusion and blow molding.

UNIT I COMPRESSION MOULDING
Basic principles of compression and transfer moulding—Meaning of terms—Bulk factor and flow properties as applied to moulding materials—The methods adopted for estimating these properties and their limitations—Process variables—Inter relation between flow properties—Curing time—Mould temperature and Pressure requirements—Preforms and preheating—Techniques of preheating—Machines used—Types of compression mould—Common moulding faults and their correction—Finishing of mouldings.

UNIT II TRANSFER MOULDING

UNIT III INJECTION MOULDING
Principles processing outline—Process variables—Mould cycle—Machinery used—Parts and functions—Specifications—Construction and maintenance—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—Introduction to trouble shooting.

UNIT IV EXTRUSION
Basic principles of extrusion—Types of extruders, general features of extruders viz. barrel, screw, types of screws, drive mechanism, specifications, heating & cooling systems, flow mechanism, die entry effects and exit instabilities. Melt fracture & Barn-booing. Factors affecting the output of an extruder, process variables in extrusion Extrusion processes and the downstream equipments for

UNIT V BLOW MOULDING
Basic principles and definitions- Processer – viz, Injection Blow moulding, extrusion blow moulding, Accumulation blow moulding, Merits & Demerits - Development of blow moulding industry Processing Parameters-Temperature-Pressure and cycle time Components – Materials requirements related to process and product performance- Materials used-Limitations in product design presented by process characteristics- Design guide lines for optimum product performance and appearance-Equipment used- Hand and power operated equipment. Screw and Plunger Systems-Cross head and die design-Blow moulding machine features and operation including hydraulic and electrical control systems-faults, causes and remedies. Parison programming, blow mould construction, cooling methods, mould venting, blow moulding of difficult articles like fuel tanks, odd shaped containers with handles, limitation in blow moulding, decoration of blow moulding products, hot stamping-multi colour printing-faults, causes and remedies.

TOTAL: 45 PERIODS

OUTCOMES:
On completing this course, the students would
- Demonstrate knowledge of processing of plastic materials by injection moulding, extrusion, and blow moulding.
- Understand processing techniques like compression molding and transfer moulding of thermoset plastics.

TEXT BOOKS:
4. Extrusion of Plastics By Fisher
5. Plastics Extrusion Technology By Grief

REFERENCES:
1. A Guide to Injection Molding of Plastics By Bolur, P.C.,
6. Injection Molding Technology By V.D.I.
9. Compression Molding By Iyesew, A.I.
GE3451 ENVIRONMENTAL SCIENCE AND SUSTAINABILITY  L T P C  2002

OBJECTIVES:
- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT I: ENVIRONMENT AND BIODIVERSITY  6

UNIT II: ENVIRONMENTAL POLLUTION  6

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

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


TOTAL: 30 PERIODS

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

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

REFERENCE BOOKS:
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NCC Credit Course Level 2*
NX3451 (ARMY WING) NCC Credit Course Level - II

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

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

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

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

GENERAL AWARENESS 4
GA 1 General Knowledge 4

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

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

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

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

**GENERAL AWARENESS**
- GA 1 General Knowledge 4

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

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

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

**TOTAL: 45 PERIODS**

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

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

**ENVIRONMENTAL AWARENESS & CONSERVATION**

| EA 1 | Environmental Awareness and Conservation | 3 |

**GENERAL AWARENESS**

| GA 1 | General Knowledge | 4 |

**GENERAL SERVICE KNOWLEDGE**

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

**ADVENTURE**

| AD 1 | Introduction to Adventure Activities | 1 |

**BORDER & COASTAL AREAS**

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

**TOTAL: 45 PERIODS**

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**PT3411 POLYMER SCIENCE LABORATORY**

**OBJECTIVES:**
- To prepare the students with Methodology for facing the Industrial and academic challenges in identifying various polymers and controlling the quality of incoming raw materials and processing.
- To make the students understand the laboratory scale synthesis process of various types of thermoplastics and thermosets.
- To enable the student to carry out production, research and development in the areas of polymer synthesis, polymer nanocomposites, coating formulation development, fiber reinforced composites, polymer processing.
- To make them aware of Environmental concerns of Polymer Synthesis.
- To make the students understand and do calculations, observations, formulations, involved team work and understanding practical problems related to the experiment.

**LIST OF EXPERIMENTS**

1. Preparation of phenol - formaldehyde (Novalac) resin.
2. Preparation of phenol - formaldehyde (Resol) resin.
3. Preparation of Urea formaldehyde resin.
5. Bulk polymerization of styrene.
7. Solution Polymerization of acrylonitrile.
8. Bulk Polymerization of Methyl methacrylate.
9. Copolymerization of styrene and methyl methacrylate.
10. Ring opening polymerization of Caprolactone.
11. Solution Polymerization of Vinyl acetate.
12. Depolymerization of waste thermoplastics such as polystyrene or polymethylmethacrylate
13. Determination of acid value in unsaturated polyester resin
14. Preparation of saturated polyester resin
15. Determination of acid value in saturated polyester resin
(Any Nine of the above)

TOTAL: 45 PERIODS

OUTCOMES:
Upon Completion of the Course the students would:
• Have skills in preparation of polymers using various polymerization techniques.
• Develop the conversion of polymeric materials into product.
• Design and conduct experiments for synthesis of Resins and polymers and understand the practical problems related to the experiment.
• Interpret data, process parameters within realistic constraints of the experiment.
• Communicate effectively in team and understand professional and ethical responsibility.

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PT3412 PLASTICS PROCESSING LABORAOTY

OBJECTIVES:
• To practice the students in different types of moulding machines.

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<th>Name of M/c/ Equipment/ Mould</th>
<th>Description of Practical Exercise to be done</th>
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| 1      | Hand operated Injection Moulding Machine | (i) Study of Machine in Idle-Run Observation (IRO), Parts & functions, operating principle, Free sketch of Machine-parts eg. Nozzle, Torpedo, Hopper, Rack & Pinion Barrel etc., shot capacity definition
(ii) Operation practice to produce moulding on Different and injection moulds. Recording the observation and results in practical record books. |
(ii) Operation of Pneumatic & Hydraulic type of Semi automatic Injection moulding M/cs, to produce |
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<td>11</td>
<td>Introduction to Study of Different Types of Moulds &amp; its Parts and Components in different moulds. Cycle-time analysis, observations of Process- Parameters &amp; Procedure to be recorded</td>
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| 3 | (i) Study of Extruders in IRO, Free sketch of machines, their parts and parts-function, List of products manufactured by Extrusion-Process. Study of different types of extrusion process.  
(ii) Operation-Practice by Trainee on setting up of Process parameter to produce Blown-Film on Film-plant, observations on extruder output, size of film produced and technical specifications of machines to be recorded |
(ii) Operating Principle of Hand Compression Press, mould setting procedure & parameter setting, operation practice on different compression moulds, M/c specification observations and recording |
| 5 | (i) Study of Hand Blow Moulding M/cs, Free-sketch of M/c with parts & study of part-function, Specification of M/c, Study of Parison-die with sketch.  
(ii) Die-centering practice by Trainees, operation of Hand Blow Machines, to produce components observations, cycle time analysis Procedure of operation and observations. |
| 6 | (i) M/c Study in IRO, specification of M/c, study of parts & function, Line Diagram of M/c.  
(ii) Operation-practice with different materials and output study in Kg/hour for different materials. |
| 7 | Study of M/c Parts & function, Study of clamping systems in M/cs, Technical spec. of M/c, study of process sequence in Machine, Study & definitions of terms related to M/c operation e.g. M/c Day light, Locating – Ring Dimensions, ejector-stroke, Tie-Bar distance, M/c Platen sizes & mould clamping arrangements. Definitions of all Processing Parameters & study of controls in M/cs. |
| 8 | Technical specification of M/c, Mould clamping on M/c, Parameter setting, operation-practice on different compression & Transfer Moulds, Cycle-time analysis, observation & Procedure of start-up & shut down of M/c. |
| 9 | Technical specification of M/c, Mould clamping on M/c, operation Practice with different moulds, Familiarisation with control-switches/ valves on the M/c, cycle-time analysis & procedure of operation of M/c. |
| 10 | Basic knowledge of Hydraulic & Pneumatic systems, Electrical system, Definition of terms- Hydraulic fluid, viscosity Directional Valves, Resistance, Current, Voltage, Power, Hydraulic Pumps -Types & function, electrical heaters, thermocouples and temp control parameters and timers, electrical Motors - Types & fn. |
| 11 | Study of Different Types of Moulds & its Parts and Components in different moulds. Cycle-time analysis, observations of Process- Parameters & Procedure to be recorded |
Moulds, Tool Room M/ c & Drawing Practice

function, free hand drawing practice, exposure to tool room machines.

TOTAL: 45 PERIODS

OUTCOMES:
- Upon completing this practical course, the student will have hands on experience on different types of moulding machines

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PT3512 INDUSTRIAL TRAINING / INTERNSHIP I*

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

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

No.of Weeks: 04

OUTCOMES:
On completion of the course, the student will know about
CO1: Plant layout, machinery, organizational structure and production processes in the firm or research facilities in the laboratory/research institute
CO2: Analysis of industrial / research problems and their solutions
CO3: Documenting of material specifications, machine and process parameters, testing parameters and results
CO4: Preparing of Technical report and presentation

PT3501 PLASTICS TESTING AND CHARACTERIZATION

OBJECTIVES:
- To develop the knowledge of National & International standards for testing methods.
- To create the knowledge about the different testing techniques and its basic concepts for evaluating the chemical, mechanical, electrical, optical, thermal, and permanence properties of plastic materials.
- To enable the students to identify and compare the properties of different plastics materials.
- To enable the students to learn about the property of the plastic material for several

UNIT I  INTRODUCTION TO STANDARDS AND IDENTIFICATION OF PLASTICS  9
Importance of testing, Standard and specifications- National and International standards-BIS, ASTM, ISO,BS,DIN, JIS, UL etc- Laboratory accreditations – NABL, NABCB, APLAC, FDA, ROHS, UL & REACH.
Identification of plastics by simple methods e.g., visual inspection, density, effects of heat, combustion and solvents analysis, melting & Softening point, elemental analysis, confirmation test analytical techniques used for identification and quantification of additives and fillers.

UNIT II  TESTING OF MECHANICAL PROPERTIES  9
Preconditioning and test atmosphere, Specimen preparation techniques – Moulding, Contour cutting, contour punching,. Techniques for testing of Short term mechanical properties of Plastics – Stress – Strain curve, toughness, brittle and ductile nature of materials, Tensile, Flexural, Compression, Shear, Impact strength, Tear, abrasion, Hardness and friction test.

UNIT III  TESTING OF THERMAL, ELECTRICAL AND OPTICAL PROPERTIES  9
Techniques for testing of Thermal properties – Melting Point, Specific heat capacity, HDT, VSP, Flammability (Rate of burning, UL 94, LOI ), Ignition properties of plastics. Thermal conductivity, Coefficient of Thermal Expansion, Brittleness Temperature Electrical properties – Surface & Volume Resistivity, Arc Resistance, CTI, Dielectric Strength, Dielectric constant and Dissipation factor. Optical properties – Luminous transmittance, Haze, Specular Gloss, Refractive Index, colour measurement, optical microscopy

UNIT IV  TESTING OF ENDURANCE, PERMANENCE AND WEATHERING PROPERTIES  9

UNIT V  ANALYTICAL TECHNIQUES  9
Characterization Principles and analysis of polymers / plastics –Fourier Transformed Infrared Spectroscopy (FTIR),UV-Visible spectroscopy, Differential Scanning Calorimetry (DSC), Thermogravimetric Analyzer (TGA), Dynamic Mechanical Analyzer (DMA), X-Ray Diffraction (XRD), Electron Microscope (SEM & TEM), Chromatography (GPC, GC-MS, HPLC, CHNSO analyzer), Rheometer (Capillary, Rotational Rheometer)

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course,
- Students are able to identify the plastic materials by simple methods as well as by analytical characterization.
- Students will be able to test and understand the chemical, mechanical, electrical, optical, thermal, and permanence properties of plastics.
- Students will be able the principles of plastics testing and characterization.

TEXT BOOKS:

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**PT3511  PLASTICS TESTING AND CHARACTERIZATION LABORAOTY**

**OBJECTIVES:**
- To create the knowledge about the different testing techniques and its basic concepts for evaluating the chemical, mechanical, electrical, optical, thermal, and permanence properties of plastic materials.
- To enable the students to identify and compare the properties of different plastics materials
- To understand about characterisation techniques and equipments

**LIST OF EXPERIMENTS**
1. Determination of tensile, flexural and compression properties of plastics materials using universal testing machine.
2. Determination of Rate of flow of plastics (Melt flow index)
3. Identify the given plastic material using FTIR spectrum
4. Composition analysis of plastics composites using DSC and TGA
5. Determine the hardness (Shore A & D, Barcol and Rockwell) of plastic material
6. Determine the abrasion resistance of Plastic materials
7. Determine the impact strength (Izod, Charpy) of Plastic materials and dart impact strength of plastic films
8. Determine the Density, Moisture content and water absorption for plastic materials.
9. Testing of electrical properties of plastics a) Arc resistance b) Surface and Volume resistance c) Comparative tracking index (CTI) d) Dielectric strength e) Dielectric constant and dissipation factor
10. Determine the filler content (Ash content) and TiO₂ content in plastics
11. Determination of Heat deflection temperature and Vicat softening point of plastics materials
12. Determine the moulding shrinkage of given plastic materials  
(Any Nine of the above)  
TOTAL: 45 PERIODS

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

- Determine important properties of plastic materials
- Prepare specimen by injection moulding and contour cutting
- Will be able to get knowledge about the different testing techniques and its basic concepts for evaluating the chemical, mechanical, electrical, optical, thermal, and permanence properties of plastic materials.
- Will learn about sophisticated characterisation equipments

TEXT BOOKS:

REFERENCES:
1. ASTM, ISO and BIS standards of relevant tests

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PT3601  
PLASTICS PRODUCT TESTING  
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OBJECTIVES:
- To impart knowledge of National & International standards for testing methods.
- To create the knowledge about the different testing techniques and its basic concepts for evaluating the chemical, mechanical, electrical, optical, thermal, and permanence of plastic materials.
- To enable the students to identify and compare the properties of different plastics materials.
- To enable the students to learn about the property of the plastic material for several applications.
- To learn about failure analysis and destructive testing in polymers

UNIT I  
TESTING OF PLASTIC FILMS AND MULTILAYER LAMINATES  
Methods for identifying the construction of materials of films / laminates, chemical properties: Ash Content, Carbon Black content & dispersion, overall migration, colour migration and specific

UNIT II TESTING OF MOULDED PRODUCTS 9

UNIT III TESTING OF PIPES, SHEATHS AND TEXTILES 9

UNIT IV TESTING OF COMPOSITES 9
FRP: Thermoplastic and Thermosets, Tensile properties – Flexural Properties, Chemical Properties: Acid value, Amine Value, Carboxylic end group analysis, Gel time, Pot life, Resin viscosity, Fire retardant characteristics: Flammability, Spread of Flame, Toxicity Index, Smoke Density.

UNIT V FAILURE ANALYSIS OF PLASTICS PRODUCTS 9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course,

- Students will learn how the plastics products are tested to ensure its performance and quality.
- Will be able to get knowledge about the different testing techniques and its basic concepts for evaluating the chemical, mechanical, electrical, optical, thermal, and permanence properties of plastic materials.
- Will learn about sophisticated characterisation equipments
- Students can identify different plastics based on applications
- Students will be able to identify the root cause for failure of plastics products

TEXT BOOKS:
1. Allen; W.S and Baker; P.N, Hand Book of Plastics Technology, Volume 2, Identification,

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

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

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

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

COMMUNICATION
C 1  Introduction to Communication & Latest Trends 3

INFANTRY
INF 1  Organisation of Infantry Battalion & its weapons 3

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

TOTAL: 45 PERIODS

NAVAL ORIENTATION
NO 3  Modes of Entry - IN, ICG, Merchant Navy 3
AF 2  Naval Expeditions & Campaigns 3

NAVAL COMMUNICATION
NC 1  Introduction to Naval Communications 1
NC 2 Semaphore 1

NAVIGATION 2
N 1 Navigation of Ship - Basic Requirements 1
N 2 Chart Work 1

SEAMANSHIP 15
MH 1 Introduction to Anchor Work 2
MH 2 Rigging Capsule 6
MH 3 Boatwork - Parts of Boat 2
MH 4 Boat Pulling Instructions 2
MH 5 Whaler Sailing Instructions 3

FIRE FIGHTING FLOODING & DAMAGE CONTROL 4
FFDC 1 Fire Fighting 2
FFDC 2 Damage Control 2

SHIP MODELLING 3
SM Ship Modelling Capsule 3

TOTAL : 45 PERIODS

NCC Credit Course Level 3*

NX3653 (AIR FORCE WING) NCC Credit Course Level - III 3 0 0 3

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

BORDER & COASTAL AREAS 4
BCA 2 Security Setup and Border/Coastal management in the area 2
BCA 3 Security Challenges & Role of cadets in Border management 2

AIRMANSHP 1
A 1 Airmanship 1

BASIC FLIGHT INSTRUMENTS 3
FI 1 Basic Flight Instruments 3

AERO MODELLING 3
AM 1 Aero Modelling Capsule 3

GENERAL SERVICE KNOWLEDGE 2
GSK 4 Latest Trends & Acquisitions 2

AIR CAMPAIGNS 6
AC 1 Air Campaigns 6

PRINCIPLES OF FLIGHT 6
PF 1 Principles of Flight 3
PF 2 Forces acting on Aircraft 3

NAVIGATION 5
NM 1 Navigation 2
NM 2 Introduction to Met and Atmosphere 3
PT3611 PLASTICS PRODUCT TESTING LABORATORY

OBJECTIVES:
- To understand the mechanical and electrical properties of plastics
- To familiarize with various testing standards
- To identify different plastic materials for different applications

1. Testing of HDPE Pipes
2. Testing of UPVC Pipes
3. Testing of Water Storage Tanks
4. Testing of Films/Sheets
5. Testing of HDPE/PP Woven Sacks/Tapes
6. Testing of Baby Feed Bottles
7. Testing of Milk Packing Pouches
8. Testing of UPVC Pipe Fittings
9. Testing of Irrigation Product-Lateral
10. Testing of Irrigation Product-Emitters
11. Testing of Irrigation Product-Quick Coupled Pipes
12. Testing of FRP Sheets
13. Testing of PVC Conduit
14. Testing of electrical enclosures
15. Testing of UPVC profiles
(Any Nine of the above)

COURSE OUTCOMES:
- Carry out testing independently
- Understand the operating procedure of various testing machines
- Identify plastics for various applications

TEXT BOOKS:

REFERENCES:
PT3712  INDUSTRIAL TRAINING / INTERNSHIP II##
L T P C
0 0 0 2

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

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

No.of. Weeks: 04

OUTCOMES:
On completion of the course, the student will know about
CO1: Plant layout, machinery, organizational structure and production processes in the firm or research facilities in the laboratory/research institute
CO2: Analysis of industrial / research problems and their solutions
CO3: Documenting of material specifications, machine and process parameters, testing parameters and results
CO4: Preparing of Technical report and presentation

PT3701  PLASTICS PRODUCT DESIGN
L T P C
3 0 0 3

OBJECTIVES:
To enable the students
- To understand the concepts and features of Plastic Product design.
- To learn the basic concepts of designing with plastics for various loading applications, structural elements and joints.
- To understand the concepts of composite product design.
- To understand the concepts of assembly features
- To learn about holes & threads mould

UNIT I  PRODUCT DESIGN REQUIREMENT
9
UNIT II  PRODUCT DESIGN FEATURES
Wall thickness – variations in wall thickness – suggested wall thickness for various plastics materials – Taper & Draft – Design of radii, fillets, ribs and bosses – Shrinkage - Fits & Tolerances - External & Internal Undercuts

UNIT III  HOLES & THREADS

UNIT IV  ASSEMBLY FEATURES

UNIT V  DESIGN FOR COMPOSITES
Design Criteria for Composites- Cost, Size, Mechanical Properties, Repeatability and Precision, Damage Tolerance and Durability, Environmental Constraints - Design allowables- Need for Design allowables- development of design allowables- Important factors that affect the selection of allowables - Specific techniques used in the statistical development of allowable values.

TOTAL: 45 PERIODS

OUTCOMES:
- The students will understand the basics of plastics product design.
- The students will understand the basics of plastics mould design.
- They also acquire knowledge about various moulds for different processing techniques.
- The students can apply the basic design aspects related to Injection Mould, Compression Mould, Transfer Mould, Blow Mould.
- Will be able to apply the basic design aspects related to extrusion dies.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
To enable the students
- To know various sources of plastics waste generation
- To know segregation methods for recycling the plastics
- To know recycling codes of commodity and engineering plastics.
- To learn about primary recycling techniques with examples/case studies.
- To understand the recycling of various commodity and engineering plastics.

UNIT I INTRODUCTION TO PLASTICS WASTE MANAGEMENT

UNIT II PROCESSING OF COMINGLED PLASTIC WASTE
Size reduction of recycled plastics – cutting / shredding, densification, pulverization and chemical size reduction processes- municipal solid waste and composition – recycling of plastics from urban solid wastes - household waste – industrial sector –density and mechanical properties of recyclable plastics–Processing of commingled / mixed plastic waste – super wood, plastic lumber

UNIT III RECYCLING OF POLYOLIFINS, PET & PVC

UNIT IV RECYCLING OF ENGINEERING THERMOPLASTICS
Engineering thermoplastics and their major areas where engineering polymers are recycled – major recyclers of engineering plastics – GE/ Bayer/ MRC Polymers – PC, PBT, Nylon, PPO, ABS and polyacetals and their blends

UNIT V RECYCLING OF THERMOSET COMPOSITES

OUTCOMES:
Will understand the impact of plastic waste on environment
Will able to recycle of both commercial and engineering plastics.
Will thorough with policies related to environmental issues of plastics waste.
Will know legislations related to environmental issues of plastic waste.

TEXT BOOKS:

REFERENCES:
1. Degradable polymers, Recycling and Plastic Waste Management (Eds) Ann Christine
2. Albertson and Samuel J. Huang, Marcel Dekker, New York.

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

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

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

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

UNIT II SECULAR VALUES 6
Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.
UNIT III  SCIENTIFIC VALUES  6

UNIT IV  SOCIAL ETHICS  6
Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.

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

REFERENCES:
5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022

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

PT3711  CAD/CAM/CAE LABORATORY  L  T  P  C
0  0  4  2

OBJECTIVE:
To practice the students in Computer Aided Design, Manufacturing and Engineering software for mould design

LIST OF EXPERIMENTS:
I. Mold Design using CAD Software:
(1) Design calculations for No. of cavities, Selection of injection moulding machine, shot capacity, plasticizing rate, Clamping force for Injection mould
(2) 2D modeling for Two plate Injection Mould using CAD Software
(3) 2D modeling of Three Plate Injection Mould using CAD Software
(4) Design calculations for No. of cavities, Flash thickness allowances, Loading chamber, Bulk factor, Pressure pad, Heaters for Compressive Mould
(5) 2D modeling for Compression Mould using CAD Software
(6) Design calculations for Clamping force, pinch-off, Head die design, Parison dimensions for Blow Mould
(7) 2D Modeling for Blow Mould using CAD Software

II Mould machining using CAM software:

(1) CAM Programming for CNC Machining of Core and Cavity

III Mould Flow Analysis using CAE Software:

(1) Modelling and Mesh Creation using CAE Software
(2) Creation of Feed system and cooling system using CAE Software
(3) Gate Location Analysis using CAE software
(4) Fill Analysis using CAE software
(5) Flow Analysis using CAE software
(6) Cooling Analysis using CAE Software

OUTCOME:
At the end of this course, the students will be able to
- Design the moulds using CAD software
- Develop mould using CAM programming
- Analyze the flow and fill characteristics using CAE software

TOTAL:60 PERIODS

REFERENCES
5. Design calculations for Compression moulds, Machinery publications, Yellow series, U.K.

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

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

TOTAL: 300 PERIODS

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

OBJECTIVES:
- To enable the students to understand the basic materials in FRP system.
- To understand the raw materials for matrix resins and reinforcements.
- To acquire knowledge about various processing methods of composites.
- To understand the post processing operations, various applications of composites.
- To understand the various testing of FRP materials.

UNIT I REINFORCEMENTS FOR COMPOSITES
Composites- classifications - metal matrix composites, ceramic matrix composites, Polymer Composites- general properties and applications- Reinforcements: Properties and applications of - various types of glass fiber, carbon fibers, aramid fibers, boron fibers, natural fibers.

UNIT II GENERAL PURPOSE RESINS
Methods of manufacturing- properties, curing characteristics and applications of unsaturated polyesters - vinyl ester - phenol formaldehyde resin-urea formaldehyde resin-melamine formaldehyde resin.

UNIT III SPECIAL PURPOSE THERMOSETS
Methods of manufacturing, properties, curing characteristic and applications of epoxy resins, Polyimide, Thermoset polyurethanes and Cyanate esters resins.
UNIT IV  PROCESSING OF COMPOSITES  9
Composites Processing techniques - Hand Lay-Up, Spray- Up, Bag Molding, Resin Transfer Molding (RTM), Filament Winding, Pultrusion, Prepregs, SMC, DMC.

UNIT V  LAMINATES & TESTING OF COMPOSITES  9

OUTCOMES:
Upon completing this course, the students
  • Will familiarize about the resins used in FRP system
  • Will attain the knowledge of reinforcement mechanism
  • Will able to understand the processing methods of composites
  • Will attain the knowledge post processing operations of composites
  • Will develop the knowledge in testing of composites

TEXT BOOKS:

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PT3002  PLASTICS IN ELECTRONICS  L T P C  3 0 0 3

OBJECTIVES:
  • To learn about basic conduction mechanism, the concept of doping and dedoping
  • To understand different insulating polymers for electronic applications
  • To enable the students to understand the basic concepts on conducting polymers
  • To understand common applications of polymers in electronic field and the science behind them
  • To acquire knowledge about the fabrication of electronic device
UNIT I  FUNDAMENTALS OF ORGANIC ELECTRONICS  9
Introduction to Plastic electronics, Concept of organic semiconductors; Electrical conductivity, Electronic structure of organic molecules: Atomic and molecular orbitals, Orbital hybridization, HOMO and LUMO levels, Charge carrier transport in polymeric and organic semiconductors; Optical properties of organic semiconductors;

UNIT II  PLASTICS FOR ELECTRONICS ENCLOSURES AND ITS PROPERTIES  9
Electrically insulating polymers: Acrylonitrile Butadiene Styrene (ABS), Acrylonitrile Styrene Acrylate, Polycarbonate (ASA+PC Blend), Polyamide (PA), Polybutylene Terephthalate (PBT), Polycarbonate (PC), Polycarbonate + Acrylonitrile Butadiene Styrene (PC+ABS Blend), Epoxy, Silicone encapsulation & coating, Polycarbonate + Acrylonitrile Butadiene Styrene (PC+ABS Blend), Polymethyl Methacrylate, Acrylic, Plexiglas (PMMA), Polyphenylene Ether+Polystyrene (PPE+PS), Styrene Ethylene Butadiene Styrene (SEBS). Fluropolymers: Perfluoroelastomers (FFKM) and Polytetrafluoroethylene (PTFE), Phenolic Resins

UNIT III  INHERENTLY CONDUCTING POLYMERS AND ITS PROPERTIES  9
Introduction to Inherently Conducting Polymers, Classification of conducting polymer, Concept of doping, n-Type, p-Type, Electrochemistry of electronically conducting polymers-source of electronic conduction in polymers, polaron, bipolaron, conduction mechanism. Poly(p-phenylene vinylene), Polypyroles, Polyindoles, Polyanilines (PANI), Polythiophenes, Poly(3,4-ethylenedioxythiophene) (PEDOT), and Poly(p-phenylene sulfide) Adhesives, coatings, potting compounds, and sealants

UNIT IV  PLASTIC ELECTRONIC DEVICES  9

UNIT V  FABRICATION TECHNOLOGIES OF PLASTICS ELECTRONIC DEVICES  9

OUTCOMES:
Upon completing this course, the students
- Will understand basic conduction mechanism, the concept of doping and dedoping
- Will learn different types of insulating polymers for electronic applications
- Will understand the basic concepts on conducting polymers
- Be familiar with common applications of polymers in electronic field and the science behind them
- Will acquire knowledge about the fabrication of electronic device

REFERENCES:
2. Conducting Polymers: Chemistries, Properties and Biomedical Applications Ram K. Gupta, Taylor & Francis (2022)
PT3003 BIODEGRADABLE POLYMERS L T P C 3 0 0 3

OBJECTIVES:
- To enable the students to understand the method to develop biodegradable polymers
- To get knowledge on need of biodegradable polymer.
- To enrich various testing methods used for analyzing the biodegradability

UNIT I CHEMISTRY AND BIOCHEMISTRY OF POLYMER DEGRADATION 9
Introduction, enzymes - enzyme nomenclature - enzyme specificity - physical factors affecting the activity of enzymes - enzyme mechanism, Chemical degradation initiates biodegradation, Hydrolysis of synthetic biodegradable polymers.

UNIT II PARTICULATE STARCH BASED PRODUCTS 9
Development of Technology, Current objectives, relative starch technology, Manufacture of master batch, Conversion technology - processing precautions - moisture and temperature – rheological considerations, cyclic conversion process, physical properties of products - sample preparation - physical testing methods

UNIT III BIOPOLYESTERS 9
Introduction, History, biosynthesis, Isolation - solvent extraction - sodium hypo chloride digestion, enzymatic digestion, Properties - crystal structure - nascent morphology, degradation-Intracellular biodegradation - extra cellular biodegradation - thermal degradation - hydrolytic degradation - environmental degradation

UNIT IV RECYCLING TECHNOLOGY FOR BIODEGRADABLE PLASTICS 9

UNIT V TEST METHODS & STANDARDS FOR BIODEGRADABLE PLASTICS 9
Introduction, defining biodegradability, criteria used in the evaluation of biodegradable polymers, choosing the most appropriate methodology, description of current test methods -screening test for ready biodegradability, tests for inherent biodegradability, tests for simulation studies, - Petridis screen -environmental chamber method - soil burial tests

OUTCOMES:

TOTAL: 45 PERIODS
Upon completing this course, the students
- Will develop biodegradable polymer by various methods.
- Will understand mechanism of degradation of rubber compounds.
- Will assess bio-degradability of polymers.
- Will do recycle of biodegradable polymer.
- Will understand standards for biodegradable polymer.

TEXT BOOKS:

REFERENCES:
UNIT IV POLYMERIC LENSES

UNIT V DENTAL POLYMERS
Dental applications, denture bases, crown and bridge resins, plastic teeth, mouth protectors, maxillofacial prosthetic materials, restorative material, polyelectrolyte based restoratives, sealants, adhesives, dental impression and duplicating materials, agar, algmater elastomers.

TOTAL: 45 PERIODS

OUTCOMES:
- Able to describe the criteria for selection of bio medical polymers
- Able to explain the biomedical applications of polymers
- Able be familiarized with the polymers used in dental applications
- Able to attain the skill on polymeric lenses used in medical applications

TEXT BOOKS:

REFERENCES:
2. Chiellini; Emo, Sunamoto; Junzo, Migliaesi; Claudio, Ottebrite; Raphael and Cohn; Daniel (Eds.), Biomedical Polymers and Polymer Therapeutics, Kluwer Academic/Plenum Publishers, New York (2001).
3. Galaev; Igor and Mattiasson; Bo (Eds.), Smart Polymers; Applications In Biotechnology and Biomedicine, CRC Press, Boca Raton (2008).

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PT3005 ADHESIVES, PAINTS AND COATINGS

OBJECTIVES:
To enable the students to understand the following:
- Understand theories of adhesion and types of specialty adhesives and their application
- Understand the concepts of adherend surface treatments and hardening of adhesives
- Compare joint design on adhesive bond and testing of adhesives
- Surface coatings - constituents and classifications
- Evaluation of application and properties of surface coatings
UNIT I CONCEPTS AND TERMINOLOGY

Definition of Adhesives and adhesive bonding, functions of adhesives, advantages and disadvantages of adhesive bonding, requirements for a good bond, criteria for selection of adhesives. Theories of adhesion-mechanical theory, adsorption theory, electrostatic theory, diffusion theory, weak-boundary layer theory.

UNIT II ADHESIVES TYPES

Types of adhesives, Adhesives from natural source, structural adhesives, Urethane structured adhesives, Modified acrylic structural adhesives, phenolic adhesives, anaerobic adhesives, cyanoacrylate adhesives, hot melt adhesives, pressure sensitive adhesives, RTV Silicone adhesives. Epoxides, conductive adhesives-Low energy and high energy surface- surface preparation of adherends-metals, plastics and rubbers-Mechanical abrasion, solvent cleaning, chemical treatment, primers, plasma treatment, corona treatment.

UNIT III JOINT DESIGN

Hardening by solvent or dispersing medium removal, Hardening by cooling, Hardening by chemical reaction, non hardening adhesives-Joint design, stresses, types of joints, selection of joint detail, joint design criteria-Adhesive bonding process methods for adhesives application and bonding equipment, Standard test methods of adhesives-Destructive and non destructive testing, adhesive specifications and quality control.

UNIT IV INTRODUCTION TO SURFACE COATINGS

Introduction to surface coatings-Components of paints. Pigments, pigment properties, different types, extenders, solvents, oils, driers, diluents, lacquers, varnishes, paint preparation, formulation, factors affecting pigment dispersion, preparation of pigment dispersion. Different types of paints-classification based on polymeric resin, emulsion, oil and alkyd paints, acrylic paints, epoxy coatings, polyurethane, silicones, formaldehyde based resins, chlorinated rubbers, hydrocarbon resins, fluropolymers, vinyl resins. Classification based on application-applicance furnishes, automotive finishes, coil coatings, can coatings, marine coatings, aircraft coatings.

UNIT V SURFACE COATING METHODS

Surface preparation and paint application-brushing, dip coating, roller coating, spray coating, electro deposition and chemiphoretic deposition. Paint properties and their evaluation-mechanism of film formation, factors affecting coating properties, methods used for film preparation—barrier properties, mechanical properties, optical properties, ageing properties, rheological properties of coatings.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students
• Will attain the knowledge in mechanism of adhesion
• Will demonstrate the adhesive types and application
• Understanding of joint designs and testing of adhesives
• Will familiarize about the compounding of paints
• Will understand application techniques and properties of surface coatings

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**PT3006 POLYMERS IN TRANSPORTATION**

**OBJECTIVES**
- To understand different polymers used in the field of transportation
- To understand processing techniques for manufacturing plastic components
- To acquire knowledge about properties and application of polymers in the field of transportation
- To understand specialty Surface coatings for automotive and its necessity
- Evaluation of properties of surface coatings

**UNIT I INTRODUCTION**
Transportation Industries:- Automotive, aerospace and marine-Use of thermoplastic and thermoset polymers, foamed polymers, elastomers, composites for transportation application-Composite-fibers, matrix, interface-Advantages and disadvantages of composites.

**UNIT II PROPERTIES OF POLYMERS FOR TRANSPORT APPLICATIONS**
Properties of polymers for transport applications- Thermal, chemical, mechanical, weathering resistance, sound insulation, durability, fire retardancy.- Application of polymers in automotive, aerospace and marine industries-polymer concrete-test methods-shrinkage, tensile elongation, water absorption, abrasion, chloride ion penetration.

**UNIT III AUTOMOTIVE COMPONENT PROCESSES**
Automotive component processes-Injection moulding, Co injection moulding-Gas assisted Injection moulding-Reaction Injection molding (RIM) Extrusion moulding, automotive plastics testing include functionality testing, perceptivity testing, weathering and environmental testing, physical testing, chemical resistance and chemical testing for automotive interiors and exteriors.

**UNIT IV ENERGY CONSUMPTION IN TRANSPORTATION**
Energy consumption in transportation-Coatings technology for fuel efficiency-coatings used for transportation applications -coating techniques-DLC coating-application to engine components-Effect of Lubricant on Friction and Wear Properties of DLC Coatings-coatings for fuel injection systems, Coatings in Turbochargers-coatings for automotive manufacturing

**UNIT V SURFACE TREATMENTS FOR AUTOMOTIVE APPLICATIONS**
Surface treatments for automotive applications-Plasma assisted surface treatments, Heat treatments-PVD treatments-Magnetic sputtering, Thermal spraying-Decorative PVD coatings on
automotive plastics-Vacuum metallization of plastics, inline metallizer-transport system-Factory integration

**TOTAL: 45 PERIODS**

**OUTCOMES**
- Will familiarize about different polymers in transportation field
- Will demonstrate various processing techniques
- Will learn about different properties and applications of polymer in transportation field
- Will understand about different coating techniques
- Will learn different surface treatments of adherends and integration of vehicle components

**TEXTBOOKS**
- Long-Term Performance of Polymer Concrete for Bridge Decks - A Synthesis of Highway Practice, Fowler, David W., Whitney David W.
- Coating technology for vehicle appliations, Springer International Publishing, Sung Chul Cha, Ali Erdemir (eds.)
- Rubin, Irvin I., Injection Molding Theory & Practice, Johnwiley & sons Inc., US, 1972
- Formulating Adhesives and sealants, B. Muller, Walter lath, (2010).

**REFERENCES**
- Friedhelm Henson, Plastics Extrusion Technology, Hanser Publishers, New York,1988

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**PT3007 BIOPOLYMERS AND GREEN COMPOSITE**

**OBJECTIVES:**
- To gain knowledge of synthetic biopolymers
- To acquire knowledge on structure and properties of biopolymers
- To understand the basic applications of various biopolymers and green composites

**UNIT I GREEN CHEMISTRY OF POLYMERS**
Raw materials for polymers – Sustainability of Petroleum resources – Need for Alternate Sources for Polymers -Polymer Recycling and Environmental Issues – Bio derived Polymers – Biodegradation and its Evaluation techniques – Standards for biodegradation – Need for
biodegradation of packaging materials – Introduction to Life Cycle Assessment – Monomers from biosources.

UNIT II BIOPOLYMERS

UNIT III PROPERTIES AND APPLICATION OF BIOPOLYMERS
Testing and Characterization of Biopolymers: Mechanical strength, Biodegradability, Biocompatibility. Applications: Agriculture - Mulching Films, Shade nets, etc., Packaging: Wrap films, shrink wraps, etc. Biomedical: Biosensors, Tissue Engineering, Controlled Drug Delivery, Organ transplants, etc.

UNIT IV GREEN COMPOSITES

UNIT V PROPERTIES AND APPLICATIONS OF GREEN COMPOSITES

TOTAL: 45 PERIODS

OUTCOMES:
- The students will acquire in depth knowledge in biopolymers.
- Gain expertise in natural polymers, polymer prepared by microorganisms and polymers prepared form renewable sources.
- Gain knowledge on the synthesis of biopolymers the characterization methods.
- Will get exposure to various kinds of natural fibers, green composites and its application in various sectors.

TEXT BOOKS:

REFERENCES:
PT3008  POLYMER BLENDS AND ALLOYS  L T P C  3 0 0 3

OBJECTIVE:

- To enable the students to understand the miscibility of polymers, characteristics of blends and mechanism of toughening

UNIT I  CLASSIFICATION OF POLYMER BLENDS AND ALLOYS  9

UNIT II  PREPARATION OF POLYMER BLENDS AND ALLOYS  9

UNIT III  SPECIALITY POLYMER BLENDS  9
Liquid Crystalline Polymer, Blends-Ternary Polymer – Elastomer, Blends-Polymer blends containing block copolymers— Biodegradable polymer blends- blends involving recycled polymers and challenges with mixed recycled polymers.

UNIT IV  TOUGHENED THERMOPLASTICS AND THERMOSETS  9
Toughened polymers- Specific examples for toughened thermoplastics and thermostets – specific interaction - hydrogen bonding interaction, dipole-dipole interaction, ion–dipole & ion-ion interaction and additional specific interaction.

UNIT V  APPLICATION OF BLENDS AND ALLOYS  9
Application of Blends in Emerging technology - Photovoltaic, Light Emitting Diode, Electro chromic, Electric conductivity polymer and blends, Lithium battery & Fuel cells Applications

TOTAL: 45 Periods

OUTCOMES:
Upon completing this course, the students

- Able to express the basic concepts of polymer blend
- Able to infer the thermodynamic of polymer -polymer miscibility
- Able to classify the types of polymer blends
- Able to interpret the characterized polymer blends
- Able to discover the application of polymer blends
TEXT BOOKS:

REFERENCES:
2. Utracki, “Polymer Blends and Alloys”, Hanser Publisher.

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PT3009 ADVANCED MOULD MANUFACTURING L T P C 3 0 0 3

OBJECTIVES:
- To impart knowledge on various Cutting Tools and CNC Machines
- To develop the knowledge on elements of the mould and manufacturing processes with CAD/CAM/CAE
- To learn the application of additive manufacturing in mould development
- To acquire skills in advanced measuring instruments for inspection of mould

UNIT I CNC MACHINING CENTERS

UNIT II CNC TURNING CENTERS

UNIT III CNC DIE SINKING EDM AND WIRE EDM

UNIT IV RAPID TOOLING
Introduction to Additive manufacturing - Difference between rapid tooling & conventional tooling - Development of mould elements with RP- conformal cooling of mold elements – silicon moulds for Vacuum Casting - Epoxy Tooling System.

UNIT V ADVANCED METROLOGY

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students
- will have the knowledge in CNC Machine Tools for mould manufacturing
- will acquire skills in 3 D printing and Rapid tooling
- will acquire skills in advanced measuring equipment for inspection of mold
- will acquire skills in rapid tooling
- will acquire skills in CNCCMM and computer aided inspection.

TEXT BOOKS:
2. HMT Production Technology, Tata McGraw Hill, 2001

REFERENCES:
OBJECTIVES:

- To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology for plastics product
- To learn the fundamentals process of additive manufacturing process.
- To gain knowledge on solid & liquid based additive manufacturing
- To gain knowledge on powder based additive manufacturing
- To understand the post processing and applications of additives.

UNIT I  INTRODUCTION
Introduction to Additive Manufacturing (AM)- AM evolution- Distinction between AM & CNC machining- Advantages of AM- AM process chain- Conceptualization- CAD- conversion to STL Transfer to AM- STL file manipulation- Machine setup- build -removal and clean up-post processing- Classification of AM processes – Advantages and limitations of AM.

UNIT II  DESIGN FOR AM

UNIT III  SOLID & LIQUID BASED AM
Liquid Based AM: Stereo lithography Apparatus (SLA) - Solid Ground Curing (SGC) - Principle, pre-build process, part-building and post-build processes, resins, Advantages, limitations and applications Solid Based AM: Fused deposition Modeling (FDM) - Laminated Object Manufacturing (LOM) -Principles, details of processes, materials, advantages, limitations and applications.

UNIT IV  POWDER BASED AM

UNIT V  POST PROCESSING & APPLICATIONS OF AM
Post processing of AM parts: Support material removal - Surface texture improvement-Accuracy improvement - Aesthetic improvement - Preparation for use as a pattern- Property enhancement using non-thermal and thermal techniques. Applications of AM: Functional models- Pattern for investment and vacuum casting – Medical models - art models - Engineering analysis models- Rapid tooling ( Direct and Indirect method-New materials development- Bi-metallic parts- Remanufacturing- Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries;

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students
Will learn about a variety of Additive Manufacturing (AM) technologies, their potential to support design and manufacturing
Will learn the important research challenges associated with AM and its data processing tools
Will learn about solid and liquid based additives
Will learn about powder based additives
Will gain knowledge on applications and post processing treatment of additives.

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PT3011  
FIBRE TECHNOLOGY  
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OBJECTIVES:
To enable the students
- To learn about the production technologies of synthetic fibres such as melt spinning, wet spinning, dry spinning, texturing and stretching methods; colouration techniques of fibres.
- To enable the students to understand the need of various fibre production methods
- To acquire knowledge about various fibre drawing processes
- To enable the students to learn the basic knowledge of modified synthetic fibres.
- To learn about modification and testing of fibre

UNIT I  
CRITERIA FOR FIBRE FORMING POLYMERS  
9

UNIT II  
FIBRE PRODUCTION METHODS –i  
9
UNIT III FIBRE PRODUCTION METHODS-II


UNIT IV MODIFIED SYNTHETIC FIBRES

Modified synthetic fibres - modified polyester, Nylon, PP, acrylics - Hydrophilic -Hollow - Low pilling - flame retardant - bicomponent fibres - Dye ability of synthetic fibres

UNIT V TESTING OF YARN AND FIBRES


TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students
- Will have knowledge of polymer used in fiber formation.
- Will demonstrate the processing techniques for fiber formation.
- Will able to prepare a fiber forming polymers
- Will able fiber stretching polymers
- Will attain the knowledge of testing of fiber.

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PT3012 PLASTICS PACKAGING TECHNOLOGY

OBJECTIVES:

- To study about the functions of packaging.
• To enable the students to understand the concepts testing of packaging material.
• To know about the different packaging materials like cans, bottles, flexible films etc.
• To study about the various methods of packaging to improve the shelf life of the products.
• To learn about the testing of packaging.

UNIT I  
SELECTION CRITERIA FOR PACKAGING MATERIALS  

UNIT II  
CONVERSION PROCESS FOR PACKAGING MATERIALS  
Conversion process - Compression & transfer for moulding, Injection moulding, Blow moulding, Extrusion, roto moulding, thermoforming, Lamination, metalizing, decoration process, Shrink wrapping, Pallet & stretch wrapping.

UNIT III  
PROCESSES FOR FLEXIBLE PACKAGING  

UNIT IV  
PROCESSES FOR RIGID PACKAGING  
Thermoformed, moulded and rigid packages, Thermoforming packages: Position & thermoforming & wrap forming, solid phase pressure forming, scrabbles, twin sheet & melt - to-mold thermoforming, skin packaging, Polystyrene & other foams systems cushioning, plastic pallets, drums, shipping containers.

UNIT V  
TESTING OF PLASTIC PACKAGING  

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students
• Will learn about the functions of packaging
• will apply and examine the knowledge of properties of polymers for selection of packaging materials
• will select between different techniques of packaging
• Will study about the various methods of packaging to improve the shelf life of the products
• Will familiarize in testing of plastic packaging

TEXT BOOKS:

REFERENCES:
OBJECTIVES:

- To provide the students with basic knowledge on the natural rubber and various synthetic rubbers and their processing.
- To enable the students to understand the need of various additives and compounding of rubbers and vulcanization.
- To enable the students to learn the basic processing of rubber products like hose conveyor belts etc.
- To understand about Thermoplastic Elastomers, its manufacturing and applications
- To acquire knowledge about Rubber testing

UNIT I  NATURAL AND SYNTHETIC RUBBERS  9
Tapping latex, Processing of Latex - Dry rubber production (Smoked sheet, air dried sheet, Creep etc.) - Grading of rubbers - Modified natural rubber, Reclaimed rubber - process of reclamation - applications. Manufacturing, structure, properties, compounding, curing and applications - Polyisoprene, Polybutadiene, SBR, EPDM, Butyl rubber, Neoprene, Nitrile rubber, Silicone rubber, Fluoroelastomer, Polysulphide rubber, polyurethane rubber, Acrylic rubber.

UNIT II  COMPOUNDING DESIGN AND VULCANIZATION  9
Sulphur vulcanization and non-sulphur vulcanization, vulcanization systems - accelerators, activators, promoters, antioxidants, antiozonants, processing aids, fillers and effect of fillers, Blowing agents etc.

UNIT III  THERMOPLASTIC ELASTOMERS  9
Basic structure, Manufacture, Morphology, Commercial grades and Applications – Thermoplastic styrene block copolymers, Polyester thermoplastic elastomers, polyamide thermoplastic elastomer, Polyurethane thermoplastic elastomers.

UNIT IV  RUBBER PRODUCT MANUFACTURING  9
Manufacturing of Belting, Hoses, Footwear, Rubber metal bonded items, sports goods, cellular rubber, tyres etc.

UNIT V  RUBBER TESTING  9

TOTAL: 45 PERIODS
OUTCOMES:
- Upon completion of this course, the students will acquire the knowledge of natural rubber and other synthetic elastomers.
- They learn the basics of rubber compounding and vulcanization and rubber products manufacturing.
- They will acquire knowledge on Thermoplastic elastomers, its manufacturing and applications.
- Will understand the basic processing of rubber products like hose conveyor belts etc.
- Students will learn about rubber testing, its principles and applications.

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PT3014 DESIGN AND MANUFACTURE OF COMPOSITES  L T P C
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OBJECTIVES:
- To enable the students to acquire knowledge on composite materials.
- To understand Lamina equations in field of composites manufacturing.
- To gain knowledge in designing of laminates.
- To learn about design of FRP’s.
- To understand various production methods for composites.

UNIT I INTRODUCTION TO COMPOSITE

UNIT II LAMINA CONSTITUTIVE EQUATIONS


UNIT IV DESIGNING OF FIBRE REINFORCED PLASTICS 9 Design variables; Selection of fiber-matrix and manufacturing process; Effects of mechanical, thermal, electrical and environmental properties, Fiber orientation, Symmetric and asymmetric structure; Effects of unidirectional continuous and short fibers; Lamination theory.

UNIT V MANUFACTURING PROCESSES 9 Open mold processes – Hand layup, Spray up, Vacuum bag, Pressure bag & autoclave, Centrifugal casting, Filament winding; Closed mold processes – Compression molding, Resin transfer molding (RTM), Injection molding, Sandwich panels, Pultrusion; SMC & DMC products, etc.

Case studies and applications
Design for failure; FEA design packages; Design examples & case studies in FRP. Damage in composites.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the students will be able to,
- Understand the basics of composites
- Gain knowledge on design of laminates
- Acquire training in design of FRP’s
- Understand various manufacturing processes for production of composites
- Gain knowledge through case studies and design examples of FRP

TEXT BOOKS:

REFERENCES:
PT3015 FINITE ELEMENT METHODS L T P C 3 0 0 3

OBJECTIVES:
- Understand basics of Finite Element Analysis.
- Conduct analysis on trusses and beams
- Acquire knowledge in finite element modeling and Jacobian, Stiffness matrix.
- Understand Importance of torsional problems
- Understand dynamic analysis

UNIT I INTRODUCTION TO FEM 9
Introduction to FEM, basic concepts, historical background, applications of FEM, general description, comparison of FEM with other methods, variational approach, Glerkin’s Methods. Coordinates, basic element shapes, interpolation function, virtual energy principle, Rayleigh – Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain-displacement relations.

UNIT II 1-D STRUCTURAL PROBLEMS 9

UNIT III 2-D PROBLEMS 9

UNIT IV SCALAR FIELD PROBLEMS 9

UNIT V DYNAMIC ANALYSIS 9

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the student will be able to,
- Apply finite element method to solve problems in solid mechanics heat transfer.
- Formulate and solve problems in one dimensional structures including trusses, beams and frames.
Formulate FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, axi-symmetric and plate bending problems. ANSYS, ABAQUS, NASTRAN, etc.

Formulate and solve problems in three dimensional structures

Understand the consideration and conduct of dynamic analysis.

TEXT BOOKS:
2. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice – Hall.

REFERENCE BOOKS:
3. Finite Element Method and applications/R.D.Cook/WILEY publications
UNIT II ADDITIVES FOR PVC

UNIT III COMPOUNDING & FORMULATIONS

UNIT IV PVC PROCESSING TECHNOLOGY

UNIT V TESTING OF RESIN AND PRODUCTS

OUTCOMES:
At the end of the course, the students will be able to,
• Having knowledge in PVC Resin & Suitable processing method based on application.
• Suggest suitable compounding ingredients based on the requirements.
• Apply knowledge in compounding & Formulation of P VC materials & formulate polymers for suitable applications
• Suggest suitable Testing Method in compliance with Indian and international standards.
• Select suitable equipment for mixing additives.

TEXT BOOKS:
1. PVC Technology by AS Athalye,
2. Technology of PVC compounding and its applications by EIRI Board of Consultants & engineers.

REFERENCES:
1. PVC Handbook – Charles E. Wikes, James W. Summers, Charles A Daniels (Eds.)
2. PVC Technology by Titow, Elsevier, UK

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PT3017 ADVANCED EXTRUSION PROCESSING

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OBJECTIVE:

- To understand the basics, types and process of extrusion process.
- To learn the different types of extrusion process.
- To gain knowledge on die manufacturing in regards to extrusion.
- To understand the different films, coating and lamination process.
- To analyse various secondary extrusion process and methods.

UNIT I INTRODUCTION

UNIT II PROFILE EXTRUSION

UNIT III FILMS, COATING & LAMINATION

UNIT IV DIE DESIGN AND PERFORMANCE

UNIT V SECONDARY OPERATIONS

OUTCOMES:
Upon completion of the course, students will be able to
- Gain Knowledge on advanced extrusion processing techniques.
- Compare and contrast manufacturing methods of various extrusion products.
- Understand the manufacturing process and defect analysis of extrusion products.
- Learn the manufacturing process of various commercial and industrial extruded products.
- Analyse the manufacturing process and end product applications.

TEXT BOOK

REFERENCES
PT3018 ADVANCED INJECTION MOULDING TECHNOLOGY

OBJECTIVES:
- To enable the students to understand the basic injection process.
- To understand the moulding process of complex shapes and sizes.
- To acquire knowledge about various injection molding process.
- To understand the post processing operations, various applications of injection moulding.
- To understand the mould design involved in injection moulding.

UNIT I ADVANCED INJECTION MOULDING – I

UNIT II ADVANCED INJECTION MOULDING – II

UNIT III ADVANCED INJECTION MOULDING – III
Multi cavity moulding process – Water assisted Injection moulding – Metal Injection Moulding – Thin wall injection moulding – Cube moulding – Die Casting

UNIT IV MICROINJECTION MOLDING

UNIT V INJECTION MOULD DESIGN

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students
- Will familiarize about the materials used in Injection molding.
• Will attain the knowledge of various injection molding process.
• Will able to understand the processing methods of various products.
• Will attain the knowledge post processing operations of injection molding products.
• Will develop the knowledge of mold design in injection process.

TEXT BOOKS:
1. A Guide to Injection Molding of Plastics By Bolur, P.C.,

REFERENCES:
1. Reaction Injection Moulding machinery and process , F. Melvin Sweeney..
4. Injection Molding Technology By V.D.I.
5. Innovation in Polymer Processing By Stevenson.,1996.

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PT3019 ADVANCED BLOW MOULDING L T P C 3 0 0 3

OBJECTIVES:
• To enable the students to understand the basic and advance blow moulding process.
• To understand different types of blow moulding process for irregular shaped products.
• To acquire knowledge about various processing methods.
• To understand the designing of mould for blow moulding process.
• To understand the various maintenance and troubleshooting process.

UNIT I ADVANCED BLOW MOULDING PROCESS - I

UNIT II ADVANCED BLOW MOULDING PROCESS – II

UNIT III BLOW MOULDING OF IRREGULAR SHAPED PARTS
Caps and closures – Multiple parting lines – Industrial double wall blow molding – Mold preparation and other considerations.

UNIT IV INTRODUCTION TO MOULDS

UNIT V MAINTAINANCE
Maintenance of machines – Preventive & breakdown maintenance of different controlling mechanism – Start & Shut down process – Handling of dies, molds and accessories – Assembly of dies & molds – Dismantling of dies & molds – Cleaning of molds & dies – Maintenance of auxiliary equipment.

OUTCOMES:
Upon completing this course, the students
• Will familiarize about various blow molding process.
• Will attain the knowledge of designing mold for blow process.
• Will able to understand the processing methods of irregular shaped products.
• Will attain the knowledge maintenance process.
• Will develop the knowledge in advanced blow molding process.

TEXT BOOKS:

REFERENCES:
2. Schar J., Press blowing option for tough to blow parts, SPE ANTEC April’87

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PT3020 POLYURETHANE TECHNOLOGY L T P C 3 0 0 3

OBJECTIVES:
• To enable the students to understand the principles of PU chemistry and its applications.
• To get the knowledge in PU raw materials and processing techniques.
• To understand the concepts of PU foams, coatings and adhesives.

**UNIT I**  **PRINCIPLES OF PU CHEMISTRY AND APPLICATIONS**  9
Reactions of isocyanate group-building blocks for PUs-polyols, isocyanates, chain extenders – Preparation methods like prepolymer process, one shot process-preparation of aqueous two phase systems – Special areas like ionomers,LCP based on PUs, hydrogels, promoters- Uses in medical areas, bio technology, optical lenses etc Structure-property relationships in hard and soft segments - Morphology of domains-Effect of cross links on PU properties, structure-property relationships in ionomers.

**UNIT II**  **RAW MATERIALS AND PROCESSING OF PU**  9
Polyols, isocyanates – Their preparation and characteristics, conversion products of the raw materials – Additives – Industrial hygiene –Principles of PU processing

**UNIT III**  **PU FOAMS**  9

**UNIT IV**  **SOLID PU MATERIALS**  9
Solid polyurethane materials- polyurethane casting systems (cast elastomers and casting resins)-thermoplastic polyurethane elastomers: productions / processing, properties and applicationselastomers fibers, manufacture / processing and applications

**UNIT V**  **PU COATINGS AND ADHESIVES**  9
Solvent based coatings, air dried coatings, solvent free paints and coatings, applications of PU based coatings two components and one component adhesives based on PUs, solvent based adhesives, dispersion adhesives, hot melts, PU binders.

**TOTAL: 45 PERIODS**

**OUTCOMES:**
Upon completing this course, the students
• Know about building blocks for Polyurethanes
• Learn about Various types of raw materials used in preparation of PU
• Study about the production of flexible and rigid polyurethane foam
• Will have the knowledge of production, properties and uses of solid polyurethane
• Will have the knowledge of PU applications as coatings and adhesives

**TEXT BOOK:**

**REFERENCES:**
PT3021 INSTRUMENTATION AND PROCESS CONTROL L T P C 3 0 0 3

OBJECTIVE:
- To enable the students to learn the basic measurements system
- To understand the concepts of temperature pressure and flow measurements system
- To understand the instrumentation applications in polymer analytical techniques
- To enable the students to learn about various indicating & recording instruments
- To attain knowledge about analytical instruments

UNIT I GENERAL CONCEPTS OF MEASUREMENTS 9
Measurement -The three stages of generalized measurement system, Transducer: classification. Factors considered in selection of Transducers classification of errors, potentiometer, LVDT, tachometer. Strain gauge Types of electric strain gauges. Calibration of strain gauges, Non conduct measurements

UNIT II TEMPERATURE AND PRESSURE MEASUREMENTS 9
Thermometer, Resistance Temperature Detector, thermistor, thermocouple, total radiation pyrometers, optical pyrometer, Pressure measurement: Manometers, Elastic transducers, McLeod gauge, thermal conductivity gauges, calibration of pressure gauge using dead weight tester.

UNIT III FLOW AND MISCELLANEOUS MEASUREMENTS 9
Venturi, Orifice & nozzle meters, Pitot tube, turbine type meters, hot wire anemometer, magnetic flow meters. Level measurement: float level meters & electrical conductivity meters.

UNIT IV INDICATING AND RECORDING INSTRUMENTS 9

UNIT V INSTRUMENTATION IN ANALYTICAL TECHNIQUE 9
IR spectroscopy, Gas chromatography, X-ray spectrometer, Thermoanalytical method, Thermal conductivity analyzer, Measurement of color.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students
- Will be able to understand the general concept of measurements.
- Will acquire the knowledge in instruments for measurement
- Will familiarize with the indicating and recording instruments used in industry machinery
- Will understand the role of process control in polymer machinery
- Will understand the role of analytical instruments in polymer characterization
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PT3022 AUTOMATION IN POLYMER PROCESSING

OBJECTIVE:
- To introduce the importance of automation techniques in polymer processing industries.
- To impart the role of PLC in industry automation.
- To expose to various control techniques employed in process automation.
- To develop automation system for polymer processing industries
- To impart knowledge about PLC

UNIT I AUTOMATION IN PROCESS INDUSTRIES
Introduction- Automation in production system, Principles and strategies of automation, Basic elements of an automated system, Advanced automation functions, Levels of automations, Automated flow lines and transfer mechanisms, Analysis of transfer lines without storage, Automated flow lines with storage buffers.

UNIT II MATERIAL HANDLING AND IDENTIFICATION TECHNOLOGIES
Overview of material handling systems, Types of material handling equipment, Design of the system, Conveyor system, Automated guided vehicle system, Automated storage systems, Interfacing handling and storage with manufacturing, Overview of Automatic Identification Methods.

UNIT III AUTOMATED MANUFACTURING SYSTEMS
Automated Manufacturing Systems-Components, Classification and overview of manufacturing systems, Cellular manufacturing, Flexible manufacturing system(FMS), FMS and its planning and implementation, Automated assembly system – design and types of automated assembly systems, Analysis of multi station and single station assembly machine.
UNIT IV  COMPUTER BASED INDUSTRIAL AUTOMATION  9
Introduction to computer based industrial automation- Direct Digital Control (DDC), Distributed Control System (DCS) and supervisory control and data acquisition (SCADA) based architectures. SCADA for process industries includes understanding of RTUs, Pumping stations, Evacuation processes, Mass Flow Meters and other flow meters, Leak-flow studies of pipelines, Transport Automation.

UNIT V  PROGRAMMABLE LOGIC CONTROLLER  9
Programmable Logic Controller (PLC)- Block diagram of PLC, Programming languages of PLC, Basic instruction sets, Design of alarm and interlocks, Networking of PLC, Overview of safety of PLC with case studies. Process Safety Automation: Levels of process safety through use of PLCs, Integrating Process safety PLC and DCS, Application of international standards in process safety control.

OUTCOMES:
On completion of this course, the students will be able to
- Familiarize with various automation technologies in manufacturing and process industries.
- Understand various automation tools and methods in polymer processing industry.
- Implement various control and automation method in process industries.
- Familiarize with various communication technologies in manufacturing and process industries.
- Understand about PLC’s

TEXT BOOKS:

REFERENCES:
OBJECTIVE:

- To understand the basics, types and chemistry of foam formation
- To gain knowledge in formulation and manufacturing of foam materials
- To gain knowledge on latex foams and their production
- To gain knowledge on fiber foams and their production
- To gain knowledge on bio foams and their production

UNIT I INTRODUCTION
Introduction to Foam-Types of foam: flexible and Rigid foam, chemistry and physics of foam formation, Foaming ingredients - Blowing agents and its effects on foam morphology, physical properties of cellular plastics, Characteristics & Application.

UNIT II FOAM MATERIALS AND PROCESSES
Formulation and manufacturing processes, Materials: Polyethylene foams, expanded polystyrene, Expanded Polyethylene, EVA foam, Polyurethane (rigid & flexible) foams, Polyethylene foam LD & HD epoxy resin foams, metallic foams and ceramic foams. Core materials in sandwich composites.

UNIT III LATEX FOAMS

UNIT IV FIBER FOAM

UNIT V BIOBASED FOAMS
Introduction, Biobased Polyol & Polyurethane, High density polyurethane foams, bio-polyethylene foam, Cellulose foam, composite foams – Bio fillers –Properties: Antimicrobial, flame retardancy, compressive strength, etc.

OUTCOMES:

Upon completion of the course, students will be able to

- Gain Knowledge on introduction and basic concepts of foams
- Compare and contrast various production methods of foams
- Understand the manufacturing process and defect analysis of latex foams
- Learn the manufacturing process and applications of fiber foams
- Analyse the manufacturing process and properties of bio foams

TOTAL: 45 PERIODS

TEXT BOOK

REFERENCES
OBJECTIVE:
- To understand the machining and joining of plastics.
- To gain knowledge on different methods on joining plastics.
- To understand the concepts of adhesion and its importance.
- To understand the importance of secondary operations.
- To understand the importance of welding process.

UNIT I  INTRODUCTION

UNIT II  ULTRASONIC AND VIBRATION WELDING

UNIT III  SPIN & RADIO FREQUENCY WELDING

UNIT IV  LASER & INFRA-RED WELDING, SEALING

UNIT V SECONDARY OPERATIONS 9


Solvent Welding - Process Description - Advantages and Disadvantages – Applications – Materials – Equipment – Application methods


OUTCOMES:
Upon completion of the course, students will be able to
- Gain Knowledge on different welding and machining process.
- Compare and contrast various machining process of plastics.
- Understand the importance of joining plastics to produce new product.
- Learn the details of different equipment involved in various process.
- Analyse the secondary operations and its importance.

TEXT BOOK

REFERENCES
1. Hot plate welders , Ultrasonic welders, Spin welders, Vibration welders, Thermos takers, Leak Testers, Supplier marketing literature(GC 1095), Forward Technology Industries Inc., 1995

PT3025 PRODUCT DESIGN AND COST ESTIMATION L T P C
3 0 0 3

OBJECTIVES:
To facilitate the students
- To understand various aspects of design process & product life cycle.
- To train the student in the concept of product costing
- To gain the ideas in the field of manufacturing economics
To acquire knowledge about optimization of product design
To learn the recent advances in product design & development

UNIT I PRODUCT DESIGN AND DEVELOPMENT

UNIT II ECONOMICS OF DESIGN
Break Even point - Selection of optimal materials and processes – Material layout planning – Value analysis – Re-engineering and its impact on product development.

UNIT III PRODUCT MODELING

UNIT IV PRODUCT COSTING
Bill of materials – Outline Process charts – Concepts of operational standard time – Work measurement by analytical estimation and synthesis of time – Budget times – Labor cost and material cost at every stage of manufacture – W.I.P. costing

UNIT V RECENT ADVANCES AND CONCEPTS IN PRODUCT DESIGN
Fundamentals of Finite Element Method (FEM) and its significance in product design – Product life cycle management – Intelligent information system – Concept of Knowledge based product and process design.

TOTAL: 45 PERIODS

OUTCOMES
Upon completion of the course, the student will be able to:
- Understand the fundamentals of product design
- Attain the knowledge in value analysis & Re-engineering
- Understand the product modeling and standardization
- Understand the concept of costing in product design
- Gain knowledge in various advances in product design

TEXTBOOKS:

REFERENCES:
PT3026  ENGINEERING STATISTICS AND QUALITY CONTROL

OBJECTIVES
- To impart knowledge on the application of statistical methods for measuring and controlling quality of processes / products.
- Enhance the student understanding of the complexities of Statistical Analysis and control chart interpretation
- To understand the concept of reliability and it’s improving techniques and design of experiments
- To understand the need of control charts for attributes
- To elucidate importance and types of economic sampling

UNIT I  QUALITY FUNDAMENTALS
Importance of quality- evolution of quality- definitions of quality- dimensions of quality- quality control- quality assurance- areas of quality- quality planning- quality objectives and policies-quality costs- economics of quality- quality loss function- quality Vs productivity- quality in random and selective assembly

UNIT II  CONTROL CHARTS FOR VARIABLES
Process variation- preliminary decisions- control limits and their computation- construction and application of X bar, R and S charts- warning and modified control limits- process adjustment for trend,- Comparison of process variation with specification limits-O.C. curve for X bar chart.

UNIT III  STATISTICAL PROCESS CONTROL
Process stability- process capability study using control charts- capability evaluation- Cp, Cpk and Cpm–capability analysis using histogram and normal probability plot- machine capability study- gauge capability study- setting statistical tolerances for components and assemblies-individual measurement charts- X-chart, moving average and moving range chart, multi-vari chart.

UNIT IV  CONTROL CHARTS FOR ATTRIBUTES
Limitations of variable control charts- Control charts for fraction non-conforming- p and np charts, variable sample size, operating characteristic function, run length- Control chart for nonconformities (defects)- c, u, ku charts, demerits control chart- applications.

UNIT V  ACCEPTANCE SAMPLING
Need- economics of sampling- sampling procedure- single and double sampling- O.C. curves-Average outgoing quality- Average sample number- Average total inspection- Multiple and sequential sampling- Standard sampling plans- Military, Dodge-Roming, IS 2500.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, students will be able to
- Understand the importance of quality control & assurance.
- Gain knowledge on control charts like X bar, R&S charts for variables.
- Understand the process control techniques in statistics.
- Expertise in control charts like p & np, C, u,Ku etc.
- Understand the need for economic sampling and its types.

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PT3027  CIRCULAR ECONOMY AND EXTENDED PRODUCER RESPONSIBILITY  L T P C 3 0 0 3

OBJECTIVES:
To facilitate the students
- To study facts about circular economy & its building blocks
- To gain knowledge in key application areas of circular economy
- To learn various business models of circular economy.
- To acquire knowledge about ERP
- To understand sustainability management & zero waste practices.

UNIT I  INTRODUCTION
Emergence of the concept and current definitions - Circular economy and Sustainable development - Global initiatives towards circular economy - Principles of the circular economy - Building Blocks of Circular Economy.

UNIT II  ACTION AREAS OF CIRCULAR ECONOMY

UNIT III  BUSINESS MODELS OF CIRCULAR ECONOMY
Circular suppliers - Resources recovery - Sharing platforms - Product life extension - Product as a service - Sharing Economy ; Industrial Symbiosis – Key benefits & steps.

UNIT IV  EXTENDED PRODUCER RESPONSIBILITY (EPR)

UNIT V  ECO-DESIGN
The historical development of Eco-design - Process of Eco Design - Legal framework of eco-design - Types of Eco-design – Stages of Eco-design – Applications of Eco Design ; Supply chain : Circular Economy & supply chain – Loopy supply chain

OUTCOMES:
Upon completion of the course, the student will be able to:
- Understand the fundamentals of circular economy
- Attain the knowledge in applications & building blocks of circular economy
- Understand the cSoncept of waste management & recycling
- Be familiar with eco design process
- Gain knowledge in various supply chain & its importance

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PT3028 POLUTION, REGULATORY NORMS AND CONTROL EQUIPMENT L T P C 3 0 0 3

OBJECTIVES:
To enable the students
- To understand the nature, ecosystem and role of pollution
- To train the student in the regulatory norms of pollution
- To gain the ideas in the field OHASMS
- To acquire knowledge about air, water and noise pollution
- To learn the mitigation measures and control equipment of pollution

UNIT I ENVIRONMENTAL POLLUTION 9

UNIT II ENVIRONMENTAL PROTECTION & ENVIRONMENTAL LAW 9

UNIT III AIR POLLUTION & CONTROL 9

UNIT IV WATER POLLUTION & CONTROL 9
Sources of surface and ground water pollution - water quality parameters: COD, BOD, DO - Effect of water contaminants on human health (nitrate, fluoride, arsenic, chlorine, cadmium, mercury, pesticides) - water borne diseases - concept and working of effluent treatment plants (ETPs). Sources of marine pollution: oil spill, coral reefs, coastal area management - Control - Activated Sludge Process (ASP) – Trickling Filters – oxidation ponds, fluidized bed reactors, membrane bioreactor neutralization - ETP sludge management; digesters, up flow anaerobic sludge blanket

UNIT V  NOISE POLLUTION & CONTROL

OUTCOMES
Upon completion of the course, the student will be able to:
- Understand the fundamentals of environmental pollution
- Attain the knowledge in various acts & laws of environmental protection
- Understand the concept of air pollution & its mitigation
- Understand the concept of water pollution & its mitigation
- Gain knowledge in various waste management methods

TOTAL: 45 PERIODS

TEXTBOOKS:

REFERENCES:
1. P. Leelakrishnan, Environmental Law in India (5th ed., 2019)

PT3029  FINTECH AND BLOCK CHAIN

OBJECTIVES:
To facilitate the students
- To understand the several aspects of Fintech & Regtech
- To train the student in the concept of Block Chain
- To gain the ideas in the field of application & classification of Block Chain
- To acquire knowledge about the role of Block Chain in ICO & its implementation
- To learn about various block chain models
UNIT I  FINTECH  9

UNIT II  FINTECH REGULATION AND REGTECH  9

UNIT III  INTRODUCTION TO BLOCKCHAIN  9
Introduction to Block chain – History of Blockchain-Terminologies in Blockchain-Types of Blockchain-Applications of Blockchain- working methodology-Ingredients of Blockchain - Generic elements of Blockchain - Features of Blockchain - Types of Blockchain.

UNIT IV  BLOCK CHAIN IN BUSINESS  9
Public versus private and permissioned versus permission less blockchains- Privacy and anonymity in Ethereum- Importance privacy and anonymity - The Ethereum Enterprise Alliance- Block Chain as-a-Service- Initial Coin Offering (ICO): Project setup for ICO implementation- Token contracts- Token sale contracts-Contract security and testing the code.

UNIT V  BLOCKCHAIN BUSINESS MODELS  9

TOTAL: 45 PERIODS

OUTCOMES
Upon completion of the course, the student will be able to:
- Understand the fundamentals of FinTech & its infrastructure
- Attain the knowledge in RegTech Ecosystem & RegTech Startups
- Understand the block chain concepts
- Identify the various key application areas of block chain
- Gain knowledge in various business models for block chain

TEXTBOOKS:

REFERENCES:
2. Jai Singh Arun, Jerry Cuomo, Nitin Gaur Blockchain for Business- For Understanding transformation, growth and new models of Business -First Edition Published by Pearson Paperback–12December2019


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PT3030 ENTREPRENEURSHIP DEVELOPMENT L T P C 3 0 0 3

OBJECTIVES:
- To develop and strengthen entrepreneurial quality and motivation in students
- To impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.
- To impart knowledge on small enterprises and their classification
- To elucidate the basics of finance and accounting
- To understand the various support systems available for entrepreneurs.

UNIT I ENTREPRENEURSHIP

UNIT II MOTIVATION
Major Motives Influencing an Entrepreneur–Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III BUSINESS

UNIT IV FINANCING AND ACCOUNTING

UNIT V SUPPORT TO ENTREPRENEURS

TOTAL: 45 PERIODS
OUTCOME:
Upon completion of the course, students will be able
- To gain knowledge and skills needed to run a business successfully.
- To understand the basic concepts and factors affecting entrepreneurship
- To learn about small enterprises and their classification
- To understand the steps involved in setting up a business
- To acquire knowledge about finance and accounting and supports available for entrepreneurs

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PT3031 INTELLECTUAL PROPERTY RIGHTS (IPR) L T P C 3 0 0 3

OBJECTIVES:
- To give an idea about IPR, registration and its enforcement.
- To give an overview of the research methodology and explain the technique of defining a research problem.
- To explain the art of interpretation and the art of writing research reports.
- To discuss leading International Instruments concerning Intellectual Property Rights.
- To understand the types of patents & various process for patent application

UNIT I PRINCIPLES OF IPR 9
UNIT II PATENT LAW AND PRACTICES

UNIT III COPYRIGHT LAW AND PRACTICES
Copyright concept and principles - Historical background and Development of Copyright Law. Copyright Act, 1957. Terms of Copyright, conditions for grant of copyright - extent of rights - exception to copyright protection - fair use provision, assignment and licensing. Author Special Rights - Right of Broadcasting and performers. Copyright Registrar and Copyright Board. Power of Procedure Copyright Societies, Ownership, Assignment, License - Translation of Copyright, Compulsory Licenses. Infringement - Criteria of Infringement. Infringement of Copyright - Films, Literary and Dramatic works, Importation and Infringement.

UNIT IV TRADEMARK LAW AND PRACTICES

UNIT V EMERGING ISSUES AND CHALLENGES
Public health and Intellectual Property Rights - Case study—Novartis Pharmaceuticals, Bayer Pharmaceuticals - TRIPS Flexibilities and access to medicine - IPR and Climate change, Patents and Biotechnology - Traditional knowledge and IPR - Bio piracy - Domain Name Disputes - Cyber squatting.

TOTAL: 45 PERIODS

OUTCOMES
- Ability to manage Intellectual Property portfolio to enhance the value of the firm.
- Formulate a research problem for a given engineering domain.
- Analyse the available literature for given research problem.
- Develop the technical writing and presentation skills.
- To understand the concept related to IPR
- Comprehend concepts related to patents, trademark and copyright

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PT3032 ENGINEERING MANAGEMENT

**OBJECTIVE:**
- To introduce the employment trends and challenges in engineering sector
- To impart knowledge on business essentials
- To elucidate the importance of Engineers as Managers/Leaders
- To impart knowledge about ethics in industrial and business sector
- To brief new trends and growth of engineering management

**UNIT I** INTRODUCTION TO MANAGEMENT CHALLENGES FOR ENGINEERS

**UNIT II** BUSINESS ESSENTIALS FOR ENGINEERING MANAGERS

**UNIT III** ENGINEERING LEADERSHIP IN THE NEW MILLENNIUM

**UNIT IV** ETHICS, OPERATIONAL EXCELLENCE AND GLOBALIZATION

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UNIT V  ENGINEERING MANAGEMENT IN NEW MILLENNIUM  9

OUTCOME:
Upon successful completion of the course, students will be able to:
• Gain knowledge in basics of industrial management
• Learn about business essentials like Cost Accounting, Marketing and finance Accounting
• Learn the prerequisites and career plan leading to turn engineers as managers
• Learn about the work place ethics, globalization and operational excellence
• Gain ideas on scope of new techniques in engineering management.

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GE3751  PRINCIPLES OF MANAGEMENT  L T P C  3 0 0 3

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

UNIT I  INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS  9
UNIT II  PLANNING  9

UNIT III  ORGANISING  9

UNIT IV  DIRECTING  9

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

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

UNIT I  INTRODUCTION  9
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality – Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM – Benefits of TQM.

UNIT II  TQM PRINCIPLES  9

UNIT III  TQM TOOLS & TECHNIQUES I  9

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

UNIT V  QUALITY MANAGEMENT SYSTEM  9

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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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  9
Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice.

UNIT IV  FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT)  9
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)  9
Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.

TOTAL: 45 PERIODS

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

TEXT BOOKS:

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

MAPPING OF COS AND POS:

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OBJECTIVE:

- To provide knowledge about management issues related to staffing,
- To provide knowledge about management issues related to training,
- To provide knowledge about management issues related to performance
- To provide knowledge about management issues related to compensation
- To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.

UNIT I            INTRODUCTION TO HUMAN RESOURCE MANAGEMENT                                   9

UNIT II            HUMAN RESOURCE PLANNING                                           9

UNIT III            TRAINING AND EXECUTIVE DEVELOPMENT                               9
Types of training and Executive development methods – purpose – benefits.

UNIT IV            EMPLOYEE COMPENSATION                                        9

UNIT V            PERFORMANCE EVALUATION AND CONTROL                                9

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

TOTAL: 45 PERIODS

TEXT BOOKS:


REFERENCES:

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

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

UNIT II CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING

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

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

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

COURSE OUTCOMES:
Upon completion of the course, the student should be able to:
CO1: Understand the process of acquiring knowledge from experts
CO2: Understand the learning organization.
CO3: Use the knowledge management tools.

TOTAL: 45 PERIODS
CO4: Develop knowledge management Applications.
CO5: Design and develop enterprise applications.

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

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**TEXT BOOK:**

**REFERENCE:**

**GE3792**
**INDUSTRIAL MANAGEMENT**
**L T P C**
3 0 0 3

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

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

**UNIT – II**
**FUNCTIONS OF MANAGEMENT - I**
9
Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.
UNIT – III  FUNCTIONS OF MANAGEMENT - II  9
Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin)
Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines;
Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics;
Nature; Process; Classifications.

UNIT – IV  ORGANIZATION THEORY  9
Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group;
Conflict Management – Maslow’s hierarchy of needs theory; Herzberg’s motivation-hygiene theory; McClelland’s three needs motivation theory; Vroom’s valence-expectancy theory – Change Management: Concept of Change; Lewin’s Process of Change Model;
Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

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

TOTAL: 45 PERIODS

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

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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
OBJECTIVE:

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

1. COURSE CONTENTS
   Introduction to Elements of Literature

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

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

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

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

3. READINGS:


3.1 Textbook:
3.2 *Reference Books:: To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper.
4. OTHER SESSION:
   4.1 Tutorials:
   4.2 Laboratory:
   4.3 Project: The students will write a term paper to show their understanding of a particular piece of literature

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

TOTAL: 45 PERIODS

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

MX3083 FILM APPRECIATION
3 0 0 0

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

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

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

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

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

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

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

MX3084  
DISASTER RISK REDUCTION AND MANAGEMENT  
L T P C  
3 0 0 0  
COURSE OBJECTIVE  
- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management  
- To acquaint with the skills for planning and organizing disaster response  

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

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

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

UNIT IV  
TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT  
Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient
Development – Standard operation Procedure for disaster response – Financial planning for disaster Management

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

TOTAL : 45 PERIODS

TEXT BOOKS:

REFERENCES

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

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MANDATORY COURSES II

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

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

UNIT I HEALTH AND ITS IMPORTANCE

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


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

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

UNIT II DIET

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


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

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

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

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 4+4
AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.
Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.
Principles of Siddha & Ayurveda systems - Macrocosp and Microcosop theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal

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

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

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

TOTAL : 45 PERIODS

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

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

COURSE OUTCOMES:
After completing the course, the students will be able to:
- Learn the importance of different components of health
- Gain confidence to lead a healthy life
- Learn new techniques to prevent lifestyle health disorders
- Understand the importance of diet and workouts in maintaining health
Development in medical knowledge, interaction between Unani and Ayurveda and alchemy
Astronomy and Mathematics: interaction with Arabic Sciences
Science and Technology on the eve of British conquest

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

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

TOTAL: 45 PERIODS

MX3087 POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY  L T P C
Pre-Requisite: None. (Desirable: Universal Human Values 1, Universal Human Values 2)

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

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

(Refs: A Nagaraj, M K Gandhi, JC Kumarappa)
Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. (5 lectures)

(Refs: Adam smith, J S Mill)
Fascism and totalitarianism. World war I and II. Cold war. (2 lectures)
Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.

(Refs: Marx, Lenin, Mao, M N Roy) (5 lectures)
Welfare state. Relation with human desires. Empowered human beings, satisfaction. (3 lectures)
Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one’s lives. Relationship with nature. (6 lectures)

(Refs: M K Gandhi, Schumacher, Kumarappa)
Essential elements of Indian civilization. (3 lectures)

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

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

Conclusion (2 lectures)

Total lectures: 39

Preferred Textbooks: See Reference Books

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

GRADING:

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TOTAL : 45 PERIODS

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

MX3088 STATE, NATION BUILDING AND POLITICS IN INDIA

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?

TOTAL: 45 PERIODS

OUTCOME OF THE COURSE:

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

SUGGESTED READING:


MX3089 INDUSTRIAL SAFETY L T P C 3 0 0 0

OBJECTIVES

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

UNIT I SAFETY TERMINOLOGIES

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

UNIT II STANDARDS AND REGULATIONS

UNIT III SAFETY ACTIVITIES

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

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

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

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

REFERENCES:
5. Society of Safety Engineers, USA

ONLINE RESOURCES
<table>
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<td>Understand the basic concept of safety.</td>
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<td>CO2</td>
<td>Obtain knowledge of Statutory Regulations and standards.</td>
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<td>CO3</td>
<td>Know about the safety Activities of the Working Place.</td>
<td>PO 3</td>
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<td>CO4</td>
<td>Analyze on the impact of Occupational Exposures and their Remedies.</td>
<td>PO 4</td>
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<td>CO5</td>
<td>Obtain knowledge of Risk Assessment Techniques.</td>
<td>PO 5</td>
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OPEN ELECTIVE I AND II

OCS351 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS

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

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH 6

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

**UNIT III**

**LEARNING**

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

**UNIT IV**

**SUPERVISED LEARNING**


**UNIT V**

**UNSUPERVISED LEARNING**

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

**PRACTICAL EXERCISES: 30 PERIODS**

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

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

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

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

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

**TEXT BOOK**

**TOTAL PERIODS: 60**
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  

OCS353  
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  
6  
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  
9  
Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance

UNIT III MACHINE LEARNING 5
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 5

UNIT V HANDLING LARGE DATA 5
Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system - Tools and techniques needed - Research question - Data preparation - Model building – Presentation and automation.

PRACTICAL EXERCISES: 30 PERIODS
LAB EXERCISES 30 PERIODS
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.

TEXT BOOKS

REFERENCES

CCS333 AUGMENTED REALITY/VIRTUAL REALITY

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

UNIT I INTRODUCTION 7

UNIT II VR MODELING 6

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

UNIT IV APPLICATIONS 6

UNIT V AUGMENTED REALITY 5
Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation-Navigation-Wearable devices

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

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

CO’s – PO’s & PSO’s MAPPING

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

CO-PO & PSO MAPPING

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

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

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

TEXTBOOKS:

REFERENCE BOOKS:

WEBSITES
- [http://civilservicesmentor.com/](http://civilservicesmentor.com/)
- [http://www.educationobserver.com](http://www.educationobserver.com)
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
Concepts in lean thinking - Principles of lean construction - Variability and its impact - Traditional construction and lean construction - Traditional project delivery - Lean construction and workflow reliability - Work structuring - Production control.

UNIT IV LEAN TOOLS AND TECHNIQUES

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

OUTCOME:
On completion of this course, the student is expected to be able to
CO1 Explain 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 Develop 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:
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

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

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

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

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

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

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

TOTAL 45 : PERIODS

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

CME365 RENEWABLE ENERGY TECHNOLOGIES

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

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

UNIT – II SOLAR ENERGY

UNIT – III WIND ENERGY

UNIT – IV BIO-ENERGY

UNIT – V OCEAN AND GEOTHERMAL ENERGY

TOTAL: 45 PERIODS

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

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

OME354 APPLIED DESIGN THINKING

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

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

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

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

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

System Thinking, Understanding Systems, Examples and Understandings, Complex Systems

TOTAL: 45 PERIODS

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.idealou.com/pages/design-thinking#process
4. https://blog.forgefor ward.in/evaluating-product-innovations-e8178e58b86e
5. https://blog.forgefor ward.in/user-guide-for-product-innovation-rubric-857181b253dd
6. https://blog.forgefor ward.in/star_tup-failure-is-like-true-lie-7812cde9b85

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 of material characteristics, part durability and life limitation in reverse engineering of product design and development.
● Applying the concept and principles of material identification and process verification in reverse engineering of product design and development.
● Analysing the various legal aspect and applications of reverse engineering in product design and development.
● Understand about 3D scanning hardware & software operations and procedure to generate 3D model

UNIT I  INTRODUCTION & GEOMETRIC FORM

UNIT II  MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION  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:

### Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial

**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
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
Technology Management - Definition - Functions - Evolution of Modern Management - Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization - Individual Ownership - Partnership - Joint Stock Companies - Co-operative Enterprises - Public Sector Undertakings, Corporate Frame Work- Share Holders - Board of
Directors - Committees - Chief Executive Line and Functional Managers,-Financial-Legal-Trade Union

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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OIE354 QUALITY ENGINEERING

COURSE OBJECTIVES

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

UNIT I INTRODUCTION 9

UNIT II CONTROLCHARTS 9
Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables—X, R and S charts, attribute control charts—p, np, c and u—Construction and application.

UNIT III SPECIAL CONTROL PROCEDURES 9
Warning and modified control limits, control chart for individual measurements, multi-vari chart, X chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

UNIT IV STATISTICALPROCESSCONTROL 9
Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNIT V ACCEPTANCESAMPLING 9
The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS 2500 standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students will be able to:

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

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

CO3: Control the occurrence of defects in services.

CO4: Analyzing and understanding the process capability study.

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

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187
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

TOTAL : 45 PERIODS

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

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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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.

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1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS

REFERENCES
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-Effecter Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

TOTAL : 45 PERIODS

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

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CO/PO & PSO Average

1 – Slight, 2 – Moderate, 3 – Substantial

### TEXT BOOKS:

### REFERENCES:

### OAE352 FUNDAMENTALS OF AERONAUTICAL ENGINEERING

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

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

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

**UNIT III  BASICS OF AERODYNAMICS**
UNIT IV  BASICS OF AIRCRAFT STRUCTURES  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.

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

TEXT BOOKS

REFERENCE

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

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

UNIT I  REMOTE SENSING AND ELECTROMAGNETIC RADIATION  9

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

UNIT IV SENSING TECHNIQUES

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

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

TEXTBOOKS:

REFERENCES:

CO-PO MAPPING

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

UNIT I SOURCES OF WATER
Public water supply system - Planning, Objectives, Design period, Population forecasting; Water demand - Sources of water and their characteristics, Surface and Groundwater - Impounding Reservoir - Development and selection of source - Source Water quality - Characterization - Significance - Drinking Water quality standards.

UNIT II CONVEYANCE FROM THE SOURCE
Water supply - Intake structures - Functions; Pipes and conduits for water - Pipe materials - Hydraulics of flow in pipes - Transmission main design - Laying, jointing and testing of pipes - Appurtenances - Types and capacity of pumps - Selection of pumps and pipe materials.

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
Requirements of water distribution - Components - Selection of pipe material - Service reservoirs - Functions - Network design - Economics - Computer applications - Appurtenances - Leak detection - Principles of design of water supply in buildings - House service connection - Fixtures and fittings, systems of plumbing and types of plumbing.

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

TEXTBOOKS:

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

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**

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COURSE OBJECTIVES

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

**UNIT I ROTATING POWER CONVERTERS**


**UNIT II STATIC POWER CONVERTERS**

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

**UNIT III CONTROL OF DC AND AC MOTOR DRIVES**

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

**UNIT IV HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS**

UNIT V  MECHANICS OF HYBRID ELECTRIC VEHICLES AND CONTROL OF VEHICLES

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

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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TOTAL: 45 PERIODS

REFERENCES:

OEI353  INTRODUCTION TO PLC PROGRAMMING  

COURSE OBJECTIVES:

1. Understand basic PLC terminologies digital principles, PLC architecture and operation.
2. Familiarize different programming language of PLC.
3. Develop PLC logic for simple applications using ladder logic.
4. Understand the hardware and software behind PLC and SCADA.
5. Exposures about communication architecture of PLC/SCADA.
UNIT I  INTRODUCTION TO PLC
Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers/DSP, PLC/DDC- PLC Construction: What is a PLC, PLC Memories, PLC I/O, PLC Special I/O, PLC Types.

UNIT II  PLC INSTRUCTIONS
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

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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OFD352 TRADITIONAL INDIAN FOODS L T P C 3 0 0 3

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

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

UNIT II TRADITIONAL METHODS OF FOOD PROCESSING 9

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

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1To understand the historical and traditional perspective of foods and food habits
CO2 To understand the wide diversity and common features of traditional Indian foods and meal patterns.

TEXT BOOKS:

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

TOTAL: 45 PERIODS

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

TEXT BOOKS/REFERENCES:

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

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

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

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

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


UNIT V INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY


TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES:
The student will be able to
C1 Understand and differentiate the categories of intellectual property rights.
C2 Describe about patents and procedure for obtaining patents.
C3 Distinguish plant variety, traditional knowledge and geographical indications under IPR.
C4 Provide the information about the different enforcements and practical aspects involved in protection of IPR.
C5 Provide different organizations role and responsibilities in the protection of IPR in the international level.
C6 Understand the interrelationships between different Intellectual Property Rights on International Society

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<th>CO – PO MAPPING</th>
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204
OBJECTIVE:

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

UNIT I RESIN FINISHING

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

UNIT III SOIL RELEASE AND ANTISTATIC FINISHES

UNIT IV MECHANICAL FINISHES

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

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 repellant, Antimicrobial finishes.
- CO: 3 Concept of Soil Release, Anti Pilling, UV Protection and Antistatic finishes.
- CO: 4 Concept of Mechanical finishing.
- CO: 5 Basics of Micro encapsulation techniques, Nano finish, Plasma Treatment.

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
1. Microencapsulation in finishing, Review of progress of Colouration, SDC, 2001 62
Upon the completion of the course the student shall be able to understand

**OUTCOMES:**

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

**UNIT I  INTRODUCTION**

Scope of industrial engineering in apparel Industry, role of industrial engineers.

**Productivity:** Definition - Productivity, Productivity measures .Reduction of work content due to the product and process, Reduction of ineffective time due to the management, due to the worker. Causes for low productivity in apparel industry and measures for improvement.

**UNIT II  WORK STUDY**

Definition, Purpose, Basic procedure and techniques of work-study.

**Work environment** – Lighting, Ventilation, Climatic condition on productivity. Temperature control, humidity control, noise control measures. Safety and ergonomics on work station and work environment

**Material Handling** – Objectives, Classification and characteristics of material handling equipments, Specialized material handling equipments.

**UNIT III  METHOD STUDY**

Definition, Objectives, Procedure, Process charts and symbols. Various charts – Charts indicating process sequence: Outline process chart, flow process chart (man type, material type and equipment type); Charts using time scale – multiple activity chart. Diagrams indicating movement – flow diagram, string diagram, cycle graph, chrono cycle graph, travel chart

**MOTION STUDY:** Principle of motion economy, Two handed process chart, micro motion analysis – therbligs, SIMO chart.

**UNIT IV  WORK MEASUREMENT**

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

**UNIT V  WORK STUDY APPLICATION**

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

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

REFERENCES

Course Articulation Matrix:

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<th>Course Outcomes</th>
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<td>Ergonomics and its application to garment industry</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

OTT353        BASICS OF TEXTILE MANUFACTURE          L T P C
                                            3 0 0 3

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

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

UNIT II       REGENERATED AND SYNTHETIC FIBRES
Production sequence of regenerated and modified cellulosic fibres: viscose rayon, Acetate Rayon, high wet modulus and high tenacity fibres; synthetic fibres – chemical structure, fibre forming polymers, production principles.
UNIT III       BASICS OF SPINNING
Spinning – principle of yarn formation, sequence of machines for yarn production with short staple fibres and blends, principles of opening and cleaning machines; yarn numbering - calculations

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

UNIT V       BASICS OF KNITTING AND NONWOVEN

TOTAL : 45 PERIODS

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

TEXTBOOKS

REFERENCES:
COURSE ARTICULATION MATRIX:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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<td>Classification of fibres and production of natural fibres</td>
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<td>Regenerated and synthetic fibres</td>
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<tr>
<td>CO3.</td>
<td>Yarn spinning</td>
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<tr>
<td>CO4.</td>
<td>Weaving</td>
<td>2 1 - 1 1 - 1 -</td>
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<tr>
<td>CO5.</td>
<td>Knitting and nonwoven</td>
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</table>

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

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

UNIT III REFORMING AND HYDROTREATING

UNIT IV INTRODUCTION TO PETROCHEMICALS
Petrochemicals - Cracking of Naphtha and Feed stock gas for the production of Ethylene, Propylene, Isobutylene and Butadiene. Production of Acetylene from Methane, and Extraction of Aromatics.
UNIT V PRODUCTION OF PETROCHEMICALS
Production of Petrochemicals like Dimethyl Terephthalate (DMT), Ethylene Glycol, Synthetic glycerine, Linear Alkyl Benzene (LAB), Acrylonitrile, Methyl Methacrylate (MMA), Vinyl Acetate Monomer, Phthalic Anhydride, Maleic Anhydride, Phenol, Acetone, Methanol, Formaldehyde, Acetaldehyde, Pentaerythritol and production of Carbon Black.

TOTAL: 45 PERIODS

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

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

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

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

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

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

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

TEXT BOOKS

REFERENCES

CPE352 ENERGY CONSERVATION AND MANAGEMENT

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

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

UNIT I INTRODUCTION

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

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:
1. Energy Manager Training Manual (4 Volumes) available at
   www.energymanagertraining.com. a website administered by Bureau of Energy Efficiency

REFERENCES:

OCH351 NANO TECHNOLOGY L T P C
UNIT I INTRODUCTION
3 0 0 3
General definition and size effects–important nano structured materials and nano particles-
importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and
magnetic properties of nanomaterials- surface area - band gap energy and applications.
Photochemistry and Electrochemistry of nanomaterials –Ionic properties of nanomaterials- Nano
catalysis.

UNIT II SYNTHESIS OF NANOMATERIALS
8
Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel
technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron
sputtering and laser deposition methods – laser ablation, sputtering.
UNIT III  NANO COMPOSITES
Definition- importance of nanocomposites- nano composite materials-classification of composites-metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based-influence of size, shape and role of interface in composites applications.

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

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

TOTAL : 45 PERIODS

OUTCOMES:
CO1 - understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications.
CO2 – able to acquire knowledge about the different types of nano material synthesis
CO3 – describes about the shape, size, structure of composite nano materials and their interference
CO4 – understand the different characterization techniques for nanomaterials.
CO5 - develop a deeper knowledge in the application of nanomaterials in different fields.

TEXT BOOKS

REFERENCES
COURSE ARTICULATION MATRIX

<table>
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<tr>
<th>Course Outcomes</th>
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<tr>
<td>CO1</td>
<td>Understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications</td>
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<td>CO2</td>
<td>Acquire knowledge about the different types of nano material synthesis</td>
<td>PO2 2 3 1 3 3 - - 1 1 - 3 2 1 3</td>
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<td>CO3</td>
<td>Describes about the shape, size,structure of composite nano materials and their interference</td>
<td>PO3 2 2 3 3 1 1 - 1 1 - 3 2 1 3</td>
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<td>CO4</td>
<td>Understand the different characterization techniques for nanomaterials</td>
<td>PO4 2 2 1 3 3 1 1 1 1 - 1 3 1 1 3</td>
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<tr>
<td>CO5</td>
<td>Develop a deeper knowledge in the application of nanomaterials in different fields</td>
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Intelligent Polymers for Data Storage, Polymer-based Data Storage-Principle, Magnetic Vs. Polymer-based Data Storage.

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

TEXT BOOK:

REFERENCE:

OEC351 SIGNALS AND SYSTEMS

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

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

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

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS

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

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS

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

TOTAL: 45 PERIODS
CO5: Compute the output of an LTI system in the time and frequency domains

TEXT BOOKS:

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OEC352 FUNDAMENTALS OF ELECTRONIC DEVICES AND CIRCUITS

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
Cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – Tuned amplifiers – Gain and frequency response – Neutralization methods.
UNIT IV FEEDBACK AMPLIFIERS AND OSCILLATORS

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

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

TEXT BOOKS:

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CBM348 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT

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  

UNIT II   REQUIREMENTS AND SYSTEM DESIGN  

UNIT III   DESIGN AND TESTING  

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

UNIT V   BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY  

TOTAL: 45 PERIODS

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

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

REFERENCES:  

CO’s- PO’s & PSO’s MAPPING

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CBM333 ASSISTIVE TECHNOLOGY

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, Auxiliary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, cardiac pacemaker.

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

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

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

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

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

**TEXT BOOKS**

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

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**OMA352 OPERATIONS RESEARCH**

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

**UNIT I LINEAR PROGRAMMING**
9

**UNIT II TRANSPORTATION AND ASSIGNMENT PROBLEMS**
9

**UNIT III INTEGER PROGRAMMING**
9
UNIT IV  DYNAMIC PROGRAMMING PROBLEMS  9

UNIT V  NON - LINEAR PROGRAMMING PROBLEMS  9

TOTAL:45 PERIODS

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

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

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

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

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

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

UNIT V  CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS  9
Wilson's theorem – Fermat’s Little theorem – Euler’s theorem – Euler’s Phi functions – Tau and Sigma functions.

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

TEXT BOOKS:

REFERENCES:
OMA354

LINEAR ALGEBRA

L T P C
3 0 0 3

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

UNIT I
MATRICES AND SYSTEM OF LINEAR EQUATIONS

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

OTAL: 45 PERIODS

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

TEXT BOOKS

OBT353 BASICS OF BIOMOLECULES 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 9

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

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

OBT354 FUNDAMENTALS OF CELL AND MOLECULAR BIOLOGY

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

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

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

UNIT III BIO-MEMBRANE TRANSPORT

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

UNIT V CENTRAL DOGMA

TOTAL: 45 PERIODS
OUTCOMES:
- Understanding of cell at structural and functional level.
- Understand the central dogma of life and its significance.
- Comprehend the basic mechanisms of cell division.

TEXTBOOKS:

REFERENCES:

OPEN ELECTIVE IV

OHS352 PROJECT REPORT WRITING L T P C
3 0 0 3

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


UNIT 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.


TOTAL:45 PERIODS
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.

CO-PO & PSO MAPPING

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

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

REFERENCES:

OCE354 BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT

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

UNIT I OVERVIEW OF IWRM

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

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

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

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

TOTAL: 45 PERIODS

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

OUTCOMES:
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).

OMA355 ADVANCED NUMERICAL METHODS

OBJECTIVE:
- To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in engineering and technology. This will also serve as a precursor for future research.

UNIT I ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEM

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

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

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

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: demonstrate the understandings of common numerical methods for nonlinear equations, system of linear equations and eigenvalue problems;
CO2: understand the interpolation theory;
CO3: understand the concepts of numerical methods for ordinary differential equations;
CO4: demonstrate the understandings of common numerical methods for elliptic equations;
CO5: understand the concepts of numerical methods for time dependent partial differential equations

TEXT BOOKS:

REFERENCES:
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

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

UNIT I RANDOM PROCESSES

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

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

UNIT IV SYSTEM RELIABILITY

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

TOTAL: 45 PERIODS

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

**TEXT BOOKS**

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**OMG354 PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS**

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

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

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

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS

UNIT V CONTROLLING PRODUCTION & OPERATIONS MANAGEMENT

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

REFERENCES

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

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.

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

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

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

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

TOTAL: 45 PERIODS

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

REFERENCES :

CME343 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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OME355  INDUSTRIAL DESIGN & RAPID PROTOTYPING TECHNIQUES  LTPE  3003

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

REFERENCES:
MF3010 MICRO AND PRECISION ENGINEERING  LT P C  3 0 0 3

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

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  LT P C
3 0 0 3

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

UNIT – I  INTRODUCTION TO COSTING CONCEPTS  9
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT – II  INTRODUCTION TO PROJECT MANAGEMENT  9
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts

UNIT – III  PROJECT EXECUTION AND COSTING CONCEPTS  9
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing

UNIT – IV  COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL  9

UNIT – V  QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT  9
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

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

TEXT BOOKS:
REFERENCES:

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

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

UNIT I  ADVANCED BATTERIES 9
Li-ion Batteries-different formats, chemistry, safe operating area, efficiency, aging. Characteristics-SOC,DOD, SOH. Balancing-Passive Balancing Vs Active Balancing. Other Batteries-NCM and NCA Batteries. NCR18650B specifications.

UNIT II BATTERY PACK 9
Battery Pack- design, sizing, calculations, flow chart, real and simulation Model.Peak power – definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging.

UNIT III BATTERY MODELLING 9
Battery Modelling Methods-Equivalent Circuit Models, Electrochemical Model, Neural Network Model. ECM Comparisons- Rint model, Thevenin model, PNGV model. State space Models-Introduction. Battery Modelling software/simulation frameworks

UNIT IV BATTERY STATE ESTIMATION 9

UNIT V BMS ARCHITECTURE AND REAL TIME COMPONENTS 9
Battery Management System- need, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex Ray-CANedge1 package.ARBIN Battery Tester. BMS Development with Modeling software and Model-Based Design.

TOTAL =45 PERIODS

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Acquire knowledge of different Li-ion Batteries performance.
2. Design a Battery Pack and make related calculations.
3. Demonstrate a Battery Model or Simulation.
5. Approach different BMS architectures during real world usage.

TEXT BOOKS

REFERENCE BOOKS
1. Developing Battery Management Systems with Simulink and Model-Based Design-whitepaper
2. Panasonic NCR18650B- DataSheet
3. bq76PL536A-Q1- IC DataSheet
4. CC2662R-Q1- IC DataSheet

AU3008 SENSORS AND ACTUATORS L T P C 3 0 0 3

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

UNIT I INTRODUCTION TO MEASUREMENTS AND SENSORS 9

UNIT II VARIABLE RESISTANCE AND INDUCTION SENSORS 9
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers- EI pick up and LVDT

UNIT III VARIABLE AND OTHER SPECIAL SENSORS 9
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostriuctive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.

UNIT IV AUTOMOTIVE ACTUATORS 9

UNIT V AUTOMATIC TEMPERATURE CONTROL ACTUATORS 9
Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.

TOTAL = 45 PERIODS
COURSE OUTCOMES:
At the end of the course, the student will be able to
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  
9
TVC Mechanisms with a Single Nozzle – TVC with Multiple Thrust Chambers or Nozzles – Testing – Integration with Vehicle – SITVC method – other jet control methods - exhaust plume problems in space environment

UNIT V  NOSE CONE CONFIGURATION  
9
Aerodynamic aspects on the selection of nose shape of a launch vehicle - design factors in the finalization of nose configuration with respect to payload - nose cone thermal protection system - separation of fairings - payload injection mechanism

OUTCOMES:
On successful completion of this course, the student will be able to
- Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.
- Apply knowledge in selecting the appropriate rocket propulsion systems.
- Interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.
- Analyze aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.
- Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.

OIM352  MANAGEMENT SCIENCE  
L T P C  3 0 0 3

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 familiar with the concepts of human resources management.
4. To acquaint students with the concepts of project management and cost analysis.
5. To make students familiar with the concepts of planning process and business strategies.

UNITI  INTRODUCTION TO MANAGEMENT AND ORGANISATION  
9

UNITII  OPERATIONS AND MARKETING MANAGEMENT  
9

UNITIII  HUMAN RESOURCES MANAGEMENT  
9
Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager:Manpower planning, Recruitment, Selection, TrainingandDevelopment,WageandSalaryAdministration,Promotion,Transfer,PerformanceAppraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating –Capability Maturity Model (CMM)Levels.
UNITIV PROJECT MANAGEMENT 9
Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

UNITV STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, Students will be able to
CO1: Plan an organizational structure for a given context in the organisation to carry out production operations

CO2: Survey the markets, customers and competition better and price the given product appropriately

CO3: Ensure quality for a given product or service.

CO4: Plan, schedule and control projects through PERT and CPM.

CO5: Evaluate strategy for a business or service organisation.

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OIM353 PRODUCTION PLANNING AND CONTROL
L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand the concept of production planning and control act work study,
- To apply the concept of product planning,
- To analyze the production scheduling,
- To apply the Inventory Control concepts,
- To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).
UNIT I  INTRODUCTION
Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNITII  WORK STUDY
Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNITIII  PRODUCT PLANNING AND PROCESS PLANNING
Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Perquisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

UNITIV  PRODUCTION SCHEDULING

UNIT V  INVENTORY CONTROL AND RECENT TRENDS IN PPC
Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

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 production planning,
CO3: The students can able to prepare production scheduling,
CO4: The students can able to prepare Inventory Control.
CO5: They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

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OIE353 OPERATIONS MANAGEMENT  
L T P C 3 0 0 3

COURSE OBJECTIVE:
- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm's competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
- Relate the interdependence of the operations function with the other key functional areas of a firm.
- Teach analytical skills and problem-solving tools to the analysis of the operations problems.
- Apply scheduling and Lean Concepts for improving System Performance.

UNIT I INTRODUCTION TO OPERATIONS MANAGEMENT 9
Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy - Strategic fit, framework; Supply Chain Management

UNIT II FORECASTING, CAPACITY AND FACILITY DESIGN 9

UNIT III DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS 9
UNIT IV MATERIALS MANAGEMENT

UNIT V SCHEDULING AND PROJECT MANAGEMENT
Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson’s Algorithm – Gantt charts; personnel scheduling in services.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: The students will appreciate the role of Production and Operations management in enabling and enhancing a firm’s competitive advantages in the dynamic business environment.
CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.
CO3: The students will able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.
CO4: The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.
CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance.

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COURSE OBJECTIVES:
1. Demonstrate an understanding of how occupational hygiene standards are set and used in work health and safety.
2. Compare and contrast the roles of environmental and biological monitoring in work health and safety.
3. Outline strategies for identifying, assessing and controlling risks associated with airborne gases, vapours and particulates.
4. Discuss how personal protective equipment can be used to reduce risks associated with workplace exposures.
5. Provide high-level advice on managing and controlling noise and noise-related hazards.

UNIT I INTRODUCTION AND SCOPE
9

UNIT II MONITORING FOR SAFETY, HEALTH & ENVIRONMENT
9

UNIT III OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION
9

UNIT IV OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT
9

UNIT-V INDUSTRIAL HAZARDS
9

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

COURSE OBJECTIVES
- Teach the principles of safety applicable to the design, and operation of chemical process plants.
- Ensure that potential hazards are identified and mitigation measures are in place to prevent unwanted release of energy.
- Learn about the hazardous chemicals into locations that could expose employees and others to serious harm.
- Focuses on preventing incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals.
- Ensure that the general design of the plant is capable of complying with the dose limits in force and with the radioactive releases.

UNIT I SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES 9
Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief - relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation - pipe line transport - safety in chemical laboratories.

UNIT II CHEMICAL REACTION HAZARDS 9
Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self - heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening,
UNIT III SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS

Design principles - Process design development - types of designs, feasibility survey, preliminary design. Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares- new concepts in safety design and operation- Pressure vessel testing standards- Inspection techniques for boilers and reaction vessels.

UNIT IV SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS

Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards -standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures- condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

UNIT V SAFETY AND ANALYSIS

Safety vs reliability- quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students able to
CO1 Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.
CO2 Develop thorough knowledge about safety in the operation of chemical plants.
CO3 Apply the principles of safety in the storage and handling of gases.
CO4 Identify the conditions that lead to reaction hazards and adopt measures to prevent them.
CO5 Develop thorough knowledge about

TEXT BOOKS:

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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Understanding the importance of various materials used in electrical, electronics and magnetic applications
2. Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
3. Gaining knowledge on the selection of suitable materials for the given application
4. Knowing the fundamental concepts in Semiconducting materials
5. Getting equipped with the materials used in optical and optoelectronic applications.

UNIT - I  DIELECTRIC MATERIALS
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics. Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

UNIT – II  MAGNETIC MATERIALS
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, 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, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

UNIT – V  OPTICAL AND OPTOELECTRONIC MATERIALS

COURSE OUTCOMES:
After completion of this course, the students will be able to
1. Understand various types of dielectric materials, their properties in various conditions.
2. Evaluate magnetic materials and their behavior.
3. Evaluate semiconductor materials and technologies.
4. Select suitable materials for electrical engineering applications.
5. Identify right material for optical and optoelectronic applications.

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OML353  NANOMATERIALS AND APPLICATIONS  L T P C
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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications
2. Gaining knowledge on dimensionality effects on different properties of nanomaterials
3. Getting acquainted with the different processing techniques employed for fabricating nanomaterials
4. Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
5. Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

UNIT I  NANOMATERIALS  9
Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.

UNIT II  THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS  9
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.

UNIT III  PROCESSING  9
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.

UNIT IV  STRUCTURAL CHARACTERISTICS  9
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis
UNIT V  APPLICATIONS
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

COURSE OBJECTIVES:
1. To knowledge on fluid power principles and working of hydraulic pumps
2. To obtain the knowledge in hydraulic actuators and control components
3. To understand the basics in hydraulic circuits and systems
4. To obtain the knowledge in pneumatic and electro pneumatic systems
5. To apply the concepts to solve the trouble shooting
UNIT – I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS

UNIT – II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS

UNIT – III HYDRAULIC CIRCUITS AND SYSTEMS
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT – IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS

UNIT – V TROUBLE SHOOTING AND APPLICATIONS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO 1: Analyze the methods in fluid power principles and working of hydraulic pumps
CO 2: Recognize the concepts in hydraulic actuators and control components
CO 3: Obtain the knowledge in basics of hydraulic circuits and systems
CO 4: Know about the basics concept in pneumatic and electro pneumatic systems
CO 5: Apply the concepts to solve the trouble shooting hydraulic and pneumatics

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1 – 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 SENSOR CLASSIFICATION, CHARACTERISTICS AND SIGNAL TYPES 9

UNIT – II DISPLACEMENT, PROXIMITY AND RANGING SENSORS 9

UNIT – III FORCE, MAGNETIC AND HEADING SENSORS 9

UNIT – IV OPTICAL, PRESSURE, TEMPERATURE AND OTHER SENSORS 9
UNIT – V \hspace{2cm} SIGNAL CONDITIONING


TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Understand various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors. They can also analyze the sensor response.

CO2: Analyze and select suitable sensor for displacement, proximity and range measurement.

CO3: Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.

CO4: Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.

CO5: Select and design suitable signal conditioning circuit with proper compensation and linearizing element based on sensor output signal.

TEXT BOOKS:

REFERENCES:
CONCEPTS IN MOBILE ROBOTS

COURSE OBJECTIVES
1. To introduce mobile robotic technology and its types in detail.
2. To learn the kinematics of wheeled and legged robot.
3. To familiarize the intelligence into the mobile robots using various sensors.
4. To acquaint the localization strategies and mapping technique for mobile robot.
5. To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT – I INTRODUCTION TO MOBILE ROBOTICS

UNIT – II KINEMATICS

UNIT – III PERCEPTION

UNIT – IV LOCALIZATION

UNIT – V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS

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

CO1: Evaluate the appropriate mobile robots for the desired application.
CO2: Create the kinematics for given wheeled and legged robot.
CO3: Analyse the sensors for the intelligence of mobile robotics.
CO4: Create the localization strategies and mapping technique for mobile robot.
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.

TEXTBOOK
REFERENCES:

MV3501 MARINE PROPULSION

COURSE OBJECTIVES:
1. To impart knowledge on basics of propulsion system and ship dynamic movements
2. To educate them on basic layout and propulsion equipment's
3. To impart basic knowledge on performance of the ship
4. To impart basic knowledge on Ship propeller and its types
5. To impart knowledge on ship rudder and its types

UNIT I BASIC 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 BASIC OF PROPELLER 9
- Propeller dimension, Propeller and its types – fixed propeller, control pitch propeller, kort nozzle, ducted propeller, voith schneider, Parts of propeller, 3 blade - 5 blade - 6 blade propellers and its advantages, propeller boss hub, crown nut, propeller skew, pitch of propeller - Thrust creation by propeller. Propeller Material – Propeller balancing- static and dynamic.

UNIT V BASIC OF RUDDER 9
- Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings- Rudder pintle – Rudder types- Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits of various types of rudders, Propeller and rudder interaction, Rudder stopper, movement of rudders, Basic construction of Rudder

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
CO1: Explain the basics of propulsion system and ship dynamic movements
CO2: Familiarize with various components assisting ship stabilization.
CO3: Demonstrate the performance of the ship.
CO4: Classify the Propeller and its types, Materials etc.
CO5: Categories the Rudder and its types, design criteria of rudder.

TEXT BOOKS:
1. GP. Ghose, “Basic Ship propulsion”, 2015

REFERENCES BOOKS:

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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
Archimedes Principle- Laws of floatation– Meta centre – stability of floating and submerged bodies-
Density, relative density – Displacement – Pressure – centre of pressure.

UNIT II TYPES OF SHIP
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  
L T P C  
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OBJECTIVES:
At the end of the course, students are expected to
1. Understand the role of Marine machinery systems
2. Be familiar with Marine propulsion machinery system
3. Acquaint with Marine Auxiliary machinery system
4. Have acquired basics of Marine Auxiliary boiler system
5. Be aware of ship propellers and steering system

UNIT I  
ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS  
Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems
UNIT II MARINE PROPULSION MACHINERY SYSTEM  
Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system

UNIT III MARINE AUXILIARY MACHINERY SYSTEM  
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications

UNIT IV MARINE BOILER SYSTEM  
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories

UNIT V SHIP PROPELLERS AND STEERING MECHANISM  
Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear.

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

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COURSE OBJECTIVES:
1. To understand the basics of drone concepts
2. To learn and understand the fundamentals of design, fabrication and programming of drone
3. To impart the knowledge of an flying and operation of drone
4. To know about the various applications of drone
5. To understand the safety risks and guidelines of fly safely
UNIT – I INTRODUCTION TO DRONE TECHNOLOGY
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

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

UNIT – III DRONE FLYING AND OPERATION
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications

UNIT – IV DRONE COMMERCIAL APPLICATIONS
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

UNIT – V FUTURE DRONES AND SAFETY
The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Know about a various type of drone technology, drone fabrication and programming.
CO2: Execute the suitable operating procedures for functioning a drone
CO3: Select appropriate sensors and actuators for Drones
CO4: Develop a drone mechanism for specific applications
CO5: Create the programs for various drones

CO-PO MAPPING:

<table>
<thead>
<tr>
<th>COs/Pos&amp;PSOs</th>
<th>POs</th>
<th>PSOs</th>
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<tr>
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<tr>
<td>CO/PO &amp; PSO Average</td>
<td>1 2 3 1 3 2</td>
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</tbody>
</table>

1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS
REFERENCES:

OGI352 GEOPHYSICAL INFORMATION SYSTEM

OBJECTIVES:
To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.

UNIT I FUNDAMENTALS OF GIS

UNIT II SPATIAL DATA MODELS

UNIT III DATA INPUT AND TOPOLOGY

UNIT IV DATA QUALITY AND STANDARDS
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure

UNIT V DATA MANAGEMENT AND OUTPUT
Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS- distributed GIS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- On completion of the course, the student is expected to
- CO1 Have basic idea about the fundamentals of GIS.
- CO2 Understand the types of data models.
- CO3 Get knowledge about data input and topology
- CO4 Gain knowledge on data quality and standards
- CO5 Understand data management functions and data output

TEXTBOOKS:
REFERENCES:

CO – PO – PSO MAPPING: GEOGRAPHIC INFORMATION SYSTEM

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<thead>
<tr>
<th>PO</th>
<th>GRADUATE ATTRIBUTE</th>
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<td>Engineering Knowledge</td>
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<td>PO2</td>
<td>Problem Analysis</td>
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<td>PO3</td>
<td>Design/Development of Solutions</td>
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<td>PO4</td>
<td>Conduct Investigations of Complex Problems</td>
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<td>PO5</td>
<td>Modern Tool Usage</td>
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<td>PO6</td>
<td>The Engineer and Society</td>
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<td>PO 7</td>
<td>Environment and Sustainability</td>
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<td>PO 8</td>
<td>Ethics</td>
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<td>PO 9</td>
<td>Individual and Team Work</td>
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<td>PO 10</td>
<td>Communication</td>
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<tr>
<td>PO 11</td>
<td>Project Management and Finance</td>
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<td>PO 12</td>
<td>Life-long Learning</td>
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<tr>
<td>PSO 1</td>
<td>Knowledge of Geoinformatics discipline</td>
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<tr>
<td>PSO 2</td>
<td>Critical analysis of Geoinformatics problems and innovations</td>
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<tr>
<td>PSO 3</td>
<td>Conceptualization and evaluation of Design solutions</td>
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</table>

OAI352  AGRICULTURE ENTREPRENEURSHIP DEVELOPMENT  L T P C
9 3 0 0 3

OBJECTIVES
- To introduce the importance of Agri-business management, its characteristics and principles
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.

UNIT I  ENTREPRENEURIAL ENVIRONMENT IN INDIAN CONTEXT
Entrepreneur Development(ED): Concept of entrepreneur and entrepreneurship assessing overall business environment in Indian economy- Entrepreneurial and managerial characteristics-Entrepreneurship development programmers (EDP)-Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment.

UNIT II  AGRIP RENEURSHIP IN GLOBAL ARENA: LEGAL PERSPECTIVE
Importance of agribusiness in Indian economy - International trade-WTO agreements- Provisions related to agreements in agricultural and food commodities - Agreements on Agriculture (AOA)-Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS).
UNIT III ENTREPRENEURSHIP MANAGEMENT: FINANCIAL PERSPECTIVE

Entrepreneurship - Essence of managerial Knowledge - Management functions - Planning-organizing-Directing-Motivation-ordering-leading-supervision - communication and control - Understanding Financial Aspects of Business - Importance of financial statements - liquidity ratios - leverage ratios, coverage ratios - turnover ratios - Profitability ratios. Agro-based industries - Project cycle - Project appraisal and evaluation techniques - undiscounted measures - Payback period - proceeds per rupee of outlay, Discounted measures - Net Present Value (NPV) - Benefit-Cost Ratio (BCR) - Internal Rate of Return (IRR) - Net benefit investment ratio (N/K ratio) - sensitivity analysis.

UNIT IV ENTREPRENEURIAL OPPORTUNITIES: ECONOMIC GROWTH PERSPECTIVE

Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country - Overview of Indian social, political system and their implications for decision making by individual entrepreneurs - Economic system and its implication for decision making by individual entrepreneurs.

UNIT V ENTREPRENEURIAL PROMOTION MEASURES AND GOVERNMENT SUPPORT

Social responsibility of business. Morals and ethics in enterprise management - SWOT analysis - Government schemes and incentives for promotions of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors - Venture capital (VC), contract framing (CF) and Joint Venture (JV), public-private partnerships (PPP) - overview of agricultural engineering industry, characteristics of Indian farm machinery industry.

COURSE OUTCOMES
1. Judge about agricultural finance, banking and cooperation
2. Evaluate basic concepts, principles and functions of financial management
3. Improve the skills on basic banking and insurance schemes available to customers
4. Analyze various financial data for efficient farm management
5. Identify the financial institutions

TEXT BOOKS

REFERENCES
### CO-PO MAPPING

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
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<th>Overall correlation of COs with POs</th>
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<td>PO4 Conduct Investigations of Complex Problems</td>
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<tr>
<td>PSO1 To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill</td>
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<tr>
<td>PSO2 To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.</td>
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<td>PSO3 To inculcate entrepreneurial skills through strong Industry-Institution linkage.</td>
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### OEN352 BIODIVERSITY CONSERVATION

**OBJECTIVE:**
The identification of different aspects of biological diversity and conservation techniques.

**UNIT I INTRODUCTION**
Concept of Species, Variation; Introduction to Major Plant Groups; Evolutionary relationships between Plant Groups; Nomenclature and History of plant taxonomy; Systems of Classification and their Application; Study of Plant Groups; Study of Identification Characters; Study of important families of Angiosperms; Plant Diversity Application.

**UNIT II INTRODUCTION TO ANIMAL DIVERSITY AND TAXONOMY**
Principles and Rules of Taxonomy; ICZN Rules, Animal Study Techniques; Concepts of Taxon, Categories, Holotype, Paratype, Topotype etc; Classification of Animal kingdom, Invertebrates, Vertebrates, Evolutionary relationships between Animal Groups.

**UNIT III MICROBIAL DIVERSITY**
Microbes and Earth History, Magnitude, Occurrence and Distribution. Concept of Species, Criteria for Classification, Outline Classification of Microorganisms (Bacteria, Viruses and Protozoa); Criteria for Classification and Identification of Fungi; Chemical and Biochemical Methods of Microbial Diversity Analysis.
UNIT IV  MEGA DIVERSITY
Biodiversity Hot-spots, Floristic and Faunal Regions in India and World; IUCN Red List; Factors affecting Diversity, Impact of Exotic Species and Human Disturbance on Diversity, Dispersal, Diversity-Stability Relationship; Socio- economic Issues of Biodiversity; Sustainable Utilization of Bioresources; National Movements and International Convention/Treaties on Biodiversity.

UNIT V  CONSERVATIONS OF BIODIVERSITY
In-Situ Conservation- National parks, Wildlife sanctuaries, Biosphere reserves; Ex-situ conservation- Gene bank, Cryopreservation, Tissue culture bank; Long term captive breeding, Botanical gardens, Animal Translocation, Zoological Gardens; Concept of Keystone Species, Endangered Species, Threatened Species, Rare Species, Extinct Species

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

OUTCOMES
Upon successful completion of this course, students will:
CO1: An insight into the structure and function of diversity for ecosystem stability.
CO2: Understand the concept of animal diversity and taxonomy
CO3: Understand socio-economic issues pertaining to biodiversity
CO4: An understanding of biodiversity in community resource management.
CO5: Student can apply fundamental knowledge of biodiversity conservation to solve problems associated with infrastructure development.

CO’s- PO’s & PSO’s MAPPING

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<th>CO’s</th>
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</table>

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

 UNIT II Time Response Analysis & Rootlocustechnique

 UNIT III Frequency Response Analysis

 UNIT IV Stability Concepts & Analysis

 UNIT V State Variable Analysis

OUTCOMES:

- Ability to CO1: Design the basic mathematical model of physical System.
- CO2: Analyze the time response analysis and techniques.
- CO3: Analyze the transfer function from different plots.
- CO4: Apply the stability concept in various criterion.
- CO5: Assess the state models for linear and continuous Systems.

TEXTBOOKS


REFERENCES

2. Control System Dynamics” by Robert Clark, Cambridge University Press, 1996 USA.
OEI354 INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS LT P C 3 0 0 3

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 9

UNIT II AUTOMATION COMPONENTS 9
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT III COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS 9
Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 9
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT V DISTRIBUTED CONTROL SYSTEM 9
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL: 45 PERIODS
SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)  
1. Market survey of the recent PLCs and comparison of their features.  
2. Summarize the PLC standards  
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)  

COURSE OUTCOMES: 
Students able to 
CO1 Design a signal conditioning circuits for various application (L3).  
CO2 Acquire a detail knowledge on data acquisition system interface and DCS system (L2).  
CO3 Understand the basics and Importance of communication buses in applied automation Engineering (L2).  
CO4 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.(L3)  
CO5 Able to develop a PLC logic for a specific application on real world problem. (L5)

TEXT BOOKS:  

REFERENCES:  

List of Open Source Software/ Learning website:  
1. https://archive.nptel.ac.in/courses/108/105/108105062/  
2. https://nptel.ac.in/courses/108105063  

<table>
<thead>
<tr>
<th>CO’s- PO’s &amp; PSO’s MAPPING</th>
<th>CO’s</th>
<th>PO’s</th>
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</table>
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
9
Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.

UNIT II
9
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
9
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
9
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
9
Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine. Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment: plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids, Membrane separation: General considerations, materials for membrane construction, ultra-filtration, microfiltration, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electrodialysis, gel filtration, ion exchange, per-evaporation and osmotic dehydration.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to
CO1 Understand the importance of food polymers
CO2 Understand the effect of various methods of processing on the structure and texture of food materials
CO3 Understand the interaction of food constituents with respect to thermal, electrical properties to develop new technologies for processing and preservation.
TEXTBOOKS:

OFD355 FOOD SAFETY AND QUALITY REGULATIONS L T P C 3 0 0 3

OBJECTIVES:
• To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
• To help become skilled in systems for food safety surveillance
• To be aware of the regulatory and statutory bodies in India and the world
• To ensure processed food meets global standards

UNIT I
Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labeling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection, ISO 22000 – Importance and Implementation

UNIT II
Food quality: Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities.

UNIT III
Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system. Food inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system to monitor food safety, risk communication

UNIT IV
Indian and global regulations: FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)

UNIT V
Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
CO1 Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments
CO2 Awareness on regulatory and statutory bodies in India and the world

REFERENCES:
1. Handbook of food toxicology by S. S. Deshpande, 2002
2. The food safety information handbook by Cynthia A. Robert, 2009
4. Microbiological safety of Food by Hobbs BC, 1973

OPY353 NUTRACEUTICALS

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, caratenoids. 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:
3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006

REFERENCES:
1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007

COURSE OUTCOME - NUTRACEUTICALS

| CO 1 | Acquire knowledge about the Nutraceuticals and functional foods, their classification and benefits. |
| CO 2 | Acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes |
| CO 3 | Attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods. |
| CO 4 | Distinguish the various In vitro and In vivo assessment of Antioxidant activity of compounds from plant sources. |
| CO 5 | Gain information about the health benefits of various functional foods and nutraceuticals in the prevention and treatment of various lifestyle diseases. |
| CO 6 | Attain the knowledge of the regulatory and safety issues of nutraceuticals at national and international level. |

CO – PO MAPPING

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OTT354 BASICS OF DYEING AND PRINTING L T P C 3 0 0 3

OBJECTIVE:
- To enable the students to learn about the basics of Pretreatment, dyeing, printing and
  machinery in textile processing.

UNIT I INTRODUCTION 9
Impurities present in different fibres, Inspection of grey goods and lot preparation. Shearing,

UNIT II PRE TREATMENT 9
Desizing-Objective of Desizing- types of Desizing- Objective of Scouring- Mechanism of Scouring—
Degumming of Silk, Scouring of wool - Bio Scouring. Bleaching -Objective of Bleaching: Bleaching
mechanism of Hydrogen Peroxide, Hypo chlorites. Objective of Mercerizing - Physical and
Chemical changes of Mercerizing.

UNIT III DYEING 9
Dye - Affinity, Substantively, Reactivity, Exhaustion and Fixation. Classification of dyes. Direct
dyes: General properties, principles and method of application on cellulosic materials. Reactive
dyes – principles and method of application on cellulosic materials hot brand, cold brand.

UNIT IV PRINTING 9
Definition of printing – Difference between printing and dying- Classification thickeners –
Requirements to be good thicker, printing paste Preparation - different styles of printing.

UNIT V MACHINERIES 9
Fabric Processing - winch, jigger and soft flow machines. Beam dyeing machines: Printing -flat

TOTAL: 45 PERIODS

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
   Wood head publishing India , 2021
4. Bleaching & Mercerizing – BTRA Silver Jubilee Monograph series

Course Articulation Matrix:
1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and
Substantial (High) respectively
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TEXT BOOKS:

REFERENCES:

OTT355 GARMENT MANUFACTURING TECHNOLOGY L T P C
30 0 3

OBJECTIVE:
- To enable the students to understand the basics of pattern making, cutting and sewing.
- To expose the students to various problems & remedies during garment manufacturing

UNIT I PATTERN MAKING, MARKER PLANNING, CUTTING 9
Anthropometry, specification sheet, pattern making – principles, basic pattern set drafting, grading, marker planning, spreading & cutting

UNIT II TYPES OF SEAMS, STITCHES AND FUNCTIONS OF NEEDLES 9
Different types of seams and stitches; single needle lock stitch machine – mechanism and accessories; needle – functions, special needles, needlepoint

UNIT III COMPONENTS AND TRIMS USED IN GARMENT 9
Sewing thread-construction, material, thread size, packages, accessories – labels, linings, interlinings, wadding, lace, braid, elastic, hook and loop fastening, shoulder pads, eyelets and laces, zip fasteners, buttons

UNIT IV GARMENT INSPECTION AND DIMENSIONAL CHANGES 9
Raw material, in process and final inspection; needle cutting; sewability of fabrics; strength properties of apparel; dimensional changes in apparel due to laundering, dry-cleaning, steaming and pressing.

UNIT V GARMENT PRESSING, PACKING AND CARE LABELING 9
Garment pressing – categories and equipment, packing; care 276abelling 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 careabelling

TEXT BOOKS:
2. Gerry Cooklin, “Introduction to Clothing Manufacture” Blackwell Science Ltd., 1995. 64

REFERENCES:

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OCH353 ENERGY TECHNOLOGY

UNIT I INTRODUCTION
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources

UNIT II CONVENTIONAL ENERGY
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.
UNIT III  NON-CONVENTIONAL ENERGY  10
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV  BIOMASS ENERGY  10
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT V  ENERGY CONSERVATION  9
Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.

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.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
### COURSE ARTICULATION MATRIX

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<th>Course Outcomes</th>
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<td>Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.</td>
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<td>Compare different renewable energy technologies and choose the most appropriate based on local conditions.</td>
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<td>Explain the technological basis for harnessing renewable energy sources.</td>
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<td>Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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**OCH354 SURFACE SCIENCE**

**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  9
Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods

UNIT III  LIQUID INTERFACES  9
Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells

UNIT IV  HETEROGENEOUS CATALYSIS  9
Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, Fishcher-Tropsch and Automotive catalysis, Role of promoters and poisons, Bimetallic surfaces, surface functionalization and clusters in catalysis, Role of Sabatier principle in catalyst design, Rate oscillations and spatiotemporal pattern formation

UNIT V  EPITAXIAL GROWTH AND NANO SURFACE-STRUCTURES  9

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:

OPE353  INDUSTRIAL SAFETY  L T P C  3 0 0 3
OBJECTIVES:
- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen's Compensation and other laws) enacted for the protection of employees health at work settings.
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards.

UNIT I  INTRODUCTION  9
Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.
UNIT II OCCUPATIONAL HEALTH AND HYGIENE

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS

UNIT IV HAZARDS AND RISK MANAGEMENT

UNIT V ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT

OUTCOMES:
After completion of this course, the student is expected to be able to:
- Describe, with example, the common work-related diseases and accidents in occupational setting
- Name essential members of the Occupational Health team
- What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee

OPE354 UNIT OPERATIONS IN PETRO CHEMICAL INDUSTRIES 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.

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
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.

TEXTBOOKS

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.

TOTAL: 45 PERIODS

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
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
Introduction - Structure of Medical Informatics – Internet and Medicine - Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics

UNIT II COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING
Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III COMPUTERISED PATIENT RECORD
Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.
UNIT IV COMPUTER ASSISTED MEDICAL DECISION-MAKING

Neuro computers and Artificial Neural Networks application, Expert system- General model of CMD, Computer-assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis inclinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS

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

TOTAL : 45 PERIODS

Course Outcomes:

Upon completion of the course, students will be able to:
1. Explain the structure and functional capabilities of Hospital Information System.
2. Describe the need of computers in medical imaging and automated clinical laboratory.
3. Articulate the functioning of information storage and retrieval in computerized patient record system.
4. Apply the suitable decision support system for automated clinical diagnosis.
5. Discuss the application of virtual reality and telehealth technology in medical industry.

TEXT BOOKS:

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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OBT355 BIOTECHNOLOGY FOR WASTE MANAGEMENT

UNIT I BIOLOGICAL TREATMENT PROCESS


UNIT II WASTE BIOMASS AND ITS VALUE ADDITION

Types of waste biomass – Solid waste management - Nature of biomass feedstock – Biobased economy/process – Value addition of waste biomass – Biotransformation of biomass – Biotransformation of marine processing wastes – Direct extraction of biochemicals from biomass – Plant biomass for industrial application
UNIT III BIOCONVERSION OF WASTES TO ENERGY 9
Perspective of biofuels from wastes - Bioethanol production – Biohydrogen Production – dark and photofermentative process - Biobutanol production – Biogas and Biomethane production - Single stage anaerobic digestion, Two stage anaerobic digestion - Biodiesel production - Enzymatic hydrolysis technologies

UNIT IV CHEMICALS AND ENZYME PRODUCTION FROM WASTES 9
Production of lactic acid, succinic acid, citric acid – Biopolymer synthesis – Production of Amylases - Lignocellulolytic enzymes - Pectinolytic enzymes - Proteases – Lipases

UNIT V BIOCOMPOSTING OF ORGANIC WASTES 9
Overview of composting process - Benefits of composting, Role of microorganisms in composting - Factors affecting the composting process - Waste Materials for Composting, Fundamentals of composting process - Composting technologies, Composting systems – Nonreactor Composting, Reactor composting - Compost Quality

TOTAL: 45 PERIODS

COURSE OUTCOMES
After completion of this course, the students should be able
1. To learn the various methods biological treatment
2. To know the details of waste biomass and its value addition
3. To develop the bioconversion processes to convert wastes to energy
4. To synthesize the chemicals and enzyme from wastes
5. To produce the biocompost from wastes
6. To apply the theoretical knowledge for the development of value added products

TEXT BOOKS

REFERENCE BOOKS

UNIT I INTRODUCTION 9
Lifestyle diseases – Definition ; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use ; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise.

UNIT II CANCER 9
Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment
UNIT III  CARDIOVASCULAR DISEASES  9
Coronary atherosclerosis – Coronary artery disease; Causes - Fat and lipids, Alcohol abuse — Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation

UNIT IV  DIABETES AND OBESITY  9
Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI

UNIT V  RESPIRATORY DISEASES  9
Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing

TEXT BOOKS:

REFERENCES:

OBT357  BIOTECHNOLOGY IN HEALTH CARE  L T P C
3 0 0 3

COURSE OBJECTIVES
The aim of this course is to
1. Create higher standard of knowledge on healthcare system and services
2. Prioritize advanced technologies for the diagnosis and treatment of various diseases

UNIT I  PUBLIC HEALTH  9

UNIT II  CLINICAL DISEASES  9
Communicable diseases: Chickenpox / Shingles, COVID-19, Tuberculosis, Hepatitis B, Hepatitis C, HIV / AIDS, Influenza, Swine flu. Non Communicable diseases: Diabetes mellitus, atherosclerosis, fatty liver, Obesity, Cancer

UNIT III  VACCINOLOGY  9
History of Vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems. Instruments related to monitoring of temperature, sterilization, environment.

UNIT IV  OUTPATIENT & IN PATIENT SERVICES  9
Radiotherapy, Nuclear medicine, surgical units, OT Medical units, G & Obs. units Pediatric, neonatal units, Critical care units, Physical medicine & Rehabilitation, Neurology, Gastroenterology, Endoscopy, Pulmonology, Cardiology.
UNIT V  BASICS OF IMAGING MODALITIES 9

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE BOOKS

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 9
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 9
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 9

UNIT IV  FINANCING AND DIVIDEND DECISION 9
UNIT V WORKING CAPITAL DECISION


TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
2. Prasanna Chandra, Financial Management,

CMG332 FUNDAMENTALS OF INVESTMENT LT 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 Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.

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

CMG333 BANKING, FINANCIAL SERVICES AND INSURANCE LT P C 3 0 0 3

OBJECTIVES
- Understand the Banking system in India
- Grasp how banks raise their sources and how they deploy it
- Understand the development in banking technology
- Understand the financial services in India
- Understand the insurance Industry in India

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM
Overview of Banking system – Structure – Functions –Banking system in India - Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT II MANAGING BANK FUNDS/ PRODUCTS

UNIT III DEVELOPMENT IN BANKING TECHNOLOGY

UNIT IV FINANCIAL SERVICES

UNIT V INSURANCE

REFERENCES :

TOTAL : 45 PERIODS
UNIT I  INTRODUCTION TO BLOCKCHAIN
Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.

UNIT II  INTRODUCTION TO CRYPTOCURRENCY

UNIT III  ETHEREUM
Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network

UNIT IV  WEB3 AND HYPERLEDGE

UNIT V  EMERGING TRENDS

REFERENCE
2. Peter Borovykh, Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018

TOTAL : 45 PERIODS
UNIT II  
**DIGITAL FINANCE AND ALTERNATIVE FINANCE**  
A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity, Introduction to the concept of Initial Coin Offering

UNIT III  
**INSURETECH**  
InsurTech Introduction, Business model disruption, AI/ML in InsurTech, IoT and InsurTech, Risk Modeling, Fraud Detection, Processing claims and Underwriting Innovations in Insurance Services

UNIT IV  
**PEER TO PEER LENDING**  
P2P and Marketplace Lending, New Models and New Products in marketplace lending, P2P Infrastructure and technologies, Concept of Crowdfunding, Crowdfunding Architecture and Technology, P2P and Crowdfunding unicorns and business models, SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations

UNIT V  
**REGULATORY ISSUES**  

**REFERENCES:**
5. IIBF, Digital Banking, Taxmann Publication, 2016

**REFERENCES:**

**TOTAL: 45 PERIODS**

CMG336  
**INTRODUCTION TO FINTECH**  
**LT P C**  
3 0 0 3

**OBJECTIVES:**
1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I  
**INTRODUCTION**  
Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II  
**PAYMENT INDUSTRY**  
FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.
UNIT III INSURANCE INDUSTRY

UNIT IV FINTECH AROUND THE GLOBE

UNIT V FUTURE OF FINTECH
How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

REFERENCES:
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

TOTAL: 45 PERIODS

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
Types of Business Ownership – Business Environmental Factors – Political-Economic-Sociological-Technological-Environmental-Legal aspects – Human Resources Mobilisation-Basics

UNIT III FUNDAMENTALS OF TECHNOPRENEURSHIP 9
Introduction to Technopreneurship - Definition, Need, Scope - Emerging Concepts - Principles - Characterisitcs of a technopreneur - Impacts of Technopreneurship on Society – Economy - Job Opportunities in Technopreneurship - Recent trends

UNIT IV APPLICATIONS OF TECHNOPRENEURSHIP 9
Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship -- Success Stories of Technopreneurs - Case Studies

UNIT V EMERGING TRENDS IN ENTREPRENEURSHIP 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of Entrepreneurship
CO 2 Understand the business ownership patterns and environment
CO 3 Understand the Job opportunities in Industries relating to Technopreneurship
CO 4 Learn about applications of technopreneurship and successful technopreneurs
CO 5 Acquaint with the recent and emerging trends in entrepreneurship

TEXT BOOKS:
2) Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning,

REFERENCES:
4) David Sheff 2002, China Dawn: The Story of a Technology and Business Revolution,
7) Basics of Technopreneurship: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP
8) Journal articles pertaining to Entrepreneurship

295
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

OUTCOMES:
Upon completion of this course, the student should be able to:

CO 1  Learn the basics of managing teams for business.
CO 2  Understand developing effective teams for business management.
CO 3  Understand the fundamentals of leadership for running a business.
CO 4  Learn about the importance of leadership for business development.
CO 5  Acquaint with emerging trends in leadership effectiveness for entrepreneurs.

REFERENCES:

COURSE OBJECTIVES

- To develop the creativity skills among the learners
- To impart the knowledge of creative intelligence essential for entrepreneurs
- To know the applications of innovation in entrepreneurship.
- To develop innovative business models for business.

UNIT I  CREATIVITY

Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities-Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- - Creative Personality and Motivation.

UNIT II  CREATIVE INTELLIGENCE

Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training--Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III  INNOVATION


UNIT IV  INNOVATION AND ENTREPRENEURSHIP


UNIT V  INNOVATIVE BUSINESS MODELS


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

TOTAL 45 : PERIODS

SUGGESTED READINGS:

Creativity and Inovation in Entrepreneurship, Kankha, Sultan Chand
Strategic Innovation: Building and Sustaining Innovative Organizations- Course Era, Raj Echambadi.
COURSE OBJECTIVES:

- To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
- To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
- To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.

UNIT I  INTRODUCTION TO MARKETING MANAGEMENT  9

UNIT II  MARKETING ENVIRONMENT  9

UNIT III  PRODUCT AND PRICING MANAGEMENT  9

UNIT IV  PROMOTION AND DISTRIBUTUION MANAGEMENT  9

UNIT V  CONTEMPORARY ISSUES IN MARKETING MANAGEMENT  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students will be able to:

CO1 Have the awareness of marketing management process
CO 2 Understand the marketing environment
CO 3 Acquaint about product and pricing strategies
CO 4 Knowledge of promotion and distribution in marketing management.
CO5 Comprehend the contemporary marketing scenarios and offer solutions to marketing issues.
REFERENCES:

CMG341 HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS L T P C
3 0 0 3

OBJECTIVES:
- To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
- To create an awareness of the roles, functions and functioning of human resource department.
- To understand the methods and techniques followed by Human Resource Management practitioners.

UNIT I INTRODUCTION TO HRM

UNIT II HUMAN RESOURCE PLANNING
HR Planning - Definition - Factors - Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends

UNIT III RECRUITMENT AND SELECTION
Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources - eRecruitment - Selection Process- Selection techniques - eSelection- Interview Types- Employee Engagement.

UNIT IV TRAINING AND EMPLOYEE DEVELOPMENT

UNIT V CONTROLLING HUMAN RESOURCES

TOTAL 45 : PERIODS

COURSE OUTCOMES:
Upon completion of this course the learners will be able:
CO 1 To understand the Evolution of HRM and Challenges faced by HR Managers
CO 2 To learn about the HR Planning Methods and practices.
CO 3 To acquaint about the Recruitment and Selection Techniques followed in Industries.
CO 4 To known about the methods of Training and Employee Development.
CO 5 To comprehend the techniques of controlling human resources in organisations.
REFERENCES:

CMG342 FINANCING NEW BUSINESS VENTURES

Course Objectives
- To develop the basics of business venture financing.
- To impart the knowledge essential for entrepreneurs for financing new ventures.
- To acquaint the learners with the sources of debt and equity financing.
- To empower the learners towards fundraising 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.

TOTAL: 45 PERIODS
REFERENCES:


VERTICAL 3: PUBLIC ADMINISTRATION

CMG343 PRINCIPLES OF PUBLIC ADMINISTRATION L T P C
3 0 0 3

UNIT-I
1. Meaning, Nature and Scope of Public Administration
2. Importance of Public Administration
3. Evolution of Public Administration

UNIT-II
1. New Public Administration
2. New Public Management
3. Public and Private Administration

UNIT-III
1. Relationships with Political Science, History and Sociology
2. Classical Approach
3. Scientific Management Approach

UNIT-IV
1. Bureaucratic Approach: Max Weber
2. Human Relations Approach : Elton Mayo
3. Ecological Approach : Riggs

UNIT-V
1. Leadership: Leadership - Styles - Approaches
2. Communication: Communication Types - Process - Barriers

TOTAL: 45 PERIODS

REFERENCES:
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.

CMG344 CONSTITUTION OF INDIA

UNIT-I
1. Constitutional Development Since 1909 to 1947
3. Constituent Assembly

UNIT-II
1. Fundamental Rights
2. Fundamental Duties
3. Directive Principles of State Policy

UNIT-III
1. President
2. Parliament
3. Supreme Court

UNIT-IV
1. Governor
2. State Legislature
3. High Court

UNIT-V
1. Secularism
2. Social Justice
3. Minority Safeguards

TOTAL: 45 PERIODS

REFERENCES:
3. Johari J.C.: Indian Politics, Vishal Publications Ltd, New Delhi
4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi

CMG345 PUBLIC PERSONNEL ADMINISTRATION

UNIT-I
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

302
UNIT-II
1. Generalist Vs Specialist (9)
2. Civil Servants’ Relationship with Political Executive
3. Integrity in Administration.

UNIT-III
1. Recruitment: Direct Recruitment and Recruitment from Within (9)
2. Training: Kinds of Training
3. Promotion

UNIT-IV
1. All India Services (9)
2. Service Conditions
3. State Public Service Commission

UNIT-V
1. Employer Employee Relations (9)
2. Wage and Salary Administration
3. Allowances and Benefits

REFERENCES:
1. Stahl Glean O: Public Personnel Administration
4. Dwivedi O.P and Jain R.B: India’s Administrative state.
7. Davar R.S. Personnel Management & Industrial Relations

TOTAL: 45 PERIODS

CMG346
ADMINISTRATIVE THEORIES
UNIT I
Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration (9)

UNIT II
Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory (9)

UNIT III
Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design. (9)

UNIT IV
Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making (9)
UNIT V
Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard, Peter Drucker

REFERENCES:
1. Crozier M: The Bureaucratic phenomenon (Chand)
3. Presthus, R: The Organizational Society (MAC)
5. Keith Davis: Organization Theory (MAC)

TOTAL: 45 PERIODS

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 9
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 9
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 9
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 9

UNIT V CORRELATION AND REGRESSION 9

TOTAL:45 PERIODS

OUTCOMES:
➢ To facilitate objective solutions in business decision making.
➢ To understand and solve business problems
➢ To apply statistical techniques to data sets, and correctly interpret the results.
➢ To develop skill-set that is in demand in both the research and business environments
➢ To enable the students to apply the statistical techniques in a work setting.
REFERENCES:

CMG350                  DATAMINING FOR BUSINESS INTELLIGENCE                              L T P C
3 0 0 3

OBJECTIVES :
➢ To know how to derive meaning form huge volume of data and information.
➢ To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION 9
Data mining, Text mining, Web mining, Data ware house.

UNIT II DATA MINING PROCESS 9
Datamining process – KDD, CRISP-DM, SEMMA
Prediction performance measures

UNIT III PREDICTION TECHNIQUES 9
Data visualization, Time series – ARIMA, Winter Holts,

UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES 9
Classification, Association, Clustering.

UNIT V MACHINE LEARNING AND AI 9
Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization

OUTCOMES:
1. Learn to apply various data mining techniques into various areas of different domains.
2. Be able to interact competently on the topic of data mining for business intelligence.
3. Apply various prediction techniques.
4. Learn about supervised and unsupervised learning technique.
5. Develop and implement machine learning algorithms

REFERENCES :
1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
CMG351 HUMAN RESOURCE ANALYTICS

OBJECTIVE:

➢ To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
➢ To know the different types of HR metrics and understand their respective impact and application.
➢ To understand the impact and use of HR metrics and their connection with HR analytics.
➢ To understand common workforce issues and resolving them using people analytics.

UNIT I - INTRODUCTION TO HR ANALYTICS
People Analytics - stages of maturity - Human Capital in the Value Chain: impact on business – HR metrics and KPIs.

UNIT II - HR ANALYTICS I: RECRUITMENT
Recruitment Metrics: Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio - Quality of hire.

UNIT III - HR ANALYTICS - TRAINING AND DEVELOPMENT
Training & Development Metrics: Percentage of employees trained - Internally and externally trained - Training hours and cost per employee - ROI.

UNIT IV - HR ANALYTICS EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION
Employee Engagement Metrics: Talent Retention index - Voluntary and involuntary turnover - grades, performance, and service tenure - Internal hired index Career Progression Metrics: Promotion index - Rotation index - Career path index.

UNIT V - HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT
Workforce Diversity and Development Metrics: Employees per manager – Workforce age profiling - Workforce service profiling - Churnover index - Workforce diversity index - Gender mix

TOTAL: 45 PERIODS

OUTCOME:

➢ The learners will be conversant about HR metrics and ready to apply at work settings.
➢ The learners will be able to resolve HR issues using people analytics.
REFERENCES:

CMG352 MARKETING AND SOCIAL MEDIA WEB ANALYTICS L T P C
3 0 0 3

OBJECTIVE:
- To showcase the opportunities that exist today to leverage the power of the web and social media.

UNIT I MARKETING ANALYTICS
Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT II COMMUNITY BUILDING AND MANAGEMENT
History and Evolution of Social Media - Understanding Science of Social Media - Goals for using Social Media - Social Media Audience and Influencers - Digital PR - Promoting Social Media Pages - Linking Social Media Accounts - The Viral Impact of Social Media.

UNIT III SOCIAL MEDIA POLICIES AND MEASUREMENTS
Social Media Policies - Etiquette, Privacy - Ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV WEB ANALYTICS
Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT V SEARCH ANALYTICS
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

TOTAL: 45 PERIODS

OUTCOME:
- The Learners will understand social media, web and social media analytics and their potential impact.
REFERENCES:
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014
5. Ric T. Peterson, Web Analytics Demystified, Celio Group Media and CafePress 2004

CMG353  OPERATION AND SUPPLY CHAIN ANALYTICS  L T P C  3 0 0 3

OBJECTIVE:
➢ To treat the subject in depth by emphasizing on the advanced quantitative models and methods in operations and supply chain management and its practical aspects and the latest developments in the field.

UNIT I  INTRODUCTION  9
Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains.

UNIT II  WAREHOUSING DECISIONS  9
P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.

UNIT III  INVENTORY MANAGEMENT  9
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV  TRANSPORTATION NETWORK MODELS  9

UNIT V  MCDM MODELS  9
Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic an Techniques, the analytical network process (ANP), TOPSIS.

TOTAL: 45 PERIODS

OUTCOME:
➢ To enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.

REFERENCES:
CMG354  FINANCIAL ANALYTICS  L T P C  3 0 0 3

OBJECTIVE:
- This course introduces a core set of modern analytical tools that specifically target finance applications.

UNIT I  CORPORATE FINANCE ANALYSIS  9
Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.

UNIT II  FINANCIAL MARKET ANALYSIS  9
Estimation and prediction of risk and return ( bond investment and stock investment) –Time series-examining nature of data, Value at risk, ARMA, ARCH and GARCH.

UNIT III  PORTFOLIO ANALYSIS  9
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.

UNIT IV  TECHNICAL ANALYSIS  9

UNIT V  CREDIT RISK ANALYSIS  9
Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.

TOTAL: 45 PERIODS

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  9

UNIT II  SUSTAINABLE INFRASTRUCTURE PLANNING  9

UNIT III  SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES  9
Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management; precision control and real time progress monitoring - Role of logistics in achieving sustainable construction – Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice – Design considerations, Design Parameters and Procedures – Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings.

UNIT IV  SUSTAINABLE CONSTRUCTION MATERIALS  9

UNIT V  SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS  9

TOTAL: 45 PERIODS
OUTCOMES:
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 L T P C 3 0 0 3

OBJECTIVES:
• To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.
UNIT I  AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS  9
Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT II  SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT  9
Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT III  WATER MANAGEMENT  9
Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT IV  ENERGY AND WASTE MANAGEMENT  9
Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V  EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS  9
Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS

OUTCOME
- On completion of the course, the student is expected to be able to
  CO1 Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture
  CO2 Discuss the sustainable ways in managing soil health, nutrients, pests and diseases
  CO3 Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources
  CO4 Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas
  CO5 Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

REFERENCES:
1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020
CO – PO Mapping - SUSTAINABLE AGRICULTURE PRACTICES

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<tr>
<th>CO’s</th>
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1 – Low; 2 – Medium; 3 – High; ‘- “- No correlation

CES333
SUSTAINABLE BIOMATERIALS

OBJECTIVES
- To Impart knowledge of biomaterials and their properties
- To learn about Fundamentals aspects of Biopolymers and their applications
- To learn about bio ceramics 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 -Poly(methylmethacrylate) (PMMA)-Polyactic acid (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers –Polylurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT 3  BIO CERAMICS AND BIOCOMPOSITES
General properties- Bio ceramics -Silicate glass - Alumina (Al2O3) -Zirconia (ZrO2)-Carbon-Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites-Polymer Matrix Composite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)–glass ceramics - Orthopedic implants-Tissue engineering scaffolds

UNIT 4  METALS AS BIOMATERIALS
Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys- Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals
UNIT-5 NANOBIOMATERIALS
Meatlicinanobiomaterials–Nanopolymers-Nanoceramics- Nanocomposites -Carbon based
nanobiomaterials - transport of nanoparticles- release rate-positive and negative effect of
nanosize-nanofibres-Nano and micro features and their importance in implant performance-
Nanosurface and coats-Applications nanoantibiotics-Nanomedicines- Biochips – Biomimetics-
BioNEMs -Biosensor-Bioimaging/Molecular Imaging- challenges and future perspective.

TOTAL : 45 PERIODS

OUTCOMES
- Students will gain familiarity with Biomaterials and they will understand their importance.
- Students will get an overview of different biopolymers and their properties
- Students gain knowledge on some of the important Bioceramics and Biocomposite materials
- Students gain knowledge on metals as biomaterials
- Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

REFERENCES
6. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018

CES334 MATERIALS FOR ENERGY SUSTAINABILITY

OBJECTIVES
- To familiarize the students about the challenges and demands of energy sustainability
- To provide fundamental knowledge about electrochemical devices and the materials used.
- To introduce the students to various types of fuel cell
- To enable students to appreciate novel materials and their usage in photovoltaic application
- To introduce students to the basic principles of various types Supercapacitors and the materials used.

UNIT-1 SUSTAINABLE ENERGY SOURCES
Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy
UNIT-2 ELECTROCHEMICAL DEVICES
Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O₂ battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO₂, LiFePO₄, LiMn₂O₄) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)

UNIT-3 FUEL CELLS

UNIT-4 PHOTOVOLTAICS

UNIT-5 SUPERCAPACITORS
Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF) - Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

OUTCOMES

- Students will acquire knowledge about energy sustainability.
- Students understand the principles of different electrochemical devices.
- Students learn about the working of fuel cells and their application.
- Students will learn about various Photovoltaic applications and the materials used.
- The students gain knowledge on different types of supercapacitors and the performance of various materials.

TOTAL: 45 PERIODS
REFERENCES
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh

CES335 GREEN TECHNOLOGY L T P C 3 0 0 3

COURSE OBJECTIVE:
- To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.
- To provide green engineering solutions to energy demand, reduced energy footprint.

UNIT I PRINCIPLES OF GREEN CHEMISTRY
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

UNIT III ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING
Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods - Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT IV ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISK ASSESSMENT
UNIT V  AUTOMATED DATA ACQUISITION AND PROCESSING

Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks - Sensors and transducers - classification of transducers - data acquisition system - types of data acquisition systems - data management and quality control; regulatory overview.

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 solid wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc

REFERENCES
1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.

Course Articulation Matrix

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<th>Course Outcomes</th>
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COURSE OBJECTIVES:
1. To create awareness on the energy scenario of India with respect to world
2. To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation
3. Familiarisation on the concept of sustainable development and its benefits
4. Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development
5. Acquainting with energy policies and energy planning for sustainable development

UNIT I ENERGY SCENARIO
Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security

UNIT II ENERGY AND ENVIRONMENT
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

UNIT III SUSTAINABLE DEVELOPMENT

UNIT IV RENEWABLE ENERGY TECHNOLOGY

UNIT V ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the world and Indian energy scenario
2. Analyse energy projects, its impact on environment and suggest control strategies
3. Recognise the need of Sustainable development and its impact on human resource development
4. Apply renewable energy technologies for sustainable development
5. Fathom Energy policies and planning for sustainable development.

REFERENCES:
7. https://www.niti.gov.in/verticals/energy
COURSE OBJECTIVES:
1. To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
2. To create awareness on energy audit and its impacts
3. To acquaint the techniques adopted for performance evaluation of thermal utilities
4. To familiarise on the procedures adopted for performance evaluation of electrical utilities
5. To learn the concept of sustainable development and the implication of energy usage

UNIT I    ENERGY AND ENVIRONMENT
Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT II    ENERGY AUDITING
Need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

UNIT III   ENERGY EFFICIENCY IN THERMAL UTILITIES
Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression

UNIT IV    ENERGY CONSERVATION IN ELECTRICAL UTILITIES
Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

UNIT V     SUSTAINABLE DEVELOPMENT

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the prevailing energy scenario
2. Familiarise on energy audits and its relevance
3. Apply the concept of energy audit on thermal utilities
4. Employ relevant techniques for energy improvement in electrical utilities
5. Understand Sustainable development and its impact on human resource development

REFERENCES:

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