ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
REGULATIONS 2021

B. TECH. PETROLEUM ENGINEERING

CHOICE BASED CREDIT SYSTEM (CBCS)

PROGRAM EDUCATIONAL OBJECTIVES:

Bachelor of Petroleum Engineering curriculum is designed to prepare the undergraduates to

1. Have attitude and knowledge for the successful professional and technical career
2. Have strong foundation in basic sciences, engineering, management, mathematics and computational platforms
3. Have knowledge on the theory and practices in the field of Petroleum technology and allied areas
4. Engross in life-long learning to keep themselves abreast of new developments, and practice and inspire high ethical values and technical standards

PROGRAM OUTCOMES:

The Petroleum Engineering Graduates will have the ability to

1. Apply knowledge of mathematics, sciences, engineering and Petroleum technology to get solution for the technological problems in Petroleum industry
2. Identify, formulate, review literature and critically analyze the technological problems in the Petroleum industry to reach substantiated conclusion
3. Design and develop the solutions to the technological and managerial problems in Petroleum industry with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
4. 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 to the technological problems in Petroleum industry
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools for managing Petroleum companies with an understanding of the limitations
6. Apply reasoning gained through the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the profession
7. Understand the impact of the developed solutions in societal and environmental contexts, and demonstrate the knowledge for sustainable development
8. Understand ethical and professional responsibilities
9. Function effectively as an individual, and as a member or leader in diverse teams in the profession
10. Communicate effectively on complex engineering activities with the engineering community and with society at large. Able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. 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. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES:
The Petroleum Engineering Graduates will have the ability to

1. Understand and apply fundamental and the technical knowledge for managing Petroleum industry
2. Be a successful entrepreneur and designer in Petroleum.
3. Design and develop novel products and manufacturing processes in Petroleum fields
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1-Low, 2-Medium, 3-High, "-"-no correlation
## ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS COLLEGES AFFILIATED COLLEGES
REGULATIONS 2021
B.TECH. PETROLEUM ENGINEERING
CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABI FOR I TO VIII SEMESTERS

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**TOTAL** | **16** | **1** | **10** | **27** | **22** |         |

$ Skill Based Course

### SEMESTER II

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**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.

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**SEMESTER III**

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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

### SEMESTER VI

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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.

### SEMESTER VII/VIII

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

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

TOTAL CREDITS: 166

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### ELECTIVE – MANAGEMENT COURSES

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* Mandatory Courses are offered as Non–Credit Courses

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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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### VERTICAL 5: ENERGY ENGINEERING

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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)**

(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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## VERTICAL 3: PUBLIC ADMINISTRATION

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### VERTICAL 4: BUSINESS DATA ANALYTICS

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### VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

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

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

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

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

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

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

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

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

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

(iv) Literary Activity
Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules
This would address some lacunias that students might have, for example, English, computer
(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?

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

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

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

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

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

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

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

REFERENCE BOOKS:

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

### CO-PO & PSO MAPPING

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

### MA3151 MATRICES AND CALCULUS

L T P C 3 1 0 4

**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 L T P C
3 0 0 3

COURSE OBJECTIVES
- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to be successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.
UNIT I  MECHANICS  9

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

UNIT III  OSCILLATIONS, OPTICS AND LASERS  9

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

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

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

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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.

CY3151 ENGINEERING CHEMISTRY L T P C
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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  
Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel.
Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO₂ emission and carbon footprint.

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

COURSE OUTCOMES
At the end of the course, the students will be able:
CO1 :To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
CO2 :To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
CO3 :To apply the knowledge of phase rule and composites for material selection requirements.
CO4 :To recommend suitable fuels for engineering processes and applications.
CO5 :To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

REFERENCES:

CO-PO & PSO MAPPING

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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


UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS

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

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS

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

UNIT IV LISTS, TUPLES, DICTIONARIES

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

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/

COs- PO’s & PSO’s MAPPING

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GE3152  சேதாரா மாண்செயற்கை வணிச்சமான தொடர்: 3

அதாத் I  நூறு தொடர் தொடர்ச்சிகள்: 3

அதாத் II  பரந்த தொடர்ச்சிகள் மத்து தொடர் தொடர்ச்சிகள் தொடர் - தொடர்ச்சிகள்: 3

தொடர்கள் முதல் தொடர் தொடர்ச்சிகள் தொடர் - தொடர்ச்சிகள் தொடர் - பரந்த தொடர்ச்சிகள் மத்து தொடர் தொடர்ச்சிகள் தொடர் - தொடர்ச்சிகள்: 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) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
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. கரைநிலைக் காலம் - மதத்தில் பரம்பாரிகம் – கொல்கோடி பொருளாதாரம் (திருச்செய்தி: கவனியக் கல்லூரி, காணையூர் மற்றும் வாராய்ச்சி குறுக்கிள் காலம்).
2. வைகாய் வாழ்வு முடிவாட்டு - புராணங்கள் பதிப்பு ககையம். (பிரித்தின் புராணங்கள்).
3. இமக்கு - கமலக்கு இருவகுச்சார்புகள் தமிழகம் தொடரும் தகைகள் (நல்லூர் புதுக்கொலுவு பதிப்பு).
4. வேராண்டியில் - ஆக்கோஸ்தியன் தான் வாராய்ச்சி. (திருச்செய்தி: கல்லூரி வாராய்ச்சி).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNB & ESC and RMRL – (in print)
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9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
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, calculate 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:


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

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**BS3171**

**PHYSICS AND CHEMISTRY LABORATORY**

**PHYSICS LABORATORY: (Any Seven Experiments)**

**COURSE OBJECTIVES:**

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

**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.

**TOTAL: 30 PERIODS**
COURSE OUTCOMES:
Upon completion of the course, the students should be able to
CO1: Understand the functioning of various physics laboratory equipment.
CO2: Use graphical models to analyze laboratory data.
CO3: Use mathematical models as a medium for quantitative reasoning and describing physical reality.
CO4: Access, process and analyze scientific information.
CO5: Solve problems individually and collaboratively.

CO’s-PO’s & PSO’s MAPPING

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• 1-Low, 2-Medium, 3-High, "-" = no correlation
• Note: the average value of this course to be used for program articulation matrix.

CHEMISTRY LABORATORY: (Any seven experiments)

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

OUTCOMES:
• To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
• To determine the amount of metal ions through volumetric and spectroscopic techniques
• To analyse and determine the composition of alloys.

TOTAL: 30 PERIODS
The text contains information about the synthesis of nanoparticles, quantitative analysis of impurities in solution by electroanalytical techniques, and the use of various textbooks for chemical analysis. It also includes tables and charts, as well as a description of objectives, units, and laboratory activities.

**Textbooks:**

**CO-PO & PSO Mapping**

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

**GE3172 ENGLISH LABORATORY**

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

**Unit I Introduction to Fundamentals of Communication**

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

**Unit II Narration and Summation**

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

**Unit III Description of a Process/Product**

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

**Unit IV Classification and Recommendations**

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

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

TOTAL : 30 PERIODS

LEARNING OUTCOMES:
At the end of the course, learners will be able
- To listen to and comprehend general as well as complex academic texts
- To listen to and understand different points of view in a discussion
- To speak fluently and accurately in formal and informal communicative contexts
- To describe products and processes and explain their uses and purposes clearly and accurately
- To express their opinions effectively in both formal and informal discussions

ASSESSMENT PATTERN
- One online / app based assessment to test listening / speaking
- End Semester ONLY listening and speaking will be conducted online.
- Proficiency certification is given on successful completion of listening and speaking internal test and end semester exam.

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

HS3252 PROFESSIONAL ENGLISH -II

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

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

40
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.

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MA3251  STATISTICS AND NUMERICAL METHODS  L  T  P  C
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OBJECTIVES:
- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

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

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

UNIT III  SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS  9+3

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

UNIT V  NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS  9+3

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:**
UNIT II  MECHANICAL PROPERTIES


UNIT III  PHASE DIAGRAMS

Basic concepts - Gibbs phase rule – Unary phase diagram (iron) - Binary phase diagrams: isomorphous systems (Cu-Ni) – determination of phase composition and phase amounts – tieline and lever rule - binary eutectic diagram with no solid solution and limited solid solution (Pb-Sn) – eutectoid and peritectic reactions - other invariant reactions – microstructural development during the slow cooling: eutectic, hypereutectic and hypoeutectic compositions.

UNIT IV  FERROUS AND NONFERROUS ALLOYS


UNIT V  CERAMICS, COMPOSITES AND NANO MATERIALS


TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Upon completion of this course, the students should be able to

CO2: Understand the basics of crystallography and its importance in materials properties

CO3: Understand the significance of dislocations, strengthening mechanisms, and tensile, creep, hardness and fracture behavior of materials

CO4: Gain knowledge on binary phase diagrams, and also will be able to determine the phase composition and phase amount.

CO5: Understand about the Fe-C system and various microstructures in it, and also about various ferrous and non-ferrous alloys.

CO6: Get adequate understanding on the preparation, properties and applications of ceramics, composites and nanomaterials.

TEXT BOOKS:


REFERENCES:

3. J.C. Anderson, K.D. Leaver, P. Leevers and R.D. Rawlings, Materials Science for...
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
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
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

UNIT IV ANALOG ELECTRONICS

UNIT V SENSORS AND TRANSDUCERS
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.

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

TOTAL: 45 PERIODS
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:

CO’s, PO’s & PSO’s MAPPING

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PE3201 INTRODUCTION TO PETROLEUM ENGINEERING  
L T P C 3 0 0 3

OBJECTIVES
- To provide an overview of petroleum industry. Petroleum exploration and exploitation techniques, oil and gas reserve identification and evaluation. Drilling and production of oil and gas. Disposal of effluents.

UNIT I PETROLEUM GEOLOGY
- Earth science - occurrence of petroleum Rocks and traps. Reservoir rocks and properties. Classification of oil and gas reserves Reservoir mechanics and drive mechanism.

UNIT II DRILLING ENGINEERING
- 3D Drilling – introduction to drilling of oil and gas wells. Drilling rigs and equipments. Drilling fluids and cementing.

UNIT III WELL LOGGING

UNIT IV PETROLEUM PRODUCTION
- Petroleum exploitation – well testing, production potential and well performances. Material balance, Artificial lift, Improved recovery methods.
UNIT V SURFACE PRODUCTION

TOTAL: 45 PERIODS

OUTCOMES
On completion of the course students are expected to
CO1: Understand the rock types and their birth place.
CO2: Understand the concepts of rig crews and rig types.
CO3: Obtain the concepts of on-site drill systems and components while using.
CO4: Know about the reservoir modelling and geological data
CO 5: Gain the knowledge about well logging
CO 6 : To understand well investigation techniques and remediation of well production problems

TEXT BOOKS

REFERENCES:
## Course Articulation Matrix

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Drawing engineering curves.
2. Drawing freehand sketch of simple objects.
3. Drawing orthographic projection of solids and section of solids.
4. Drawing development of solids
5. Drawing isometric and perspective projections of simple solids.

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

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

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

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

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

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

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

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

UNIT III  MANUFACTURING TECHNOLOGY

UNIT IV  AGRICULTURE AND IRRIGATION TECHNOLOGY
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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. தமிழ் வரலாறு - மதுரை பாரம்பரியம் - தச. சிதில் – பிற்றாச (தமிழ்ப்பின்: வரலாற்பிற்றாச் பாரம்பரியம், மதுரை பாரம்பரியம்).
2. கல்ரிசோத கிளிக்கா - வைகுரே விளையாட்டு - குருவியஸ (தமிழ்ப்பின்: விளையாட்டு).
3. கிளிக்கா - தமிழ் வரலாற்பிற்றாச் விளையாட்டு குருவியஸ் (தமிழ்ப்பின்: வரலாற்பிற்றாச் விளையாட்டு).
4. போரைவாச - ஆராய்ச்சி வரலாற்பிற்றாச் (தமிழ்ப்பின்: வரலாற்பிற்றாச்).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
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NCC Credit Course Level 1*
NX3251 (ARMY WING) NCC Credit Course Level - I

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TOTAL: 30 PERIODS

NCC Credit Course Level 1*
NX3252 (NAVAL WING) NCC Credit Course Level - I

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

PERSONALITY DEVELOPMENT 7
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, Jhansi 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

NCC Credit Course Level 1*
NX3253 (AIR FORCE WING) NCC Credit Course Level - I

NCC GENERAL 6
NCC 1 Aims, Objectives & Organization of NCC 1
NCC 2 Incentives 2
NCC 3 Duties of NCC Cadet 1
NCC 4 NCC Camps: Types & Conduct 2

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

PERSONALITY DEVELOPMENT 7
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, Jhansi 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
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 common household 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:
  a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
  b) Practicing gas welding.

BASIC MACHINING WORK:
  a) (simple)Turning.
  b) (simple)Drilling.
  c) (simple)Tapping.
ASSEMBLY WORK:
  a) Assembling a centrifugal pump.
  b) Assembling a household mixer.
  c) Assembling an airconditioner.

SHEET METAL WORK:
  a) Making of a square tray

FOUNDRY WORK:
  a) Demonstrating basic foundry operations.

PART IV   ELECTRONIC ENGINEERING PRACTICES15

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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CO1  : 3 ; CO2 : 2 ; CO3 : 2 ; CO4 : 1

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

BE3272  BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION  L T P C
ENGINEERING LABORATORY  0 0 4 2

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

TOTAL: 60 PERIODS

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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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-describing forecasts and scenarios-talking about purchasing-discussing advantages and disadvantages-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-describing safety issues( making recommendations) talking about electrical devices-describing controlling actions- Writing: job application( Cover letter + Curriculum vitae)-writing recommendations.

TOTAL: 60 PERIODS

LEARNING OUTCOMES
- Speak effectively in group discussions held in a formal/semi formal contexts.
- 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.**

- 1-low, 2-medium, 3-high, "-"- no correlation
- **Note:** The average value of this course to be used for program articulation matrix.
MA3351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

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

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

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

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

UNIT IV FOURIER TRANSFORMS

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS

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

TEXT BOOKS:
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</table>

PE3301 GEOPHYSICS

OBJECTIVE:
- To review the basic geophysical concepts as used in the petroleum industry; Applications of seismic date in the reservoir mapping and description.

UNIT I

UNIT II

UNIT III
Land and marine geophysical methods. 2D 3D seismic methods. 3D exploration. Non conventional methods, VSP, shear waves and channel waves, seismic data processing, attribute analysis and migration techniques.

UNIT IV

UNIT V

TOTAL: 45 PERIODS
OUTCOME:
- Student would be able to understand: Main geophysical methods; Wave propagation- P and S waves, Alteration at interfaces (reflection/refraction); Seismic method (data gathering and interpretation); Use and limits of seismic in reservoir description.

TEXT BOOKS:

PE3351  PROCESS CALCULATIONS  L  T  P  C
3 0 0 3

OBJECTIVE:
- To teach concept of degree of freedom and its application to solution of mass and energy balance equations for single and network of units and introduce to process simulators.

UNIT I
Base and derived Units - Composition of Mixture and solutions - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

UNIT II
Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallisation, drying etc., - Material balance with chemical reaction - Limiting and excess reactants - recycle - bypass and purging - Unsteady state material balances.

UNIT III
Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.

UNIT IV

UNIT V
Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels - Calculation of excess air from orsat technique, problems on sulphur and sulphur burning compounds - Application of Process simulators in energy and material balance problems.

TOTAL: 45 PERIODS

COURSE OUTCOMES: (COs)
On completion of the course, the students would be able to
- Understand the fundamentals of system of units, apply ideal gas law to solve problems in pure components and mixtures.
- Apply stoichiometric principles to solve problems and write material balance for different process equipments.
- Understand and apply basics of humidity to solve problems in humidification and other processes.
- Understand and apply the basics of energy balance concepts to solve to different chemical processes.
- Understand the basics of fuels and combustion, to solve problems on combustion of various fuels and also to find excess air.
Apply the above knowledge in process flow sheeting calculations.

**TEXT BOOKS:**

**REFERENCES:**
2. Venkatramani. V, Anatharaman. N and Meera Shariffa Begam “ Process Calculations” Printice Hall of India, New Delhi,
### Course Articulation Matrix

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PROCESS CALCULATIONS</th>
</tr>
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<tbody>
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<td>CO1</td>
<td>Understand the fundamentals of system of units, apply ideal gas law to solve problems in pure components and mixtures.</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
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<tr>
<td>CO2</td>
<td>Apply stoichiometric principles to solve problems and write material balance for different process equipments.</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
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<tr>
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<tr>
<td>CO3</td>
<td>Understand and apply basics of humidity to solve problems in humidification and other processes.</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
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</tr>
<tr>
<td>CO4</td>
<td>Understand and apply the basics of energy balance concepts to solve to different chemical processes.</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
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<td>3  3  1  1  2  -  -  -  -  -  1  3  1</td>
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<tr>
<td>CO5</td>
<td>Understand the basics of fuels and combustion, to solve problems on combustion of various fuels and also to find excess air.</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
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<td>CO6</td>
<td>Apply the above knowledge in process flow sheeting calculations.</td>
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<td>Overall CO</td>
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<td>3  3  2  1  2  0  1  0  0  0  0  1  3  1</td>
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</table>
OBJECTIVE:
- To impart to the student knowledge on fluid properties, fluid static and dynamic characteristics, flow metering and transport, particle mechanics, techniques of solid-fluid separation.

UNIT I  PROPERTIES OF FLUID  15

UNIT II  FLOW THROUGH PIPES & BOUNDARY LAYER CONCEPTS  15
Reynolds number regimes, Flow through pipes – pressure drop under laminar and turbulent flow conditions; boundary layer concepts; different types of flowmeters; Valves, pumps, compressors – characteristics and sizing; Agitation and Mixing.

UNIT III  SIZE ANALYSIS  15
General characteristics of solids, techniques of size analysis; Laws of size reduction, equipments for size reduction.

UNIT IV  FLOW THROUGH FLUIDIZED BEDS  15

UNIT V  CLASSIFIERS  15
Screening, gravity separation - sedimentation, thickening, elutriation, classifiers - Centrifugal separation - continuous centrifuges, cyclones and hydro cyclones, electrostatic and magnetic separators.

COURSE OUTCOME:
On completion of the course students are expected to:
- CO1: Understand the fundamental properties of fluids, stress-strain relationship in fluids, and its characteristics under static conditions and establish force balance in static systems.
- CO2: Students will be able to apply Bernoulli’s principle, Navier – Stokes’ equation and compute pressure variation in static fluid.
- CO3: Obtain the knowledge about the size reduction techniques.
- CO4: Understand about the fluidized bed, flows of fluids in their beds.
- CO5: Understand various separation and purification techniques employed in solid particles.

TEXT BOOKS:

REFERENCES:
<table>
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<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO 1</th>
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<th>PO 7</th>
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<th>PSO 2</th>
<th>PSO 3</th>
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<td>Understand the fundamental properties of fluids, stress-strain relationshipin fluids, and its characteristics under static conditions and establish force balance in static systems.</td>
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<td>Students will be able to apply Bernoulli’s principle, Navier – Stokes’ equation and compute pressure variation in static fluid.</td>
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<td>CO3</td>
<td>Obtain the knowledge about the size reduction techniques.</td>
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<td>CO4</td>
<td>Understand about the fluidized bed, flows of fluids in their beds.</td>
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<tr>
<td>CO5</td>
<td>Understand various separation and purification techniques employed in solid particles.</td>
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</table>
OBJECTIVES:
To enable the students to understand
- Petroleum reservoir system and fluid properties
- Basic principles and operations in upstream petroleum industry

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

OUTCOME:
On completion of the course, the students would have knowledge on the understand the
- Petroleum reservoir system and fluid properties
- Darcy’s Law to calculate permeability of single phase; definition of interfacial tension
- Capillary pressure to determine saturation changes in reservoir; definition of effective and relative permeability
- Drainage/imbition curves to characterize reservoir relative permeability.
- PVT analysis for reservoir fluids

TEXT BOOKS:

REFERENCE:
Course Articulation Matrix:

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<td>Darcy's Law to calculate permeability of single phase; definition of</td>
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<td>interfacial tension</td>
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<td>Capillary pressure to determine saturation changes in reservoir;</td>
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<td>Drainage/imbibition curves to characterize reservoir relative</td>
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<td>CO5</td>
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</table>

1, 2 and 3 are correlation levels with weightages as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
- To learn experimentally to calibrate flow meters, find pressure loss for fluid flows and determine pump characteristics.
- Students develop a sound working knowledge on different types of crushing equipments and separation characteristics of different mechanical operation separators.

LIST OF EXPERIMENTS - Phase – I (minimum 5 Experiments to be conducted)
1. Calibration of constant and variable head meters
2. Open drum orifice and draining time
3. Flow through straight pipe
4. Flow through annular pipe
5. Flow through helical coil and spiral coil
6. Characteristic curves of pumps
7. Pressure drop studies in packed column

LIST OF EXPERIMENTS - Phase- II(minimum 5 Experiments to be conducted)
1. Sieve analysis
2. Batch filtration studies using a Leaf filter
3. Batch filtration studies using a Plate and Frame Filter press
4. Characteristics of batch Sedimentation
5. Reduction ratio in Jaw Crusher
6. Reduction ratio in Ball mill
7. Separation characteristics of Cyclone separator
8. Reduction ratio of Roll Crusher
9. Drop weight crusher
10. Drag on Sphere
11. Effectiveness of screen

TOTAL: 60 PERIODS

COURSE OUTCOMES:
CO1: Correlate the difference between fixed and fluidized bed columns and its application.
CO2: Select pumps for the transportation of fluids based on process conditions/requirements and fluid properties
CO3: Compare the results of theoretical analytical models to the actual behavior of real fluid flows and draw sustainable conclusions
CO4: Determine the size analysis in solid- solid separation systems
CO5: Evaluate the size reduction and various crushing parameters
CO6: Work effectively as a team with commitment to the professional ethics among the peer group involved.
### Course Articulation Matrix

<table>
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<th>Statement</th>
<th>Program Outcome</th>
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<td>PO1</td>
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<tr>
<td>CO1</td>
<td>Correlate the difference between fixed and fluidized bed columns and its application</td>
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<tr>
<td>CO2</td>
<td>Select pumps for the transportation of fluids based on process conditions/requirements and fluid properties</td>
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</tr>
<tr>
<td>CO3</td>
<td>Compare the results of theoretical analytical models to the actual behavior of real fluid flows and draw sustainable conclusions</td>
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</tr>
<tr>
<td>CO4</td>
<td>Determine the size analysis in solid- solid separation systems</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>Evaluate the size reduction and various crushing parameters</td>
<td>2</td>
</tr>
<tr>
<td>CO6</td>
<td>Work effectively as a team with commitment to the professional ethics among the peer group involved.</td>
<td>-</td>
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</tbody>
</table>

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

- To demonstrate various methods involved in the preparation of structural maps and interpretation and calculation the thickness of the beds, studying depositional environment using grain size analysis and find out sediment types using Sand – Silt – Clay ratio.

LIST OF EXPERIMENTS

Geology laboratory

1) Calculation of True and Apparent Dip.
2) Estimation of Thickness, Distance and Depth of the ore body.
3) Estimation of Throw and Nature of the fault.
4) Interpretation of surface Geology using contour maps.
5) Sand – Silt – Clay ratio estimation.
6) Grain – Size analysis.
7) Identification of important sedimentary rocks in hand specimen.
8) Identification of important sedimentary rocks in microscopic level

Surveying Laboratory

1. Study of linear measuring instruments and chain surveying.
2. Study of theodolite and traversing with theodolite,
3. Study of levels and ordinary leveling with tilting level, Profile leveling,
4. Study of total station and measurement with total station.
5. Study of Global Positioning System (GPS) and measurement with GPS.

OUTCOME:

- Students would be able to understand the preparation of Geological maps and identify the rock specimens by Megascopic and Microscopic, Identify the Depositional environment and Sediment types.
- Students would gain a basic understanding of the principles and operation of the Global Positioning System
- Students would gain the ability to measure differences in elevation, draw and utilize contour plots, and calculate volumes for earthwork
- Students would improve ability to function as a member of a survey party in completing the assigned field work
- Students would appreciate the need for licensed surveyors to establish positioning information for property and structures.

TOTAL: 60 PERIODS
## Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Students would be able to understand the preparation of Geological maps and identify the rock specimens by <strong>Megascopic and Microscopic</strong>, Identify the <strong>Depositional environment</strong> and <strong>Sediment types</strong>.</td>
<td>P O 1</td>
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</tr>
<tr>
<td>CO2</td>
<td>Students would gain a basic understanding of the principles and operation of the <strong>Global Positioning System</strong>.</td>
<td>P O 1</td>
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</tr>
<tr>
<td>CO3</td>
<td>Students would gain the ability to measure differences in elevation, draw and utilize contour plots, and calculate volumes for <strong>earthwork</strong>.</td>
<td>P O 1</td>
</tr>
<tr>
<td></td>
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<tr>
<td>CO4</td>
<td>Students would improve ability to function as a member of a survey party in completing the <strong>assigned field work</strong>.</td>
<td>P O 1</td>
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<tr>
<td>CO5</td>
<td>Students would appreciate the need for licensed surveyors to establish positioning information for property and structures.</td>
<td>P O 1</td>
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</tr>
<tr>
<td>Overall CO</td>
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<td>3</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightages as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.
- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

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

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

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

TOTAL: 30 PERIODS
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.

PE3401 DRILLING FLUIDS AND CEMENTING TECHNIQUES L T P C
3 0 0 3

OBJECTIVE:
- To enable the students to understand the types of drilling fluids and cementing techniques

UNIT I
Introduction to the basic functions and properties of drilling fluids and cement slurries. Compositions and related properties of drilling fluids and cement slurries.

UNIT II

UNIT III
Types of equipment and methods used in cementing operations. Drilling fluid and cement slurry hydraulics.

UNIT IV

UNIT V

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Understand the design of mud balance and how to be able to determine the density of drilling fluids.
CO2: Able to handle the Fann Viscometer and to determine PV and gel strength.
CO3: Handle API filtration loss equipment and determine the mud cake thickness.
CO4: Determine the sand content in the drilling fluids.
CO5: Determine the salt content in the drilling fluids

TEXT BOOKS:

REFERENCES:

Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
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<th>PO10</th>
<th>PO11</th>
<th>PS1</th>
<th>PS2</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Understand the design of mud balance and how to be able to determine the density of drilling fluids.</td>
<td>-</td>
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</tr>
<tr>
<td>CO2</td>
<td>Able to handle the Fann Viscometer and to determine PV and gel strength.</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
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</tr>
<tr>
<td>CO3</td>
<td>Handle API filtration loss equipment and determine the mud cake thickness.</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
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<td>3</td>
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</tr>
<tr>
<td>CO4</td>
<td>Determine the sand content in the drilling fluids.</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>-</td>
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<td>3</td>
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</tr>
<tr>
<td>CO5</td>
<td>Determine the salt content in the drilling fluids.</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>3</td>
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<tr>
<td>Overall CO</td>
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<td>3</td>
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</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightages as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:

- To enable the students to learn PVT behaviour of fluids, laws of thermodynamics, thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.

UNIT I


UNIT II


UNIT III

Refrigeration and liquefaction process, Thermodynamic Potentials, thermodynamic correlation, Maxwell relations, criteria for Equilibria and stability. Clapeyron equation

UNIT IV

Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, activity and property change of mixing, excess properties of mixtures.

UNIT V

Activity coefficient-composition models, thermodynamic consistency of phase equilibria, ChemicalReaction equilibria, Extent of reaction, equilibrium constant and standard free energy change

TOTAL: 60 PERIODS

OUTCOME:

On the completion of the course students are expected to

CO1: Understand the fundamental concepts of thermodynamics and its related functions

CO2: Apply second law and analyse the feasibility of system/devices

CO3: Analyze the ideal and actual vapor-compression refrigeration cycle and Evaluate the performance of Liquefaction processes

CO4: Understand the relationship connecting T, P and composition originating from the concept of chemical potential and fugacity coefficient

CO5: Understand the principle of chemical reaction thermodynamics for the prediction of equilibrium conversion.

TEXT BOOKS:


REFERENCES:

## Course Articulation Matrix

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
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<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
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<tr>
<td>CO1</td>
<td>Understand the fundamental concepts of thermodynamics and its related functions</td>
<td>3</td>
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<td>1</td>
<td>3</td>
<td>1</td>
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</tr>
<tr>
<td>CO2</td>
<td>Apply second law and analyse the feasibility of system/devices</td>
<td>3</td>
<td>3</td>
<td>1</td>
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<td>1</td>
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</tr>
<tr>
<td>CO3</td>
<td>Analyze the ideal and actual vapor-compression refrigeration cycle and Evaluate the performance of Liquefaction processes</td>
<td>3</td>
<td>3</td>
<td>1</td>
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<td>3</td>
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</tr>
<tr>
<td>CO4</td>
<td>Understand the relationship connecting T, P and composition originating from the concept of chemical potential and fugacity coefficient</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
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</tr>
<tr>
<td>CO5</td>
<td>Understand the principle of chemical reaction thermodynamics for the prediction of equilibrium conversion</td>
<td>3</td>
<td>3</td>
<td>1</td>
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</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
## OBJECTIVE:
The course is aimed to
- Teach the fundamental concepts of heat transfer viz., conduction, convection, radiation, boiling and condensation and its application to the students

## UNIT I
Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer; One dimensional steady state heat conduction through plane and composite walls, hollow cylinder and spheres - Thermal conductivity measurement-effect of temperature on thermal conductivity; Heat transfer in extended surfaces; Transient heat conduction

## UNIT II
Concepts of heat transfer by convection - Natural and forced convection, Hydrodynamic and thermal Boundary layers; analogies between transfer of momentum and heat - Reynold's analogy, Prandtl and Colburn analogy. Dimensional analysis in heat transfer, heat transfer coefficient for flow through a pipe, flow past flat plate.

## UNIT III
Heat Exchangers – classification and design, overall and individual film coefficients, mean temperature difference, LMTD correction factor for multiple pass exchanger, NTU and efficiency of Heat exchangers

## UNIT IV
Heat transfer to fluids with phase change - heat transfer from condensing vapours, drop wise and film wise condensation, Nusselt equation for vertical and horizontal tubes, condensation of superheated vapours, Heat transfer to boiling liquids - mechanism of boiling, nucleate boiling and film boiling

## UNIT V
Evaporation- single and multiple effect operation, material and Energy balance in evaporators, boiling point elevation, Duhring’s rule. Radiation heat transfer - Black body radiation, Emissivity, Stefan - Boltzman law, Plank’s law, radiation between surfaces.

**TOTAL: 45 PERIODS**

## OUTCOMES:
On the completion of the course students are expected to
- **CO1**: Familiarize the students with the fundamental concepts of Heat Transfer. provide the student with knowledge about heat transfer by conduction in solids for steady state.
- **CO2**: Understand convective heat transfer and use of heat transfer coefficients for laminar and turbulent flows
- **CO3**: Students will be able to calculate and use overall heat transfer coefficients in designing heat exchangers
- **CO4**: The course provides the student with knowledge about heat transfer with phase change (boiling and condensation) and evaporation
- **CO5**: Students will understand radiative heat transfer including blackbody radiation and Kirchoff’s law, and will be able to solve radiative problems apply knowledge of heat transfer to solve thermal engineering problems

## TEXT BOOKS:

## REFERENCES:

### Course Articulation Matrix: HEAT TRANSFER

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statements</th>
<th>PO 1</th>
<th>PO 2</th>
<th>PO 3</th>
<th>PO 4</th>
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<th>PO 6</th>
<th>PO 7</th>
<th>PO 8</th>
<th>P O 9</th>
<th>PO 10</th>
<th>PO1</th>
<th>PO12</th>
<th>PS O1</th>
<th>P S O 2</th>
<th>P S O 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>familiarize the students with the fundamental concepts of Heat Transfer, provide the student with knowledge about heat transfer by conduction in solids for steady state.</td>
<td>3</td>
<td>3</td>
<td>3</td>
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<td>1</td>
<td>2</td>
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</tr>
<tr>
<td>CO2</td>
<td>understand convective heat transfer and use of heat transfer coefficients for laminar and turbulent flows</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
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<td>2</td>
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</tr>
<tr>
<td>CO3</td>
<td>Students will be able to calculate and use overall heat transfer coefficients in designing heat exchangers</td>
<td>3</td>
<td>2</td>
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</tr>
<tr>
<td>CO4</td>
<td>The course provides the student with knowledge about heat transfer with phase change (boiling and condensation) and evaporation</td>
<td>2</td>
<td>2</td>
<td>3</td>
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<td>2</td>
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</tr>
<tr>
<td>CO5</td>
<td>Students will understand radiative heat transfer including blackbody radiation and Kirchoff’s law, and will be able to solve radiative problems apply knowledge of heat transfer to solve thermal engineering problems</td>
<td>2</td>
<td>3</td>
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<td>OVERALL CO</td>
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<td>2</td>
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</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
To enable the students to
- Understand the rock and fluid properties of a hydrocarbon reservoir
- Describe the nature of the fluid flow and pressure distribution in a reservoir
- Understand the effects of production/injection on recovery of reserves

UNIT I
Introduction to Reservoir Engineering, Basic principles, definitions and data – Reservoir fluids, oil, gas, Gas formation volume factor, oil formation, volume factor, water formation volume factor – oil, gas water, rock compressibility – Resistivity index, wettability and contact angle, effective permeability characteristics, capillary pressure curves – Resistivity factors and saturation exponents. Fluid PVT analysis and oil gas phase behaviour.

UNIT II

UNIT III

UNIT IV

UNIT V

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to
- CO1: Gain the knowledge about the reservoir fluids and their properties.
- CO2: Obtain the knowledge of rocks present over the reservoir.
- CO3: Gain the knowledge about the multiphase flow and well performance
- CO4: Understand the concepts of the oil/gas recovery techniques.
- CO5: Understand the mathematical relationships that are designed to describe the flow behaviour of the reservoir fluids.

TEXT BOOKS:
On completion of the course, the students would

REFERENCE:
## Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Statement</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PO1</td>
</tr>
<tr>
<td>CO1</td>
<td>Gain the knowledge about the reservoir fluids and their properties.</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Obtain the knowledge of rocks present over the reservoir.</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>Gain the knowledge about the multiphase flow and well performance</td>
<td>-</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand the concepts of the oil/gas recovery techniques.</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand the mathematical relationships that are designed to describe the flow behaviour of the reservoir fluids.</td>
<td>3</td>
</tr>
<tr>
<td>Overall CO</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightages as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE:
- To make the students learn about the Drilling Process and Drilling Equipments.

UNIT I

UNIT II

UNIT III
- Directional Drilling, Well Planning, Two Dimensional, Horizontal, Tools, Techniques, MWD,surveying, Muds, Mud Use, Property measurements, Types, - Pneumatic (Air, Gas, Mist, Foam), Water based, Oil based, solids Control, Definitions, Equipment, Problems, Contaminations Effect.

UNIT IV

UNIT V
- Origin of Overpressure, Kick Signs, shut –in Procedures, Kill sheets, Kill Procedures, Driller’s Methods – Engineer’s Method (Wait and Weight)

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- Upon completion of the course, the students would have the ability to
  CO1: Understand the concepts of rig crews and rig types.
  CO2: Obtain the concepts of on-site drill systems and components while using.
  CO3: Gain knowledge of drilling techniques and deep study of drill mud.
  CO4: Understand the concepts of hydraulic techniques and hole cleaning criteria
  CO5: Obtain the knowledge about rig accidents and their risks.

TEXT BOOKS:
2. D.P Helander ‘Fundamentals Of Formation Evaluation’

REFERENCE:
### Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO 1</th>
<th>PO 2</th>
<th>PO 3</th>
<th>PO 4</th>
<th>PO 5</th>
<th>PO 6</th>
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<th>PO 12</th>
<th>PO 13</th>
<th>PSO 1</th>
<th>PSO 2</th>
<th>PSO 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Understand the concepts of rig crews and rig types.</td>
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<td>3</td>
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<tr>
<td>CO2</td>
<td>Obtain the concepts of on-site drill systems and components while using.</td>
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<tr>
<td>CO3</td>
<td>Gain knowledge of drilling techniques and deep study of drill mud.</td>
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<tr>
<td>CO4</td>
<td>Understand the concepts of hydraulic techniques and hole cleaning criteria</td>
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</tr>
<tr>
<td>CO5</td>
<td>Obtain the knowledge about rig accidents and their risks.</td>
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<td><strong>Overall CO</strong></td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightages as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:

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

UNIT - I : ENVIRONMENT AND BIODIVERSITY


UNIT – II : ENVIRONMENTAL POLLUTION


UNIT – III : RENEWABLE SOURCES OF ENERGY

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

UNIT - IV : SUSTAINABILITY AND MANAGEMENT

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

UNIT - V : SUSTAINABILITY PRACTICES


TOTAL: 30 PERIODS

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:

CO-PO & PSO MAPPING

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
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</tr>
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</tbody>
</table>

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

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

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

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

NCC Credit Course Level 2*  
NX3452 (NAVAL WING) NCC Credit Course Level - II  
L T P C 3 0 0 3

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

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

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

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

GENERAL AWARENESS 4
GA 1 General Knowledge 4

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

ADVENTURE 1
AD 1  Introduction to Adventure Activities  1

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

TOTAL: 45 PERIODS

NCC Credit Course Level 2*
NX3453  (AIR FORCE WING) NCC Credit Course Level - II  

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<td>Introduction to Adventure Activities</td>
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TOTAL: 45 PERIODS

PE3481  HEAT TRANSFER LABORATORY  

<table>
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<th>COURSE</th>
<th>CODE</th>
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<tr>
<td>OBJECTIVE:</td>
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</table>

87
• To enable the students to develop a sound working knowledge on different types of heat transfer equipments through experiments.

LIST OF EXPERIMENTS
1. Heat Transfer in a Double Pipe Heat Exchanger
2. Heat transfer in Shell and Tube Heat Exchanger
3. Heat Transfer in a Bare and Finned Tube Heat Exchanger
4. Heat transfer in composite wall
5. Heat transfer by Forced / Natural Convection
6. Heat Transfer by Radiation - Determination of Stefan Boltzmann constant
7. Heat Transfer by Radiation - Emissivity measurement
8. Heat transfer in Open Pan Evaporator
9. Heat transfer by Single effect evaporation / Multiple effect evaporation
10. Boiling Heat Transfer
11. Heat Transfer through Packed Bed
12. Heat Transfer in a Horizontal Condenser / Vertical Condenser
13. Heat Transfer in Helical Coils
14. Heat Transfer in Agitated Vessels

Minimum 10 experiments to be offered

TOTAL: 60 PERIODS

COURSE OUTCOME:
CO1 : Understand the concepts of heat transfer equipments.
CO2 : Estimate the heat transfer rate and heat transfer co-efficient for heat exchangers.
CO3 : Perform and compare heat transfer operations.
CO4 : Evaluate the parameters in heat transfer equipments.
CO5 : Analyze the heat transfer data from experiments.
CO6 : Solve engineering problems effectively as an individual as well as team work.
### Course Articulation Matrix: HEAT TRANSFER LABORATORY

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
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<tr>
<td>CO1</td>
<td>Understand the concepts of heat transfer equipments</td>
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</tr>
<tr>
<td>CO2</td>
<td>Estimate the heat transfer rate and heat transfer co-efficient for heat exchangers</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>Perform and compare heat transfer operations.</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Evaluate the parameters in heat transfer equipments</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Analyze the heat transfer data from experiments.</td>
<td>3</td>
</tr>
<tr>
<td>CO6</td>
<td>Solve engineering problems effectively as an individual as well as team work</td>
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<tr>
<td><strong>Overall CO</strong></td>
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</tbody>
</table>

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

- To make the student to be conversant with the principles and experimental procedures for quantitative estimation of petroleum products.

LIST OF EXPERIMENTS

1. Fluid viscosity determination
2. Carbon residue determination
3. Karl-Fisher Conductometer Apparatus for water estimation
4. Fluid density
5. Aniline point
6. Corrosion testing of petroleum oils and copper
7. Freezing point of Aqueous Engine coolant solution
8. Automatic Distillation
9. Fire point- Flash point
10. Gas Colorific value determination
11. liquid or solid Colorific value determination
12. Smoke point determination
13. Cloud and pour point determination
14. Softening point determination
15. Ductility of bitumen
16. Penetration index determination

TOTAL: 60 PERIODS

COURSE OUTCOME:

On completion of the course students are expected to

CO1: Understand the basic principles involved in testing of Petroleum products by different techniques.
CO2: Be expertise in the testing equipment.
CO3: Be well versed in properties of oil and gas products.
CO4: Acquire the data from the testing equipment and interpret it.
CO5: Understand the industrial application of concept.
## Course Articulation Matrix:

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<thead>
<tr>
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<td>Understand the basic principles involved in testing of Petroleum products by different techniques</td>
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<tr>
<td>CO2</td>
<td>Be expertise in the testing equipment.</td>
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<td>CO3</td>
<td>Be well versed in properties of oil and gas products.</td>
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<tr>
<td>CO4</td>
<td>Acquire the data from the testing equipment and interpret it.</td>
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<td>CO5</td>
<td>Understand the industrial application of concept.</td>
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</table>

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

PE3591 PETROLEUM EQUIPMENT DESIGN
OBJECTIVE:
- To study and analyze suitable equipment for particular reservoir conditions.

UNIT I
Casing program, casing and tubing design, principles of cementing, completion added skin, well perforating, hydraulic fracturing. DRILL BIT DESIGN. ROLLER CONE BITS. PDC DRILL BITS. NOMENCLATURE AND IADC CODES for drill bits. BHA (Bottom hole assembly). ESP (Electrical submersible pumps). SRP (Sucker rod pumping) unit design.

UNIT II
Design of Surface Facilities - Design of production and processing equipment, including separation problems, treating, and transmission systems.

UNIT III
Capstone design in the areas of geology, reservoir engineering, production, drilling and well completions to practical design problems based on real field data with all of the associated shortcomings and uncertainties. Use of commercial software.

UNIT IV

UNIT V

OUTCOME:
TOTAL: 45 PERIODS
On completion of the course, the students will be able to

CO1 Understand the drill bit fundamentals, codes and standards
CO2 Understand design of production and processing equipment.
CO3 Understand the Capstone design in reservoir engineering.
CO4 Understand the design of Oil and Gas Treatment Equipment
CO5 Understand the design of pipe systems.

TEXT BOOKS:
1. Petroleum Exploration Hand Book by Moody, G.B.
2. Wellsite Geological Techniques for petroleum Exploration by Sahay.B et al

REFERENCE:
Course Articulation matrix:

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<th>Course Outcomes</th>
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<td>Understand the drill bit fundamentals, codes and standards</td>
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<td>CO2</td>
<td>Understand design of production and processing equipment.</td>
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<td>CO3</td>
<td>Understand the Capstone design in reservoir engineering.</td>
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<td>CO4</td>
<td>Understand the design of Oil and Gas Treatment Equipment</td>
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<td>Understand the design of pipe systems.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
To enable the students to
- Learn the concepts of petroleum site exploration, analysis of onshore structure
- Understand the onshore soil mechanics.

UNIT I
Physico, Chemical and Biological processes in Coastal ecosystems - Salt Marshes, Mangroves, Corals and Sandy and Rocky Beaches - Sediments - Types and Characteristics - Nature of sediment movement and Transportation - Sea water circulations and Sediment dynamics - Beach nourishment through sedimentation.

UNIT II

UNIT III
Drilling. Sampling techniques. Laboratory testing, In situ testing methods and geophysical methods. Current design practices of pile supported and gravity on shore structures.

UNIT IV

UNIT V
Onshore soil mechanics; onshore pile foundations and caissons; Design of breakwaters; Buoy design and mooring systems; onshore drilling systems and types of platforms; Ocean mining and energy systems. ROV. Onshore drilling-on shore oil rigs. Onshore drilling equipments-onshore rig structures-hydraulics applied in onshore rigs

TOTAL: 45 PERIODS

OUTCOME:
On completion of the course students are expected to
CO1: Know about basic concepts of onshore drilling.
CO2: Know about the onshore platforms.
CO3: Know about the installation of equipment.
CO4: Gain Knowledge about the dynamic analysis in on-shore structures.
CO5: Learn the equipment involved in the Production practices.

TEXT BOOKS:

REFERENCE:
1. Petroleum Exploration Hand Book by Moody, G.B.
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<td>CO1</td>
<td>Know about basic concepts of onshore drilling</td>
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<tr>
<td>CO3</td>
<td>Know about the installation of equipment.</td>
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</tr>
<tr>
<td>CO4</td>
<td>Gain Knowledge about the dynamic analysis in on-shore structures.</td>
<td>3 - 2 3 2 3 3 2 - - - 3 2 3</td>
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<tr>
<td>CO5</td>
<td>Learn the equipment involved in the Production practices.</td>
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<td>Overall CO</td>
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<td>3 - 2 3 2 3 3 3 - - - 3 1 2</td>
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</table>

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PE3511 DRILLING FLUIDS AND CEMENTING TECHNIQUES LABORATORY

OBJECTIVE:
- To demonstrate the processes involved in drilling and cementing operations, introduce laboratory techniques which are used to select and optimize drilling fluids and cement slurries and to develop interest in experimentation.

LIST OF EXPERIMENTS
1) Drilling Fluid properties measurements using: Mud balance – Determination on density or weight of a drilling mud.
2) Determination of thickening time of cement slurry.
3) Determination and measurement of fluid loss of a drilling fluid and mud cake properties of a drilling fluid using atmospheric filter press.
4) Determination and measurement of fluid loss of cement slurry using atmospheric filter press.
5) Determination of rheology of drilling fluid by Fann viscometer.
6) Determination of rheology of cement slurries using Fann viscometer.
7) pH
8) Measurement and control of the basic properties of drilling fluids (density, viscosity, filtration, lubricity and electrochemical properties) and cement slurries (density, viscosity, filtration, thickening time and mechanical properties).
9) Determination of compressive strength of cement slab.

OUTCOME:
On completion of the course students are expected to
CO1: Understand the design of mud balance and how to be able to determine the density of drilling
fluids.
CO2: Able to handle the Fann Viscometer and to determine PV and gel strength.
CO3: Handle API filtration loss equipment and determine the mud cake thickness.
CO4: Determine the sand content in the drilling fluids.
CO5: Determine the salt content in the drilling fluids.

Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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<th>PROGRAM OUTCOME</th>
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<tr>
<td></td>
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<td>PO 1</td>
</tr>
<tr>
<td>CO1</td>
<td>Understand the design of mud balance and how to determine the density of drilling fluids.</td>
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</tr>
<tr>
<td>CO2</td>
<td>Able to handle the Fann Viscometer and to determine PV and gel strength.</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>Handle API filtration loss equipment and determine the mud cake thickness.</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>Determine the sand content in the drilling fluids.</td>
<td>-</td>
</tr>
<tr>
<td>CO5</td>
<td>Determine the salt content in the drilling fluids.</td>
<td>-</td>
</tr>
<tr>
<td>Overall CO</td>
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</table>

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PE3512 COMPUTATIONAL PETROLEUM ENGINEERING LABORATORY

OBJECTIVE:
- To enhance the students to develop enrich practical knowledge on computational process simulator with different refinery operation.
- To provide industrial working environment and practical working knowledge on different oil/gas upstream sectors
- To give the students an understanding the fundamentals concepts in mathematics, problems solving and computer programming.

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LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:
Minimum10 experiments to be offered
Stand alone desktops/server with respective simulation software’s 30 users.
Software’s
MATLAB Single user license
Chemical engineering simulation software
process simulator software package – Petrochemical Engineering Suite Open source office
Modelling in Reservoir Characterization

LIST OF SUGGESTED EXERCISES
Practice the following using process simulator. The simulator can be used from Virtual Lab simulators:
1. Change the P & I values and process parameters and observe the change in trend, bar graph and mimics
2. Attend the malfunction occurring in the plant then restoring to its design conditions.
3. Perform the experiments using the simulator by varying the process variables and tabulate the results.
4. Practice correct start up and shut down procedure of plant.
Practice the above exercise on the following modules given below using process simulator.
- Glass plant
- Refinery operations.
- Fractionation column for the distillation of binary mixture.
- shell and tube Heat exchanger
- Level and flow control in different sizes of vessel
- Centrifugal pump
- Centrifugal compressor
- Fluidized bed column
- Packed bed column
- Cyclone separator
- Evaporator
- Crude Distillation unit
- Manufacture of urea in urea plant
5. Equations of state using Newton’s method
6. Regression for parameter estimation using a set of data points
7. Equilibrium flash distillation (Multicomponent Ideal)
8. Solving a simple flow sheet by simultaneous approach
9. Simulation of batch Distillation (binary ideal).
10. Gravity Flow Tank
11. Heat Exchanger
12. Absorber
Specific examples in MATLAB/EXCEL / PROCESS SIMULATION SOFTWARE TOOL
1. Solving equation of state, regression of parameters using EXCEL/MATLAB
2. Calculation of Reynolds number, friction factor and pressure drop using EXCEL/MATLAB
3. Calculation of heat transfer coefficient in a Crude Heat Exchanger using EXCEL/MATLAB
4. Calculation of minimumRefluxratioforbinary/tertiarysysteminafractionatorsusing EXCEL/ MATLAB
5. Calculation of HTU and NTU in a Absorber using EXCEL/MATLAB
6. Calculation of Antoine’s coefficient using EXCEL/MATLAB
7. Estimation of settling velocity ofsolidsinliquidsusingStoke’slawusingEXCEL/MATLAB
8. CalculationofminimumnumberofstagesinadistillationcolumnusingEXCEL/MATLAB
9. Solving mass and energy balance problems using EXCEL/MATLAB
10 Dynamic simulation of an Absorption column using PROCESS SIMULATION SOFTWARE TOOL
11. Developing Heat and Mass balance diagram using PROCESS SIMULATION SOFTWARE TOOL
OUTCOME:
CO1: Remembering industrial exposure environment in computational pro-simulation.
CO2: Understanding In-depth reservoir characterization
CO3: Applying project knowledge and Carry out In-house projects
CO5: Evaluate the Intricacy & Complexity of process dynamics.
CO6: Create Employability opportunities in simulation models.

TOTAL: 45 PERIODS

REFERENCES:
**Course Articulation Matrix: COMPUTATIONAL PETROLEUM LABORATORY**

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<th>Course Outcomes</th>
<th>Statement</th>
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<td>CO1</td>
<td>Remembering industrial exposure environment in computational pro-simulation.</td>
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<tr>
<td>CO2</td>
<td>Understanding In-depth Processes of chemical and refinery operation.</td>
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<tr>
<td>CO3</td>
<td>Applying project knowledge and Carry out In-house projects</td>
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<tr>
<td>CO4</td>
<td>Analyze Sound Fundamental Concepts of Process Control and safety with DCS Operations.</td>
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<tr>
<td>CO5</td>
<td>Evaluate the Intricacy &amp; Complexity of process dynamics.</td>
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<td>CO6</td>
<td>Create Employability opportunities in simulation models.</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
- To introduce open and closed loop systems and its responses, control loop components and stability of control systems along with instrumentation.

UNIT I  INSTRUMENTATION  9
Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

UNIT II  OPEN LOOP SYSTEMS  9
Laplace transformation and its application in process control. First order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag.

UNIT III  CLOSED LOOP SYSTEMS  10
Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability.

UNIT IV  FREQUENCY RESPONSE  9
Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controllers Z-N tuning rules, CC tuning rules.

UNIT V  ADVANCED CONTROL SYSTEMS  8
Introduction to advanced control systems, cascade control, feed forward control, Smith predictor, control of distillation towers and heat exchangers, introduction to computer control of chemical processes.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course students are expected to
CO1: Understand process industry as it allows real-time measurement and control of process variables such as levels, flow, pressure, temperature, pH, and humidity.
CO2: Develop transient models for chemical processes using material and/or energy balance equations by incorporating constitutive relationships and seek their solution using Laplace Transforms.
CO3: Develop transient models for chemical processes using material and/or energy balance equations by incorporating constitutive relationships and seek their solution using Laplace Transforms.
CO4: Understand Frequency response of control systems and tune the PID controllers
CO5: Appreciate the performance augmentation of PID controllers by using advanced control strategies such as Cascade, Feed forward, Dead time compensation.

TEXT BOOKS:

REFERENCES:

### Course Articulation Matrix:

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<td>CO1</td>
<td>Understand process industry as it allows real-time measurement and control of process variables such as levels, flow, pressure, temperature, pH, and humidity.</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P S O 1 P S O 2 P S O 3</td>
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<tr>
<td>CO2</td>
<td>Develop transient models for chemical processes using material and/or energy balance equations by incorporating constitutive relationships and seek their solution using Laplace Transforms.</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P S O 1 P S O 2 P S O 3</td>
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<tr>
<td>CO3</td>
<td>Develop transient models for chemical processes using material and/or energy balance equations by incorporating constitutive relationships and seek their solution using Laplace Transforms.</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P S O 1 P S O 2 P S O 3</td>
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<tr>
<td>CO4</td>
<td>Understand Frequency response of control systems and tune the PID controllers.</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P S O 1 P S O 2 P S O 3</td>
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<tr>
<td>CO5</td>
<td>Appreciate the performance augmentation of PID controllers by using advanced control strategies such as Cascade, Feed forward, Dead time compensation.</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P S O 1 P S O 2 P S O 3</td>
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<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P S O 1 P S O 2 P S O 3</td>
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</table>
1, 2 and 3 are correlation levels with weightages as Slight (Low), Moderate (Medium) and Substantial (High) respectively

PE3602 OFFSHORE ENGINEERING

OBJECTIVE
The course is aimed to
- To learn about the important aspects of offshore structural design.
- To know about description and operation techniques.
- To understand about the types and installation.
- To learn about offshore drilling platforms.
- To understand about the offshore production and storage.

UNIT I
9
Introduction to offshore oil and gas operations-Sea States and Weather-Meteorology, oceanography, ice, sea bed soil.

UNIT II
9

UNIT III
9
Offshore Mobile Units: Types, description and installation-Station keeping methods like conventional mooring and dynamic positioning system.

UNIT IV
9
Offshore Drilling-Difference in drilling from land, from fixed platform, jack up, ships and semi submersibles-Use of conductors and risers-Deep sea drilling-Offshore Well Completion- Platforms and subsea completions-Deep water applications of subsea technology.

UNIT V
9

TOTAL: 45 PERIODS

COURSE OUTCOMES
On completion of the course students are expected to
CO1: Know about basic concepts of offshore drilling.
CO2: Know about the off-shore platforms.
CO3: Know about the installation of equipment.
CO4: Gain Knowledge about the subsea technologies.
CO5: Learn the equipment involved in the Production practices.

REFERENCES:
### Course Articulation Matrix:

<table>
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<td>Know about basic concepts of offshore drilling.</td>
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<tr>
<td>CO2</td>
<td>Know about the offshore platforms.</td>
<td>3 - - 2 2 3 - 2 - - - 3 - 2</td>
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<tr>
<td>CO3</td>
<td>Know about the installation of equipment.</td>
<td>3 - 3 - 3 2 2 3 - - - 3 1 -</td>
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<td>CO4</td>
<td>Gain Knowledge about the subsea technologies.</td>
<td>3 - 2 3 2 3 3 2 - - - 3 - -</td>
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<td>CO5</td>
<td>Learn the equipment involved in the Production practices.</td>
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1, 2 and 3 are correlation levels with weightages as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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

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**TOTAL: 45 PERIODS**

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**TOTAL: 45 PERIODS**
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

AERO ENGINES 6
E 1 Introduction and types of Aero Engine 3
E 2 Aircraft Controls 3

TOTAL : 45 PERIODS

PE3611 PROCESS CONTROL AND INSTRUMENTATION LABORATORY

OBJECTIVE:
- To determine experimentally, the methods of controlling the processes including measurements using process simulation techniques.

LIST OF EXPERIMENTS
1. Response of first order system
2. Response of second order system
3. Response of Non-Interacting level System
4. Response of Interacting level System
5. Open loop study on a thermal system
6. Closed loop study on a level system
7. Closed loop study on a flow system
8. Closed loop study on a thermal system
9. Tuning of a level system
10. Tuning of a pressure system
11. Tuning of a thermal system
12. Flow co-efficient of control valves
13. Characteristics of different types of control valves
14. Closed loop study on a pressure system
15. Tuning of pressure system
16. Closed loop response of cascade control system

*Minimum 10 experiments shall be referred.

TOTAL : 60 PERIODS

OUTCOME:
On completion of the course students are expected to
CO1: Able to determine the response of a first order and second order system for various input and an interacting and non-interacting system for various input
CO2: Understand the difference between an open loop and closed loop system and the concept of three classical controller P, PI, PID controller.
CO3: Understand the concept of stability and tuning of a system
Course Articulation Matrix:

<table>
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<tr>
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</tr>
<tr>
<td>CO1</td>
<td>Able to determine the response of a first order and second order system for various input and an interacting and non-interacting system for various input</td>
<td>- 2 3 2 3 - - - 3 3 - - 2 - -</td>
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<tr>
<td>CO2</td>
<td>Understand the difference between an open loop and closed loop system and the concept of three classical controller P, PI, PID controller.</td>
<td>- 3 - 2 2 - - - 3 2 - - 2 - -</td>
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<tr>
<td>CO3</td>
<td>Understand the concept of stability and tuning of a system.</td>
<td>- 2 2 3 3 - - - 3 2 - - 2 - -</td>
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<tr>
<td>Overall CO</td>
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<td>- 2 3 2 3 - - - 3 2 - - 2 - -</td>
</tr>
</tbody>
</table>

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

PE3612 OIL FIELD EQUIPMENT DESIGN AND DRAWING

OBJECTIVE:
- To train the students in designing of the following equipments as per IADC, API, ISME, TEMA, ISI codes and drawing according to scale

LIST OF EXPERIMENTS
1. Drawing and design of Offshore platform TLP (TENSION LEG PLATFORM) - Fixed
2. platform design,
3. Drawing and design of offshore Jack ups
4. Drawing and design of well equipments
5. Drawing and design of ROV (remotely operated vehicle)
6. Drawing and design of natural gas storage tank(Horton sphere)
7. Drawing and Designing of Mud tank
8. Drawing and design of on/offshore pipeline.
9. Drawing and design of rotary system in drilling

OUTCOME:
On completion of this practical course, the students would be able
- Know the draw and design of offshore jackups,
- Know the draw and design of natural gas storage tank
- Understand the design of well equipments

TOTAL: 60 PERIODS
- Know the draw and design of ROV (remotely operated vehicle)
- Know the draw and design of on/offshore pipeline.

**Course Articulation Matrix:**

<table>
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<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
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<td>Know the draw and design of offshore jackups,</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P O 12 P S O 1 P S O 2 P S O 3</td>
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<td></td>
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<td>3 - - - 3 2 3 3 - - - - 3 - -</td>
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<tr>
<td>CO2</td>
<td>Know the draw and design of natural gas storage tank</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P O 12 P S O 1 P S O 2 P S O 3</td>
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<td>3 - - 2 2 3 - 2 - - - - 3 - 2</td>
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<tr>
<td>CO3</td>
<td>Understand the design of well equipments</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P O 12 P S O 1 P S O 2 P S O 3</td>
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<td>3 - 3 - 3 2 2 3 - - - - 3 1 -</td>
</tr>
<tr>
<td>CO4</td>
<td>Know the draw and design of ROV (remotely operated vehicle)</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P O 12 P S O 1 P S O 2 P S O 3</td>
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<tr>
<td>Overall CO</td>
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<td>3 - 3 2 3 2 3 3 - - - - 3 1 2</td>
</tr>
</tbody>
</table>

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

**PE3711**  
**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/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

PE3701  PROCESS SAFETY IN OIL AND GAS INDUSTRIES                      L  T  P  C
                                                  3  0   0   3

Learning Objectives:
- Knowledge of environment issues and all related Acts.
- Knowledge of drilling fluids and its toxic effects with environment.
- Proper disposal of drilling cutting after appropriate treatment.
- Treatment of produced water and makeup water and its disposal as per state pollution control board norms.
- Knowledge of oil mines regulations and proper implementation in drilling & production mines as per Act.
- Knowledge of Hazop in drilling rigs & production installations.
- Knowledge of disaster management to fight any fire accident at drilling rig/ production installation/production platform.

UNIT-I

Introduction to environmental control in the petroleum industry: Overview of environmental issues- A new attitude. Drilling and production operations: Drilling- Production- Air emissions.

UNIT-II


UNIT-III

Oil mines regulations: Introduction-Returns, Notices and plans- Inspector, management and duties- Drilling and workover- Production- Transport by pipelines- Protection against gases and fires- Machinery, plants and equipment- General safety provisions- Miscellaneous-Remediation of contaminated sites- Site assessment-Remediation process.

UNIT-IV

Toxicity, physiological, asphyxiation, respiratory, skin effect of petroleum hydrocarbons and their mixture- Sour gases with their threshold limits- Guidelines for occupational health monitoring in oil and gas industry. Corrosion in petroleum industry- Additives during acidizing, sand control and fracturing.

UNIT-V


TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to:
• Be conversant with the knowledge of various Acts related to safety, Health and environment in petroleum industry.
• Have the knowledge of various drilling fluids handling and safe disposal such toxic products.
• Gain Knowledge of disaster management to fight any crisis.
• Apply Hazop to petroleum equipment operation and assess risk involved
• Mitigate occupational health hazards in the industry.

TEXT BOOKS:

REFERENCES:

Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Be conversant with the knowledge of various Acts related to safety, Health and environment in petroleum industry</td>
<td>P O 1 P O 2 P O 3 P O 4 P O 5 P O 6 P O 7 P O 8 P O 9 P O 10 P O 11 P O 12 P S O 1 P S O 2 P S O 3</td>
</tr>
<tr>
<td>CO2</td>
<td>Have the knowledge of various drilling fluids handling and safe disposal such toxic products.</td>
<td>3 - - 2 2 3 - 2 - - - - 3 - 2</td>
</tr>
<tr>
<td>CO3</td>
<td>Gain Knowledge of disaster management to fight any crisis.</td>
<td>3 - 3 - 3 2 2 3 - - - - 3 1 -</td>
</tr>
<tr>
<td>CO4</td>
<td>Apply Hazop to petroleum equipment operation and assess risk</td>
<td>3 - 2 3 2 3 3 2 - - - - 3 - -</td>
</tr>
</tbody>
</table>
PE3702 WELL COMPLETION TESTING AND WORK OVER

OBJECTIVE:
- To provide insights into the Well Operation during the hydrocarbon Explorations.

UNIT I

UNIT II
Drilling methods and equipment for directional, horizontal and multilateral wells. Selection of casing shoes, material properties and design of casing program, perforation, skin effect, activation.

UNIT III
Well Completion and Stimulations: Well completion design, types of completion, completion selection and design criteria. Interval selection and productivity considerations: effects of producing mechanisms. Inflow performance and multiple tubing performance analyses using commercial software. Well stimulation.

UNIT IV
Well stimulation and work over planning. Tubing-packer movement and forces. Tubing design: graphical tubing design and simplified tensional strength design. Selection of down hole equipment, tubing accessories and wellhead equipment.

UNIT V

TOTAL: 45 PERIODS

OUTCOME:
On completion of the course students are expected to
CO1: Understand the concept of well completion basics and managing conditions.
CO2: Obtain the knowledge about the drill string designing.
CO3: Gain the knowledge about completion types and design criteria
CO4: Understand the concept of pressure maintenance and material properties.
CO5: Obtain the knowledge about the perforation techniques.

TEXT BOOKS:
1. Wellsite Geological Techniques for Petroleum exploration by Sahay .B. et al
2. Petroleum Exploration Hand Book by Moody, G.B.
**REFERENCE:**

**Course Articulation Matrix:**

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Understand the concept of well completion basics and managing conditions.</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Obtain the knowledge about the drill string designing</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>Gain the knowledge about completion types and design criteria</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand the concept of pressure maintenance and material properties.</td>
<td>-</td>
</tr>
<tr>
<td>CO5</td>
<td>Obtain the knowledge about the perforation techniques</td>
<td>3</td>
</tr>
<tr>
<td>Overall CO</td>
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<td>3</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightages as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
COURSE DESCRIPTION
This course aims to provide a broad understanding about the modern values and ethical principles that have evolved and are enshrined in the Constitution of India with regard to the democratic, secular and scientific aspects. The course is designed for undergraduate students so that they could study, understand and apply these values in their day to day life.

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

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

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

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

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

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

REFERENCES:
4. The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,
5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022

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

<table>
<thead>
<tr>
<th>PE3811</th>
<th>PROJECT WORK / INTERNSHIP</th>
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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

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<thead>
<tr>
<th>PE3001</th>
<th>WELL LOGGING</th>
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**OBJECTIVE:**
- To enable the students to understand the concept of formation evaluation and well logging and techniques involved in it.

**UNIT I**

**UNIT II**
Principles, instrumentation, operational procedures and applications of different geophysical logs: S.P., electrical, induction, nuclear, sonic, caliper, temperature, dip and direction. Natural gamma
UNIT III  
Recording, transmission and processing of log data. Formation evaluation for hydrocarbons. Qualitative and quantitative interpretations of well log data. Overlays and cross-plots. Determination of reservoir parameters – porosity, resistivity, permeability, water and hydrocarbon saturation, movable oil. Lithology determination by neutron, density and sonic cross-plots, dual mineral method, triporosity method, litho porosity cross-plot (M-N plot), clean sand and shaly sand interpretations.

UNIT IV  

UNIT V  
Theoretical computations of normal and lateral log responses. Identification and delineation of sub-surface formations from well log data. Calculation of reservoir parameters: formation factor, porosity, permeability, resistivity, water and hydrocarbon saturations, and movable oil. Sub-surface correlation of formations and interpretation of field data.

OUTCOME:
On completion of the course students are expected to
  CO1: Understand the principles of well logging
  CO2: Understand the concept and operational procedures of different geophysical logs
  CO3: to know the qualitative and quantitative interpretation of well log data
  CO4: Understand the Well logging for metallic and non-metallic minerals:
  CO5: Able tp characterize the formation based on interpretation of well logs

TEXT BOOKS:
2. D.P Helander ‘Fundamentals Of Formation Evaluation’

REFERENCE:
## Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Understand the principles of well logging</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Understand the concept and operational procedures of different geophysical logs</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>to know the qualitative and quantitative interpretation of well log data</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>understand the well logging of metallic and non metallic minerals</td>
<td>3</td>
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<td>Overall CO</td>
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**PE3002**  
**NUMERICAL RESERVOIR SIMULATION**  
**L T P C**  
3 0 0 3

**OBJECTIVE:**  
- To enable the student to understand the basic concept and applications of Numerical Methods in Reservoirs.

**UNIT I**  
9  
Introduction, fracturing, Stress Distribution, Vertical Versus Horizontal Fractures, Pressure Related to Fracturing, Closure Pressure, Fracturing Pressure –Decline anlaysis, Pressure Interpretation After Closure, Properties of Fracturing Fluids.

**UNIT II**  
9  

**UNIT III**  
9  
Acid Fracturing, Acid Systems and Placement Techniques, Fracturing of Deviated and Horizontal Wells, Matrix Stimulations, Matrix Acidizing Design, Rate and Pressure Limits for Matrix Treatment, Fluid Volume Requirements,
UNIT IV
Design and implementation of a multiphase flow reservoir simulator, including interphase mass transfer and variable fluid saturation pressure. Design of compositional reservoir simulators using generalized equation of state. Recent advances in reservoir simulation.

UNIT V

OUTCOME:
On completion of the course students are expected to
CO1: Know about the fracturing, stress distribution and properties of fracturing fluids
CO2: Gain the Fracture Propagation Models and evaluation of fracture design
CO3: Work on Acid Fracturing and Matrix acidizing design
CO4: Know about the multiphase flow behavior in reservoir and simulation
CO5: Know about the simulator models used for the reservoir applications.

TOTAL: 45 PERIODS

TEXT BOOK:

REFERENCE:
1. Petroleum Exploration Hand Book by Moody, G.B.

Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Know about the fracturing, stress distribution and properties of fracturing fluids</td>
<td>P O P P O O O O 1 2 3 4 5 6 7 8 9 O O O 1 0 1 1 2 3 4</td>
</tr>
<tr>
<td>CO2</td>
<td>Gain the Fracture Propagation Models and evaluation of fracture design</td>
<td>P O O O O O O O S S O O O O</td>
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<tr>
<td>CO3</td>
<td>Work on Acid Fracturing and Matrix acidizing design</td>
<td>P O O O O O O O S S O O O O</td>
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<tr>
<td>CO4</td>
<td>Know about the Multiphase behavior in reservoir and simulation</td>
<td>P O O O O O O O S S O O O O</td>
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Know about the simulator models used for the reservoir applications.

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**OBJECTIVE:**

- To impart knowledge on how residual oil is recovered and the problems associated with Enhanced Oil Recovery.

**UNIT I  FUNDAMENTALS OF ENHANCED OIL RECOVERY**

- Pore Geometry, Microscopic aspects of displacement. Residual oil magnitude and mobilization.
- Buoyancy forces and prevention of trapping, Wettability, Residual oil and Oil recovery.
- Macroscopic aspect of displacement.

**UNIT II  WATER FLOODING**

- Properties, sampling and analysis of oil field water; Injection waters; Water flooding - Sweep efficiency, Predictive techniques, Improved water flood processes, Performance of some important water floods.

**UNIT III  ENHANCED OIL RECOVERY OPERATIONS - 1**

- Flooding – miscible, CO₂, polymer, alkaline, surfactants, steam;

**UNIT IV  ENHANCED OIL RECOVERY OPERATIONS - 2**

- Gas injection, in-situ combustion technology, microbial method.

**UNIT V  PROBLEMS IN ENHANCED OIL RECOVERY**

- Precipitation and deposition of Asphaltenes and Paraffin’s, Scaling problems, Formation of damage due to migration of fines, Environmental factors.

**OUTCOME:**

- On completion of the course students are expected to
  - CO1: Understand the purpose of enhanced recovery process.
  - CO2: Understand the concept of capillary force, viscous force and how it traps the oil.
  - CO3: Understand the sampling and analysis of reservoir fluid and to develop flooding fluid which is suitable for that particular field.
  - CO4: Understand the flooding mechanisms.
  - CO5: Understand how gas injection works to maintain the reservoir pressure and to understand the mechanism leading to positive skin.

**REFERENCE:**

## Course Articulation Matrix:

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<tbody>
<tr>
<td>CO1</td>
<td>Understand the purpose of enhanced recovery process.</td>
<td>P O O O O O O O 1 2 3 4 5 6 7 8 9 10 11 12 S S S S O O O O O O O O 4</td>
</tr>
<tr>
<td>CO2</td>
<td>Understand the concept of capillary force, viscous force and how it traps the oil.</td>
<td>2 3 - 3 - - 3 - - 3 - 2 - - 2</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand the sampling and analysis of reservoir fluid and to develop flooding fluid which is suitable for that particular field.</td>
<td>3 2 - 2 - - 2 - - - - 3 1 - -</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand the flooding mechanisms.</td>
<td>3 2 - 2 - - 3 - - - 2 - 2 - 1 2</td>
</tr>
<tr>
<td>CO5</td>
<td>Understand how gas injection works to maintain the reservoir pressure and to understand the mechanism leading to positive skin.</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE:
- To enable the students to follow and utilize different concepts of reservoir modeling and characteristics and their usage.

UNIT I
Overview of reservoir characterization and modeling problems. Reservoir mapping. 3D modeling. Univariate, bivariate and multivariate statistics for geological data analysis.

UNIT II

UNIT III

UNIT IV
Reservoir simulation – Investigation of petroleum reservoir characteristics and behavior, including: pore volume, fluid distribution and movement, and recovery. Optimized field development and management plans.

UNIT V

OUTCOME:
CO1: Know about the reservoir modelling and geological data
CO2: Gain the knowledge about well logging
CO3: Work on reservoir simulation.
CO4: Know about the behaviour and characteristics of petroleum reservoirs.
CO5: Know about the software used for the reservoir modelling.

TEXT BOOKS:
2. Wellsite Geological Techniques for petroleum Exploration by Shay’s et al.

REFERENCE:
Course Articulation Matrix:

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<tbody>
<tr>
<td>CO1</td>
<td>Know about the reservoir modelling and geological data.</td>
<td>PO1 3 PO2 - PO3 - PO4 2 PO5 - PO6 - PO7 - PO8 - PO9 - PO10 - PO11 - PO12 S PSO1 3 PSO2 2 PSO3 3</td>
</tr>
<tr>
<td>CO2</td>
<td>Gain the knowledge about well logging.</td>
<td>PO1 3 PO2 3 PO3 - PO4 - PO5 - PO6 - PO7 - PO8 - PO9 - PO10 - PO11 - PO12 S PSO1 3 PSO2 3 PSO3 2</td>
</tr>
<tr>
<td>CO3</td>
<td>Work on reservoir simulation.</td>
<td>PO1 3 PO2 2 PO3 - PO4 - PO5 - PO6 - PO7 - PO8 - PO9 - PO10 - PO11 - PO12 S PSO1 3 PSO2 2 PSO3 2</td>
</tr>
<tr>
<td>CO4</td>
<td>Know about the behaviour and characteristics of petroleum reservoirs.</td>
<td>PO1 3 PO2 3 PO3 2 PO4 - PO5 - PO6 - PO7 - PO8 - PO9 - PO10 - PO11 - PO12 S PSO1 3 PSO2 3 PSO3 2</td>
</tr>
<tr>
<td>CO5</td>
<td>Know about the software used for the reservoir modelling.</td>
<td>PO1 2 PO2 3 PO3 3 PO4 - PO5 - PO6 - PO7 - PO8 - PO9 - PO10 - PO11 - PO12 S PSO1 3 PSO2 3 PSO3 3</td>
</tr>
<tr>
<td>Overall CO</td>
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<td>PO1 3 PO2 3 PO3 2 PO4 - PO5 - PO6 - PO7 - PO8 - PO9 - PO10 - PO11 - PO12 S PSO1 3 PSO2 2 PSO3 2</td>
</tr>
</tbody>
</table>

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PE3005 FLOW ASSURANCE IN PETROLEUM INDUSTRIES L T P C 3 0 0 3

OBJECTIVES
The course is aimed to
- To learn the fundamentals in flow assurance.
- To gain knowledge on the hydraulics.
- To know about transfer of heat in flow assurance.
- To characterize the formation mechanism for organic deposits.
- To learn about the removal and prevention methods of organic deposits.

UNIT I INTRODUCTION TO FLOW ASSURANCE 9
Flow Assurance concerns and challenges; Economic impact of Flow Assurance problems, components of typical Flow Assurance process; Composition and Properties of Hydrocarbons; Equations of State; Phase behaviour of hydrocarbons, Compositional and Physical Characterization of Crude oil.

UNIT II HYDRAULICS IN FLOW ASSURANCE 9
Hydrocarbon flow, single phase and multiphase flow, Two phase flow correlations; Slugging and Liquid Handling, Types of slugs, Slug prediction, detection and control systems; Pressure surge analysis; Hydraulic/Pressure drop calculations.

UNIT III HEAT TRANSFER IN FLOW ASSURANCE 9
Buried pipeline heat transfer, Temperature prediction along the pipeline in steady state and transient modes; Thermal management strategy like external coating systems, direct heating, pipe in pipe, etc.; Insulation performance.
UNIT IV CHARACTERIZATION AND FORMATION MECHANISMS FOR ORGANIC DEPOSITS

Characterization, Formation mechanism, prediction and models for deposition and stability for wax (Paraffins), Asphaltenes and Gas Hydrates

UNIT V ORGANIC DEPOSITS REMOval AND PREVENTION METHODS

Mechanical Removal Methods like Coiled Tubing, Pigging, Pressurization Depressurization etc.; Chemical Solvents and Dispersants, Other techniques like Ultrasonic, Laser Technology, etc., Bacterial Removal Methods. Heating in Wellbore and Piping; Cold flow methods; Chemical inhibitors for waxes, asphaltenes and hydrates; Dehydration of Natural Gas; Special Materials and Coatings.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On completion of the course students are expected to

CO1: Predict the phase behaviour of hydrocarbons under different operating conditions.

CO2: Perform slug handling and pressure surge analysis

CO3: Implement a thermal management strategy in pipelines transporting hydrocarbons

CO4: Predict the formation of paraffin waxes, asphaltenes and hydrates in crude oil

CO5: Apply the appropriate method for prevention and removal of organic deposits.

REFERENCE


Course Articulation Matrix:

<table>
<thead>
<tr>
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<th>Statement</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Predict the phase behaviour of hydrocarbons under different operating conditions.</td>
<td>PO 1 2 3 4 5 6 7 8 9 10 11 12 PSO 1 2 3</td>
</tr>
<tr>
<td>CO2</td>
<td>Perform slug handling and pressure surge analysis.</td>
<td>- 2 - 2 2 - - - - - 3 2 -</td>
</tr>
<tr>
<td>CO3</td>
<td>Implement a thermal management strategy in pipelines transporting hydrocarbons</td>
<td>2 - - 3 2 - - - - - 3 2 -</td>
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</table>
### PE3006 PETROLEUM FORMATION AND EVALUATION

**OBJECTIVE:**

The course is aimed to

- To apply quick look methods of log interpretation.
- To analyse open hole logs and integrate log and core data to obtain properties of rocks and fluids.
- To learn about the types of tools and its applications
- To gain the knowledge on DSI and NMR logging principles.
- To analyse the log interpretation and techniques.

#### UNIT I

Petrophysical measurements to sub-surface engineering.

#### UNIT II

Indirect Methods: SP and resistivity logs, radioactive logs, acoustic logs (principles, types of tools, limitation and applications). Evaluation of CBL/ VDL, USIT, SFT, RFT.

#### UNIT III

Production Logging: Introduction, type of tools, principles, limitations and applications.

#### UNIT IV

Special Type of Logging Tools: Casing inspection tools (principles, application and limitation), Formation micro scanner (FMS), DSI, NMR logging principles. Logging in high-angle wells.

#### UNIT V


**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

On completion of the course students are expected to

- CO1. Apply different logging methods for the evaluation of subsurface formations
- CO2. Apply principles of mud logging in the recognition of oil and gas show
- CO3. Apply principles of physics in the recognition and calculation of different parameters of formations
- CO4. Apply quick look interpretation methods in the evaluation of hydrocarbon recognition
- CO5. Interpret broad depositional environment from log signatures.
TEXT BOOKS:

REFERENCE:

Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO1 PO1 PO1 PO1 PO1 PO1 PO1 PO1 PO1 PO1</td>
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<td>CO1</td>
<td>Apply different logging methods for the evaluation of subsurface formations</td>
<td>3 2 2 2 2 - - - - - 2 3 3 2</td>
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<tr>
<td>CO2</td>
<td>Apply principles of mud logging in the recognition of oil and gas show.</td>
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<tr>
<td>CO3</td>
<td>Apply principles of physics in the recognition and calculation of different parameters of formations</td>
<td>3 - 3 2 - - - - - - - - 2 3 2</td>
</tr>
<tr>
<td>CO4</td>
<td>Apply quick look interpretation methods in the evaluation of hydrocarbon recognition.</td>
<td>3 2 2 - 3 - - - - - - - - 3 3 2</td>
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<tr>
<td>CO5</td>
<td>Interpret broad depositional environment from log signatures.</td>
<td>3 - 3 - 3 - - - - - - - - 2 3 2</td>
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<tr>
<td>Overall CO</td>
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<td>3 2 3 2 3 2 - - - - - 2 3 3 2</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
UNIT I MOLECULAR DIFFUSION
Introduction to mass transfer operations; Molecular diffusion in gases, liquids and solids; diffusivity measurement and prediction; multi-component diffusion.

UNIT II CONVECTIVE TRANSFER AND INTERPHASE MASS TRANSFER
Eddy diffusion, concept of mass transfer coefficients, theories of mass transfer, different transport analogies, application of correlations for mass transfer coefficients, inter phase mass transfer, relationship between individual and overall mass transfer coefficients.

UNIT III ABSORPTION
Gas Absorption and Stripping – Equilibrium; material balance; limiting gas-liquid ratio; tray tower absorber - calculation of number of theoretical stages, tray efficiency, tower diameter; determination of height of packing using HTU and NTU calculations.

UNIT IV DISTILLATION
Vapour liquid equilibria - Raoult's law, Principle of distillation - flash distillation, differential distillation, steam distillation, multistage continuous rectification, Number of ideal stages by McCabe - Thiele method, Total reflux, minimum reflux ratio, optimum reflux ratio.

UNIT V LEACHING & EXTRACTION
Liquid - liquid extraction - solvent characteristics-equilibrium stage wise contact calculations for single stage extraction, multi-stage cross current extraction, multi-stage counter current operation. Solid-liquid equilibria- equilibrium diagram for leaching, single stage leaching, multi stage continuous cross current and counter current leaching, stage calculations, stage efficiency.

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Understand the fundamentals, types and mechanism of mass transfer operations
CO2: Understand the theories of mass transfer and the concept of inter-phase mass transfer
CO3: Understand concept and determine the theoretical stages, number of transfer units and height requirements for a gas absorption process
CO4: Identify the suitable distillation techniques, determine the number of trays for stage wise contact and determine the height of the packed tower
CO5: Apply the ternary equilibrium diagram concepts for separation of liquid-liquid extraction process, Describe core principles of leaching, estimate the number of ideal stages in leaching operation

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
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<th>Course Outcome</th>
<th>Statements</th>
<th>PO 1</th>
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<th>PS O1</th>
<th>P S O2</th>
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<td>Understand the fundamentals, types and mechanism of mass transfer operations</td>
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<td>CO3</td>
<td>Understand concept and determine the theoretical stages, number of transfer units and height requirements for a gas absorption process</td>
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<td>CO4</td>
<td>Identify the suitable distillation techniques, determine the number of trays for stage wise contact and determine the height of the packed tower</td>
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<tr>
<td>CO5</td>
<td>Apply the ternary equilibrium diagram concepts for separation of liquid-liquid extraction process, describe core principles of leaching, estimate the number of ideal stages in leaching operation</td>
<td>3</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
- Students will gain knowledge about petroleum refining process and production of petrochemical products

UNIT I

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

UNIT III
Treatment Techniques: Removal of Sulphur Compounds in all Petroleum Fractions to improve performance, Solvent Treatment Processes, Dewaxing, Clay Treatment and Hydrofining.

UNIT IV
Cracking of Naphtha and Feed stock gas for the production of Ethylene, Propylene, Isobutylene and Butadiene. Production of Acetylene from Methane, Catalytic Reforming of Petroleum Feed Stocks and Extraction of Aromatics.

UNIT V
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 and Acetone, Methanol, Formaldehyde, Acetaldehyde, Pentaerythritol and Production of Carbon Black.

TOTAL: 45 PERIODS

OUTCOMES:
- Understand the classification, composition and testing methods of crude petroleum / product
- Understand to develop innovative refining process
- Apply the knowledge of treatment processes to develop the manufacture of petroleum products.
- Know about the different reaction mechanism for the manufacture of petroleum products.
- Acquiring to develop quality control and assurance techniques in petroleum refining.

TEXT BOOKS:

Course Articulation Matrix:
| CO1 | Understand the classification, composition and testing methods of crude petroleum / product | 3 | - | - | 2 | - | - | - | - | 3 | 2 | 3 | - |
| CO2 | Understand to develop innovative refining process | 3 | - | 3 | 2 | 3 | - | - | - | - | - | 3 | 3 | 2 | - |
| CO3 | Apply the knowledge of treatment processes to develop the manufacture of petroleum products. | 3 | - | 2 | 2 | - | - | - | - | - | - | 3 | 2 | 2 | - |
| CO4 | Acquiring to develop quality control and assurance techniques in petroleum refining. | 3 | - | 3 | 2 | 2 | - | - | - | - | - | 3 | 3 | 2 | - |
| CO5 | Acquiring to develop quality control and assurance techniques in petroleum refining. | 2 | - | 2 | 3 | 3 | - | - | - | - | - | 3 | 2 | 3 | - |
| Overall CO | 3 | - | 3 | 2 | 3 | - | - | - | - | - | - | 3 | 2 | 2 | - |

CPE331 CHEMICAL REACTION ENGINEERING

OBJECTIVE:
- To enable the students to gain knowledge on different types of chemical reactors, the design of chemical reactors under isothermal and non-isothermal conditions

UNIT I KINETICS OF HOMOGENEOUS REACTIONS
Rate equation, elementary, non-elementary reactions, theories of reaction rate - Arrhenius theory, interpretation of kinetic data, integral and differential analysis.

UNIT II IDEAL REACTORS
Design equation for constant and variable volume batch reactors, Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors, combination of reactors-Equal sized CSTRs in series and parallel - Equal sized PFRs in series and parallel, size comparison of reactors.

UNIT III MULTIPLE REACTIONS
Design of reactors for multiple reactions – Series, parallel Reactions - factors affecting choice, optimum yield and conversion, selectivity, reactivity.
UNIT IV NON-ISOTHERMAL REACTORS 9
Heats of reaction and equilibrium conversion from thermodynamics, Non-isothermal homogeneous reactor systems, adiabatic reactors, Material and energy balances in batch reactors, Material and energy balances in plug flow and mixed flow reactors.

UNIT V NON-IDEAL REACTORS 9
Residence time distribution as a factor of performance; residence time functions and relationship between them in reactors; basic models for non-ideal flow-single parameter model, conversion in non-ideal reactors.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students would be able to
1. Apply the principles of reaction kinetics, formulate rate equations and analyze the batch reactor data.
2. Analyze the experimental kinetic data to select a suitable reactor for a particular application and to workout conversion and space time for different types of reactors.
3. Evaluate selectivity, reactivity and yield for parallel and mixed reactions.
4. Design isothermal and non-isothermal reactors for homogeneous reactions.
5. Examine how far real reactors deviate from the ideal reactors.
6. Solve the complex reaction engineering problems.

TEXT BOOKS:

REFERENCE:
## Course Articulation Matrix: CHEMICAL REACTION ENGINEERING

<table>
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<th>Course Outcomes</th>
<th>Statement</th>
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<th>PSO2</th>
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<td>Apply the principles of reaction kinetics, formulate rate equations and analyze the batch reactor data.</td>
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<tr>
<td>CO2</td>
<td>Analyze the experimental kinetic data to select a suitable reactor.</td>
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<tr>
<td>CO3</td>
<td>Evaluate selectivity, reactivity and yield for multiple reactions.</td>
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<tr>
<td>CO4</td>
<td>Design isothermal and non-isothermal reactors for homogeneous reactions.</td>
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<td>CO5</td>
<td>Examine how far real reactors deviate from the ideal reactors.</td>
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<tr>
<td>CO6</td>
<td>Solve the complex reaction engineering problems.</td>
<td>2</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
- To enable the students to learn the design aspects of fluidized beds.

UNIT I  BASICS OF FLUIDIZATION  9
Packed bed – Velocity – Pressure drop relations – Correlations of Ergun, Kozney karman – On set of fluidization – Properties of fluidized beds – Development of fluidization from fixed bed.

UNIT II FLUIDIZED BED TYPES  9

UNIT III DESIGN ASPECTS  9

UNIT IV HEAT AND MASS TRANSFER IN FLUIDIZED BEDS  9
Heat and mass transfer in fluidized bed systems – Industrial applications and case studies of fluidized bed systems.

UNIT V OTHER TYPES OF FLUIDIZATION  9
Single stage and multistage fluidization – Collection of fines – Use of cyclones.

TOTAL: 45 PERIODS

OUTCOME:
CO1 :Understand the basics and governing equations of fluidization
CO2 :Understand the fluidization conditions/behaviours as well as types of fluidization
CO3 :Analyse and apply design concepts for designing the fluidization systems.
CO4 :Understand heat and mass transfer concepts & case studies in fluidization.
CO5 :Understand the various accessories used & stages of fluidization.
CO6 :knowledge on industrial applications of fluidization systems.

TEXT BOOKS:

REFERENCES:
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<th>PO 2</th>
<th>PO 3</th>
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<th>PSO1</th>
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<td>Understand the basics and governing equations of fluidization</td>
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<td>CO3</td>
<td>Analyse and apply design concepts for designing the fluidization systems.</td>
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<tr>
<td>CO4</td>
<td>Understand heat and mass transfer concepts &amp; case studies in fluidization.</td>
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<tr>
<td>CO5</td>
<td>Understand the various accessories used &amp; stages of fluidization.</td>
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<tr>
<td>CO6</td>
<td>Knowledge on industrial applications of fluidization systems.</td>
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</table>
OBJECTIVE:
- To understand the types of corrosion found in the petroleum industries. This course will provide the student with knowledge of the analytical methods needed to diagnose, treat, and monitor corrosion to reduce costs, protect the environment, and increase safety.

UNIT I

UNIT II

UNIT III
Role of oxygen in oil filed corrosion- down hole and surface equipment - water flood. Removal of oxygen, analysis and criteria for control. Role of carbon dioxide (CO₂) in corrosion-Effect of temperature and pressure - Corrosion of well tubing and other equipments. Role of hydrogen sulphide (H₂S)-Corrosion in downhole, surface, storage and pipelines.

UNIT IV

UNIT V
Inspection and corrosion monitoring. Oil treatment corrosion - crude oil properties - desalting- sweetening processes. Corrosion in oil storage tank corrosion- oilfield and oil treating facilities-oil/ gas pipelines -offshore platforms- subsea systems.

TOTAL: 45 PERIODS

OUTCOME:
CO1 : Understand the basic concepts of corrosion and its impacts.
CO2 : Understand the various types of corrosion in petroleum processes.
CO.3 : Gain knowledge on removal techniques of various gases in pipelines applications.
CO4 : Understand the corrosion preventing methods.
CO5 : Design the offshore drilling structures based on project requirement.
CO6 : Evaluate the corrosion rate and propose the protection method based on environmental considerations.

TEXT BOOKS:

REFERENCE:
Course Articulation Matrix:

<table>
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<tr>
<th>Course Outcomes</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Understand the basic concepts of corrosion and its impacts.</td>
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<tr>
<td>CO2</td>
<td>Understand the various types of corrosion in petroleum processes.</td>
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<tr>
<td>CO3</td>
<td>Gain knowledge on removal techniques of various gases in pipelines applications.</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand the corrosion preventing methods</td>
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<tr>
<td>CO5</td>
<td>Design the offshore drilling structures based on project requirement</td>
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<tr>
<td>CO6</td>
<td>Evaluate the corrosion rate and propose the protection method based on environmental considerations.</td>
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<tr>
<td>Overall CO</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
- To enable the students to understand the process plant utilities and optimization techniques to optimize various parameters in chemical industries.

UNIT I  IMPORTANT OF UTILITIES  9
Hard and Soft water, Requisites of Industrial Water and its uses. Methods of water Treatment such as Chemical Softening and Demineralization, Resins used for Water Softening and Reverse Osmosis. Effects of impure Boiler Feed Water.

UNIT II  STEAM AND STEAM GENERATION  9
Properties of Steam, problems based on Steam, Types of Steam Generator such as Solid Fuel Fired Boiler, Waste Gas Fired Boiler and Fluidized Bed Boiler. Scaling and Trouble Shooting. Steam Traps and Accessories.

UNIT III  REFRIGERATION  9
Refrigeration Cycles, Methods of Refrigeration used in Industry and Different Types of Refrigerants such as Monochlorodifluoro Methane, Chlorofluoro Carbons and Brins. Refrigerating Effects and Liquefaction Processes.

UNIT IV  COMPRESSED AIR  9

UNIT V  FUEL AND WASTE DISPOSAL  9

TOTAL: 45 PERIODS

OUTCOME:
On completion of the course, the students will be able to
CO1: gain knowledge in the importance of process plant utilities
CO2: be familiar on various types of steam generators and boiler corrosion
CO3: Understand the concept of refrigeration used in industries
CO4: Learn the classification of compressors and humidification equipments
CO5: Understand the Requisites Fuel Disposal and Waste Disposal

TEXT BOOKS:

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Course Articulation matrix:

<table>
<thead>
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<th>PO2</th>
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<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
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<tr>
<td>CO1</td>
<td>gain knowledge in the importance of process plant utilities</td>
<td>2</td>
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<tr>
<td>CO2</td>
<td>be familiar on various types of steam generators and boiler corrosion</td>
<td>2</td>
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<td>CO3</td>
<td>Understand the concept of refrigeration used in industries</td>
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<tr>
<td>CO4</td>
<td>Learn the classification of compressors and humidification equipments</td>
<td>2</td>
<td>2</td>
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<tr>
<td>CO5</td>
<td>Understand the Requisites Fuel Disposal and Waste Disposal</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVE:
This course offers an insight into the design, operation and maintenance of pipes and piping networks.

UNIT I  PIPING FUNDAMENTALS:

UNIT II  PIPING IN PRACTICE:
Piping Network – Series and Parallel pipes, Pipe Network analysis using spreadsheets. piping for pumps and compressor

UNIT III  GENERIC PIPING DESIGNS:

UNIT IV  PIPING SYSTEMS:
Design considerations for piping systems – water and waste water, steam, compressed air, industrial gases, oil, refrigeration, solid and slurry systems

UNIT V  OPERATION AND MAINTENANCE:
Inspection of Pipelines – Testing techniques and leak detection. Maintenance – Cleaning, coating, freeze prevention, drag reduction, insulation, Common failures and repair techniques, Piping Plan development

TOTAL: 45 PERIODS

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

CO1: Apply the fundamental principles of fluid mechanics to solve fluid flow problems
CO2: Interpret the piping symbols and codes and sketch a piping layout for a given Problem.
CO3: Describe the concepts of generic piping design for optimal design of piping systems
CO4: Explain the process of design of various pipelines systems
CO5: Discuss the techniques involved in inspection and maintenance of pipelines
CO6: Explain various applications of pipes & pipeline systems in process industries

TEXT BOOKS

REFERENCES:
<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
<th>CO6</th>
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<td>Apply the fundamental principles of fluid mechanics to solve fluid flow</td>
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<td>Interpret the piping symbols and codes and sketch a piping layout for</td>
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<td>a given Problem</td>
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<td>Describe the concepts of generic piping design for optimal design of</td>
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<td></td>
<td>Explain the process of design of various pipeline systems</td>
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<td></td>
<td>Discuss the techniques involved in inspection and maintenance of</td>
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<td>Explain various applications of pipes &amp; pipeline systems in process</td>
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</table>

PROGRESS THROUGH KNOWLEDGE
CPE345 STORAGE TRANSPORTATION OF CRUDE OIL AND NATURAL GAS

OBJECTIVE:
- To understand the natural gas regasification technology, crude oil transportation and to learn the concepts of storage.

UNIT I INTRODUCTION
Crude oil Trade, Selection of Port Location, Ship Building/Shipyards.

UNIT II NATURAL GAS REGASIFICATION TECHNOLOGY
Commercial Sourcing of Natural Gas, Different Kinds of Regasification Techniques, Regasification Process & Cold Utilization, Synchronization of Degasified gas and Pipelines, Current Status in India

UNIT III CRUDE OIL TRANSPORTATION
Transportation techniques of crude oil, Pipeline specification, Corrosion Prevention techniques, Pressure drop, Pumps and Booster station, Wax deposition and prevention, Chemical treatment

UNIT IV DESIGN
Basic Engineering Aspects of Terminal Design, Design of Liquefaction Train, Ship Building/Shipyards, Storage Facilities

UNIT V CHARTERTICS OF STORAGE

OUTCOME:
CO1: Students would be able to design various terminal design.
CO2: They will be familiarize with the storage systems.
CO3: Compute the Different Kinds of Regasification Techniques.
CO4: Evaluate the Pipeline specification, Corrosion Prevention techniques
CO5: To know about the Properties of Storage Reservoir, Rocks & Fluids
CO6:Regulate the Pressure- Content Hysteresis

TEXT BOOKS:
### Course Articulation Matrix: STORAGE TRANSPORTATION OF CRUDE OIL AND NATURAL GAS

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO1</th>
<th>PO2</th>
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<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
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<tbody>
<tr>
<td><strong>CO1</strong></td>
<td>Students would be able to design various terminal design.</td>
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<tr>
<td><strong>CO2</strong></td>
<td>They will be familiarize with the storage systems.</td>
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<tr>
<td><strong>CO3</strong></td>
<td>Compute the Different Kinds of Regasification Techniques.</td>
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<td><strong>CO4</strong></td>
<td>Evaluate the Pipeline specification, Corrosion Prevention techniques</td>
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<tr>
<td><strong>CO5</strong></td>
<td>To know about the Properties of Storage Reservoir, Rocks &amp; Fluids</td>
<td>3</td>
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<tr>
<td><strong>CO6</strong></td>
<td>Regulate the Pressure-Content Hysteresis</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE
The course is aimed to
- To understand about basic concepts behind the product design.
- To know the concept behind the selection and testing of the design.
- To learn about the product architecture.
- To know about the Industrial design.
- To understand the manufacturing design.

UNIT I  INTRODUCTION
Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer - behavior analysis. Understanding customer-promoting customer understanding-involve customer in development and managing requirements - Organization process management and improvement.

UNIT II  CONCEPT GENERATION, SELECTION AND TESTING

UNIT III  PRODUCT ARCHITECTURE
Product development management - establishing the architecture - creation - clustering - geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems -architecture of the chunks - creating detailed interface specifications- Portfolio Architecture.

UNIT IV  INDUSTRIAL DESIGN
Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design-impact – design process - investigation of customer needs - conceptualization - refinement - management of the industrial design process.

UNIT V  DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT
Definition - Estimation of Manufacturing cost-reducing the component costs and assembly costs – Minimize system complexity - Prototype basics - Principles of prototyping – Planning for prototypes - Economic Analysis.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Know the basic concepts and importance of product design.
CO2: Understand the planning, selection criteria of the design and products.
CO3: Gain knowledge about the product management and architecture.
CO4: Understand the industrial design and tools for designs.
CO5: Understand the economic analysis of the design.

TEXT BOOK

REFERENCES
## Course Articulation Matrix: PRODUCT DESIGN AND DEVELOPMENT FOR PETROCHEMICAL ENGINEERS

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Statement</th>
<th>Program Outcome</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Know the basic concepts and importance of product design.</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
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<tr>
<td>CO2</td>
<td>Understand the planning, selection criteria of the design and products.</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
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<tr>
<td>CO3</td>
<td>Gain knowledge about the product management and architecture.</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
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<td>3  3  3  3  2  -  1  -  -  -  1  2  3  3</td>
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<tr>
<td>CO4</td>
<td>Understand the industrial design and tools for designs.</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
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<tr>
<td>CO5</td>
<td>Understand the economic analysis of the design.</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
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<td>Overall CO</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
CPE332 DESIGN OF PRESSURE VESSELS AND STORAGE VESSELS L T P C
3 0 0 3

OBJECTIVES:
- The main objective is to present the industrial related problems, procedures and design.
- Principles for pressure vessels and enhance the understanding of design procedure of pressure vessel and supports.

UNIT I DESIGN OF PIPE FITTINGS AND JOINTS 9
Stress-strain relationships of elastic materials subjected to tensile, compressive and shear forces; Membrane stresses in shells of revolutions; Theories of failures. Design and schematic of simple bolts and screws. Design and drawing of shafts and couplings.

UNIT II DESIGN OF PRESSURE VESSELS 9
Unfired pressure vessel: Pressure vessel codes; Design of cylindrical and spherical shells under internal and external pressures; Selection and design of flat plate, tori spherical, ellipsoidal, and conical closures; Shell design of tall vertical vessels; Compensations of openings.

UNIT III DESIGN OF STORAGE VESSELS 9
Liquid storage tanks: Storage tank codes; Classification; Design of shell, bottom plates, self-supported, and column supported roofs; Wind girder; Nozzles and other accessories.

UNIT IV FABRICATION AND MATERIALS 9
Fabrication of equipment: Major fabrication steps; Vessel lining; Materials used in fabrication of Chemical Equipments. Vessel Coatings – selection and application. Selection of process equipment’s material. Material selection for process fluids.

UNIT V DESIGN OF SUPPORTS FOR VESSELS 9

TOTAL: 45 PERIODS

OUTCOME:
CO1: Students would be able to understand the principles Stress-strain relationships of elastic materials Design and drawing of shafts and couplings
CO2: Enhanced the knowledge on Design of cylindrical and spherical shells under internal and external pressures.
CO3: Study on Fundamental and Technological principled involved in design of storage vessels.
CO4: Understanding the principles involved in Material selection for process fluids.
CO5: Understanding the principles involved in piping layout and piping stress Analysis.
CO6: Skills on Fundamental and Technological principles involved design of pressure vessels and storage vessels

TEXT BOOKS:

REFERENCES:
5. J.M. Coulson and J. Richardson, "Chemical Engineering", Vol. 6, Asian Books Printers Ltd.
# Course Articulation Matrix: DESIGN OF PRESSURE VESSELS AND STORAGE VESSELS

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
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<td>Students would be able to understand the principles Stress-strain relationships of elastic materials Design and drawing of shafts and couplings</td>
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<td>CO2</td>
<td>Enhanced the knowledge on Design of cylindrical and spherical shells under internal and external pressures.</td>
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<td>CO3</td>
<td>Study on Fundamental and Technological principled involved in design of storage vessels.</td>
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<td>CO4</td>
<td>Understanding the principles involved in Material selection for process fluids.</td>
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<td>Understanding the principles involved in piping layout and piping stress Analysis.</td>
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<tr>
<td>CO6</td>
<td>Skills on Fundamental and Technological principles involved design of pressure vessels and storage vessels</td>
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**OVERALL CO**

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
- To learn the basic concept and properties, composition of natural gas.
- To impart estimation and production of natural gas.
- To gain knowledge about production of natural gas from condensate oil fields.
- To learn the acid gas treating of natural gas.
- To gain knowledge about dehydration of natural gas and LNG processes.

UNIT I PROPERTIES AND COMPOSITION OF NATURAL GAS 9

UNIT II ESTIMATION AND PRODUCTION OF NATURAL GAS 9

UNIT III GAS FROM CONDENSATE OIL FIELDS 9
Processing of condensate well fluids – Cycling of gas condensate reservoirs – Sweep patterns – Katy cycling plant.

UNIT IV ACID GAS TREATING OF NATURAL GAS 9
Acid gas removal: Metal oxide process – Slurry process – Amine process – Carbonate washing process – Methanol based process and other process – Sulphur recovery process.

UNIT V DEHYDRATION OF NATURAL GAS AND LNG PROCESSES 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On successful completion of this course, the students would be able to
CO1: Understand Natural gas processing.
CO2: Understand Gas Compression, Gas Gathering and Transport Installation.
CO3: Apply knowledge operation and trouble shooting of natural gas pipelines.
CO4: Understand dehydration of natural gas
CO5: Evaluate LNG processes and operations
CO6: Create new process technology for NGE and LNG processes.

TEXT BOOKS:

REFERENCES:
## Course Articulation Matrix: NATURAL GAS AND LNG PROCESSES

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PROGRAM OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Remembering knowledge about Natural gas processing.</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
</tr>
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<td>3    3    3    2    2    1    1    -    1    1    1    2    2    2    2</td>
</tr>
<tr>
<td>CO2</td>
<td>Understanding about Natural gas processing, Gas Compression, Gas Gathering and Transport Installation.</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
</tr>
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<tr>
<td>CO3</td>
<td>Applying knowledge about Operation and trouble shooting of natural gas pipelines.</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
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</tr>
<tr>
<td>CO4</td>
<td>Analyzing knowledge about dehydration of natural gas</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
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<td>3    3    3    1    1    1    1    -    1    1    1    2    2    2    2</td>
</tr>
<tr>
<td>CO5</td>
<td>Evaluating LNG processes and operations</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
</tr>
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<td>3    3    3    3    3    1    1    -    1    1    1    2    2    2    2</td>
</tr>
<tr>
<td>CO6</td>
<td>Creating new process technology for NGE and LNG processes.</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
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<th>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</th>
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<tr>
<td></td>
<td>3    3    3    2    2    1    1    -    1    1    1    2    2    2    2</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
- To understand the basic quantitative theories and methodologist in oil sector.

UNIT I
Supply and demand curves, the elasticity of supply and demand, public finance concepts such as consumer surplus, excise and export taxes. Forecasting techniques for the energy industry, including energy prices. Demand and supply for natural gas, cured oil and pipeline transportation, determinants of energy demand, energy markets, energy pricing, stability and performance of energy markets.

UNIT II
The economics of investment, Discounted cash flow analysis, Cost Benefit Analyses, Internal Rate of Return, NPV, Profitability Index, Natural Monopoly theory, National competition Policy, Gas Market Regulation, taxation of the oil and gas industry, government policy and trade permits, Monte Carlo analysis, Net Back Pricing, Transfer Pricing and regulatory aspects.

UNIT III
Application of petroleum engineering principles and economics to the evaluation of oil and gas projects, evaluation principles, time value of money concepts, investment measures, cost estimation, price and production forecasting, risk and uncertainty, project selection and capital budgeting inflation, escalation, operating costs, depreciation, cost recovery.

UNIT IV
Petroleum exploration and production contracts. Sharing of the economic rent, portfolio management. Value creation, Corporate finance & return on capital, economic appraisal methods for oil filed development, reservoir model costs and calculations.

UNIT V
Case studies: Economic study of an oil filed development project, petrochemical plant project, natural gas break even price, natural gas liquefaction cost, LNG transport cost, investment profitability study for a gas pipeline.

OUTCOME:
On the completion of the course students are expected to
CO1: Understand the concept of economics in a process plant, time value of money and cost indices.
CO2: Able to integrate knowledge about financial statements, Depreciation and Accounting.
CO3: Able develop economic balance for petroleum engineering equipment’s and determine the optimum cost for operation.
CO4: Understand the basics of principles of management, types of organization and MIS.
CO5: Understand the theory behind Work measurement technique, Production planning and elements of production control in petrochemical industry.
CO6: Understand the concept of inventory control and the role of control charts in quality control in oil and gas industry

TEXT BOOKS:
REFERENCES:
**Course Articulation Matrix: PETROLEUM ECONOMICS**

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO1</th>
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<th>PSO1</th>
<th>PSO2</th>
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<td>CO1</td>
<td>Understand the concept of economics in a process plant, time value of money and cost indices.</td>
<td>3</td>
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<tr>
<td>CO2</td>
<td>Able to integrate knowledge about financial statements, Depreciation and Accounting.</td>
<td>3</td>
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</tr>
<tr>
<td>CO3</td>
<td>Able develop economic balance for petroleum engineering equipment's and determine the optimum cost for operation.</td>
<td>3</td>
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<tr>
<td>CO4</td>
<td>Understand the basics of principles of management, types of organization and MIS.</td>
<td>3</td>
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<tr>
<td>CO5</td>
<td>Understand the theory behind Work measurement technique, Production planning and elements of production control in petrochemical industry</td>
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<tr>
<td>CO6</td>
<td>Understand the concept of inventory control and the role of control charts in quality control in oil and gas industry</td>
<td>3</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High)
OBJECTIVES:
- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen's Compensation and other laws) enacted for the protection of employees health at work settings
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I  INTRODUCTION
Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.

UNIT II  OCCUPATIONAL HEALTH AND HYGIENE

UNIT III  WORKPLACE SAFETY AND SAFETY SYSTEMS

UNIT IV  HAZARDS AND RISK MANAGEMENT

UNIT V  ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT

TOTAL: 45 PERIODS

OUTCOMES:
After completion of this course, the student is expected to be able to:
CO1: Describe, with example, the common work-related diseases and accidents in occupational setting
CO2: Name essential members of the Occupational Health team
CO3: What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee
CO4: Analyze the occupational safety and health is organization.
CO5: Obtain knowledge on accident investigation environmental health and safety management
CO6: Know about the concept of environmental health and safety management

REFERENCES:
1. Fundamentals of Industrial Safety and Health by Dr.K.U.Mistry, Siddharth Prakashan, 2012
2. Environmental and Health and Safety Management by Nicholas P.Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995
### Course Articulation Matrix: HEALTH SAFETY AND ENVIRONMENTAL MANAGEMENT

<table>
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<th>PO3</th>
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<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
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<tr>
<td>CO1</td>
<td>Describe, with example, the common work-related diseases and accidents in occupational setting</td>
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<tr>
<td>CO2</td>
<td>Name essential members of the Occupational Health team</td>
<td>3</td>
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<tr>
<td>CO3</td>
<td>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</td>
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<tr>
<td>CO4</td>
<td>Analyze the occupational safety and health is organization.</td>
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<tr>
<td>CO5</td>
<td>Obtain knowledge on accident investigation environmental health and safety management</td>
<td>3</td>
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<tr>
<td>CO6</td>
<td>Know about the concept of environmental health and safety management</td>
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</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES
The course is aimed to
- To understand the need of safety in industries.
- To understand the safety regulations.
- To identify the hazards in the process plants.
- To know about safety audit
- To understand the risk analysis techniques.

UNIT I  NEED FOR SAFETY IN INDUSTRIES  9
Importance & objectives of safety- Safety Programmes – components and realization; Potential hazards – extreme operating conditions, toxic chemicals; safe handling

UNIT II  PLANT SAFETY AND SAFETY REGULATION  9
Implementation of safety procedures – periodic inspection and replacement; Accidents - identification and prevention; Criteria for setting & layout of chemical plant, Factories Act and Safety Regulations.

UNIT III  PLANT HAZARDS & RISK ANALYSIS  9
Fire hazards- Chemical hazards, Toxic hazards, Explosion hazards, Electrical hazards, Mechanical hazards, Radiation hazards, Noise hazards-Overall risk analysis--emergency planning- on site & off site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment - rapid and comprehensive risk analysis; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball.

UNIT IV  SAFETY AUDIT  9
Objective of safety audit- Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough-Mexico-Madras-Vizag Bopal analysis

UNIT V  RISK ANALYSIS TECHNIQUES  9
Hazard & Operability (HAZOP) studies- Hazard Analysis (HAZAN)-Fault Tree Analysis Consequence Analysis.

COURSE OUTCOMES:
On completion of the course students are expected to
CO1: Understand the importance of safety and its objectives.
CO2: Understand the implementation of safety and identification and prevention of Accidents.
CO3: Know about the types of hazards, emergency plan and ISO standards for safety studies.
CO4: Do the safety audit in plants.
CO5: Do the risk analysis in industries using the various techniques.

TEXT BOOKS

REFERENCES
# Course Articulation Matrix: PLANT SAFETY AND RISK MANAGEMENT

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcomes</th>
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</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Understand the importance of safety and its objectives</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2</td>
</tr>
<tr>
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<td></td>
<td>3    3    3    3    1    1    3    1    1    1    1    1    2    2    2</td>
</tr>
<tr>
<td>CO2</td>
<td>Understand the implementation of safety and identification and prevention of Accidents</td>
<td>3    3    3    3    2    1    1    1    1    1    1    1    2    2    2</td>
</tr>
<tr>
<td>CO3</td>
<td>Know about the types of hazards, emergency plan and ISO standards for safety studies</td>
<td>3    3    3    3    2    1    1    1    1    1    1    1    1    1    2    2    2</td>
</tr>
<tr>
<td>CO4</td>
<td>Do the safety audit in plants.</td>
<td>3    3    3    3    1    1    1    1    1    1    1    1    1    1    2    2    2</td>
</tr>
<tr>
<td>CO5</td>
<td>Do the risk analysis in industries using the various techniques</td>
<td>3    3    3    3    2    1    1    1    1    1    1    1    1    1    2    2    2</td>
</tr>
<tr>
<td>Overall CO</td>
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<td>3    3    3    3    2    1    1    1    1    1    1    1    1    1    2    2    2</td>
</tr>
</tbody>
</table>

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

- To gain knowledge on BLEVE vapour cloud explosion.
- To learn about principles of fire extinguishers.
- To gain knowledge on industrial fire protection systems.
- To learn about the fire protection and fire safety equipment.
- To gain knowledge on explosive control.

UNIT I  PHYSICS AND CHEMISTRY OF FIRE


UNIT II  FIRE PREVENTION AND PROTECTION


UNIT III  INDUSTRIAL FIRE PROTECTION SYSTEMS


UNIT IV  BUILDING FIRE SAFETY

Objectives of fire safe building design, Fire load, fire resistant material and fire testing – structural fire protection – structural integrity – concept of egress design - exit – width calculations - fire certificates – fire safety requirements for high rise buildings.

UNIT V  EXPLOSION PROTECTING SYSTEMS

Principles of explosion-detonation and blast waves-explosion parameters – Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure explosion venting-inert gases, plant for generation of inert gas rupture disc in process vessels and lines explosion, suppression system based on carbon dioxide (CO$_2$) and halons-hazards in LPG, ammonia (NH$_3$).

OUTCOME

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

- TO obtain knowledge on properties of fire and case studies related to fire
- TO make familiar about basic concepts of fire and explosion science.
- TO know the different source of ignition and their prevention techniques.
- TO understand the operation of various types of firefighting equipments.
- TO understand the causes and prevention of explosion.
- TO equip the students to effectively employ explosion protection techniques and their Significances to suit the industrial requirement.
REFERENCES:
### Course Articulation Matrix: FIRE AND EXPLOSION CONTROL

<table>
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<th>Statement</th>
<th>Program Outcome</th>
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<td>PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PSO1 PSO2</td>
</tr>
<tr>
<td>CO1</td>
<td>To obtain knowledge on properties of fire and case studies related to fire</td>
<td>3 2 - - - - - - - 1 3 2</td>
</tr>
<tr>
<td>CO2</td>
<td>To make familiar about basic concepts of fire and explosion science.</td>
<td>3 2 - - 3 - - - - 1 3 2</td>
</tr>
<tr>
<td>CO3</td>
<td>To know the different source of ignition and their prevention techniques.</td>
<td>2 2 1 - 3 - - - - 1 3 2</td>
</tr>
<tr>
<td>CO4</td>
<td>To understand the operation of various types of firefighting equipments.</td>
<td>2 2 2 - - - - - - 3 - - 1 3 2</td>
</tr>
<tr>
<td>CO5</td>
<td>To understand the causes and prevention of explosion.</td>
<td>1 1 1 - - - - - - 3 - 1 3 2</td>
</tr>
<tr>
<td>CO6</td>
<td>To equip the students to effectively employ explosion protection techniques and their Significances to suit the industrial requirement.</td>
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<td>Overall CO</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
- To understand the basic knowledge on anatomy of human organs and its basic functions.
- To enable the students to learn about various functions and activities of occupational health services.
- To enable students to compare the hazards with the permissible levels.
- To have knowledge about types of hazards arising out of physical, chemical and biological agents.

UNIT I PHYSICAL HAZARDS 9
Noise, compensation aspects, noise exposure regulation, properties of sound, occupational damage, risk factors, sound measuring instruments, octave band analyzer, noise networks, noise surveys, noise control program, industrial audiometry, hearing conservation programs- vibration, types, effects, instruments, surveying procedure, permissible exposure limit. Ionizing radiation, types, effects, monitoring instruments, control programs, OSHA standard- nonionizing radiations, effects, types, radar hazards, microwaves and radio-waves, lasers, TLV- cold environments, hypothermia, wind chill index, control measures- hot environments, thermal comfort, heat stress indices, acclimatization, estimation and control.

UNIT II CHEMICAL HAZARDS 9

UNIT III BIOLOGICAL AND ERGONOMICAL HAZARDS 9
Classification of Biohazardous agents – examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases - Biohazard control program, employee health program-laboratory safety program-animal care and handling-biological safety cabinets - building design. Work Related Musculoskeletal Disorders -carpal tunnel syndrome CTS- Tendon pain-disorders of the neck- back injuries.

UNIT IV OCCUPATIONAL HEALTH AND TOXICOLOGY 9
Concept and spectrum of health - functional units and activities of occupational health services, preemployment and post-employment medical examinations - occupational related diseases, levels of prevention of diseases, notifiable occupational diseases such as silicosis, asbestosis, pneumoconiosis, siderosis, anthracosis, aluminosis and anthrax, lead-nickel, chromium and manganese toxicity, gas poisoning (such as CO, ammonia, coal and dust etc) their effects and prevention – cardio pulmonary resuscitation, audiometric tests, eye tests, vital function tests. Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems.

UNIT V OCCUPATIONAL PHYSIOLOGY 9

OUTCOMES:
The students will be able
CO1: To understand the various physiological functions of our body and the test methods for periodical monitoring of health.
CO2: Determine the physical hazard at workplace and suggest control measures.
CO3: Compute the chemical hazards at workplace with adequate mitigating actions.
CO4: Evaluate the biological and ergonomical hazards at workplace and associated risk factors.
CO5: Practice the occupational health strategies at workplace.
CO6: Regulate the man machine interface in the organization.

REFERENCES:
### Course Articulation Matrix: INDUSTRIAL HYGIENE

<table>
<thead>
<tr>
<th>Course Outcome’s</th>
<th>Statement</th>
<th>Program Outcome</th>
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<tr>
<td>CO1</td>
<td>To understand the various physiological functions of our body and the test methods for periodical monitoring of health.</td>
<td>3 1 2 1 - - - - - - - - 3 2</td>
</tr>
<tr>
<td>CO2</td>
<td>Determine the physical hazard at workplace and suggest control measures.</td>
<td>2 1 3 1 3 - - - - - - - - 3 2</td>
</tr>
<tr>
<td>CO3</td>
<td>Compute the chemical hazards at workplace with adequate mitigating actions.</td>
<td>2 1 2 2 3 - - - - - - - - 3 2</td>
</tr>
<tr>
<td>CO4</td>
<td>Evaluate the biological and ergonomical hazards at workplace and associated risk factors.</td>
<td>3 2 2 1 - - - - - - - - - 3 2</td>
</tr>
<tr>
<td>CO5</td>
<td>Practice the occupational health strategies at workplace.</td>
<td>2 2 1 3 - - - - - - - - - 2 3 2</td>
</tr>
<tr>
<td>CO6</td>
<td>Regulate the man machine interface in the organization.</td>
<td>- - - - - - - - - - - - 3 3 2</td>
</tr>
<tr>
<td>Overall CO</td>
<td></td>
<td>2 2 1 - 1 1 - 1 1 - 1 1 3</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
- To provide the students about the various activities/steps to be followed in safe handling the hazardous goods transportation from one location to another location.
- To educate the reasons for the road accident and the roles and responsibilities of a safe Driver and the training needs of the driver.
- To inculcate the culture of safe driving and fuel conservation along with knowing of basic traffic symbols followed throughout the highways.
- To understand the accident reporting and investigation procedures.
- To understand the various breaking characteristics of vehicle.
- To provide an in depth knowledge about the safe driving safe driving movement of cranes-conveyors.

UNIT I TRANSPORTATION OF HAZARDOUS GOODS
Transport emergency card (TREM) – driver training-parking of tankers on the highways-speed of the vehicle – warning symbols – design of the tanker lorries -static electricity-responsibilities of driver – inspection and maintenance of vehicles-check list- loading and decanting procedures – communication.

UNIT II ROAD TRANSPORT
Introduction – factors for improving safety on roads – causes of accidents due to drivers and pedestrians-design, selection, operation and maintenance of motor trucks-preventive maintenance check lists-motor vehicles act – motor vehicle insurance and surveys.

UNIT III DRIVER AND SAFETY

UNIT IV ROAD SAFETY

UNIT V SHOP FLOOR AND REPAIR SHOP SAFETY
Transport precautions-safety on manual, mechanical handling equipment operations-safe drivingmovement of cranes-conveyors etc., servicing and maintenance equipment-grease rack operationwash rack operation-battery charging-gasoline handling-other safe practices-off the road motorized equipment.

OUTCOMES:
The students will be able to
CO1: Recognize various safety activities undertaken in transporting of hazardous goods
CO2: Understand the various symbols which are specific to the road safety and able to reduce the accidents occurred in the roads.
CO3: Apply for the safe transportation of hazardous goods, creating TREM card and safe loading and unloading procedure.
CO4:To understand the various types of – emergency planning and Haz mat codes
CO5: To understand the loading and unloading of moving cars.

TOTAL : 45 PERIODS
CO6: To equip the students to effectively manual, mechanical handling equipment operations
Significances to suit the industrial requirement

REFERENCES
3. K.W.Ogden, “Safer Roads – A guide to Road Safety Engineering”
## Course Articulation Matrix: TRANSPORTATION SAFETY

<table>
<thead>
<tr>
<th>Course Outcome's</th>
<th>Statement</th>
<th>Program Outcome</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PO1</td>
</tr>
<tr>
<td>CO1</td>
<td>Recognize various safety activities undertaken in transporting of hazardous goods</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Understand the various symbols which are specific to the road safety and able to reduce the accidents occurred in the roads.</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>Apply for the safe transportation of hazardous goods, creating TREM card and safe loading and unloading procedure.</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>To understand the various types of emergency planning and Haz mat codes.</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>To understand the loading and unloading of moving cars.</td>
<td>1</td>
</tr>
<tr>
<td>CO6</td>
<td>To equip the students to effectively manual, mechanical handling equipment operations. Significances to suit the industrial requirement</td>
<td>-</td>
</tr>
<tr>
<td>Overall CO</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

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

- To gain knowledge on PHA, HAZOP studies.
- To learn about BAM testing and thermal analysis.
- To learn about HAZAN, FMEA, FET index.
- To gain knowledge on CPQRA, CAMEO.
- To learn about intermediate, risk on CPQRA.

UNIT I  HAZARD, RISK ISSUES AND HAZARD ASSESSMENT  9
Introduction, hazard, hazard monitoring-risk issue - Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, preliminary hazard analysis (PHA), hazard operability studies (HAZOP).

UNIT II  THERMAL AND MECHANICAL HAZARD ASSESSMENT  9
Applications of Advanced Equipment's and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter (DSC), Thermo Gravimetric Analyzer (TGA), Accelerated Rate Calorimeter (ARC), Principles of operations, Controlling parameters, Applications, advantages. Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test, Sensitiveness Test, Impact Sensitiveness Test (BAM) and Friction Sensitiveness Test (BAM), Shock Sensitiveness Test, Card Gap Test.

UNIT III  RISK QUANTIFICATION AND SOFTWARES  9
Fault Tree Analysis and Event Tree Analysis, Logic symbols, methodology, minimal cut set ranking - fire explosion and Index (FEI)-fire explosion and toxicity index (FETI), various indices - Hazard analysis (HAZAN)- Failure Mode and Effect Analysis (FMEA)

UNIT IV  CHEMICAL PROCESS QUANTITATIVE RISK ANALYSIS  9
CPQRA Definitions-components Techniques of CPQRA-Scope of CPQRA- Applications of CPQRA- Utilization of CPQRA results. Hazard identification based on the properties of chemicals-Chemical inventory analysis- identification of hazardous processes - Estimation of source term, Gas or vapour release, liquid release, two phase release- Heat radiation effects, BLEVE, Pool fires and Jet fire- Gas/vapour dispersion- Explosion, UVCE and Flash fire, Explosion effects and confined explosion- Toxic effects- Plotting the damage distances on plot plant/layout - Software CAMEO, ALOHA & MARPLOT.

UNIT V  APPLICATION OF CPQRA  9
Simple /consequence CPQRA Examples Characterization, application to a new process unit, application to an existing process unit. Intermediate/ Frequency CPQRA characterization-application to existing/new process units. Complex/risk CPQRA Characterization. Application to new or existing process Unit.
Case Studies of Flixborough, Bhopal, Texas, ONGC offshore, HPCL Vizag and Jaipur IOC oil-storage depot incident; Oil, natural gas, chlorine and ammonia storage and transportation hazards.

TOTAL : 45 PERIODS

OUTCOMES:
On successful completion of this course, the students will be able to
- CO1: Understand the basics of hazard and hazard assessment.
- CO2: Know about the various advanced equipment and testing.
- CO3: Acquire software knowledge on risk analysis.
- CO4: Obtain knowledge on application of CPQRA.
- CO5: Analyze the risk associated with chemicals process.
- CO6: Obtain knowledge on chemical process quantitative risk analysis

REFERENCE BOOKS:
# Course Articulation Matrix: PROCESS HAZARD ANALYSIS STUDIES

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
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<tbody>
<tr>
<td></td>
<td>PO1</td>
<td>PO2</td>
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<td>CO1</td>
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<td>CO2</td>
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<td>CO3</td>
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<td>CO4</td>
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<td>CO5</td>
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<tr>
<td>CO6</td>
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<td>3</td>
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<tr>
<td>Overall CO</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

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

- To gain Knowledge in capturing and applying forms of energy sources like solar, wind, biomass, geothermal, nuclear energy, hydrogen and fuel cells and challenges associated with implementation.
- To Understand the challenges associated with the development of unconventional hydrocarbons and distribution of unconventional hydrocarbons with emphasis on Indian resources.

UNIT I  ENERGY SOURCES & AVAILABILITY

Conventional, Non-conventional, renewable, non renewable sources of energy, prospects & perspectives & advantages. Introduction to different types of non conventional source of energy - solar, wind, biomass, OTEC, geothermal, hydrogen energy, fuel cells, MHD, thermonic convertor, thermo-electric power.

UNIT II  SOLAR & WIND ENERGY


UNIT III  BIOMASS ENERGY


UNIT IV  OTHER ENERGY SOURCES


UNIT V  UNCONVENTIONAL NON-RENEWABLE ENERGY

Introduction to Unconventional Hydrocarbon resources- Coal Bed Methane: Geological controls in CBM, Indian Scenario, Gas Hydrates: Structure of gas hydrates and their stability, producibility of gas hydrates and challenges, Indian scenario of gas hydrates, Shale Gas / oil: production techniques applied for shale gas, Indian basins for shale gas/oil potential

OUTCOMES

After completion of this course, the student is expected to be able to show the:
- Knowledge in capturing and applying forms of energy sources and its availability
- Understand the concept in various energy sources like solar, wind, biomass, geothermal, nuclear energy, hydrogen and fuel cells
- Analyze the challenges associated with implementation of various renewable energy sources.
- Study the bio-based energy sources and technologies involved in it
- Understanding of the challenges associated with the development of unconventional hydrocarbons and distribution of unconventional hydrocarbons with emphasis on Indian resources.

REFERENCES

1. Unconventional Hydrocarbon Resources, Techniques for Reservoir Engineering Analysis
   By Reza Barati, Mustafa M. Alhubail · 2020 Publisher:Wiley
# Course Articulation Matrix: RENEWABLE AND NON-RENEWABLE ENERGY

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcomes</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>PO1</td>
</tr>
<tr>
<td>CO1</td>
<td>Knowledge in capturing and applying forms of energy sources and its availability</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Understand the concept in various energy sources like solar, wind, biomass, geothermal, nuclear energy, hydrogen and fuel cells</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>Analyze the challenges associated with implementation of various renewable energy sources.</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Study the bio-based energy sources and technologies involved in it</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Understanding of the challenges associated with the development of unconventional hydrocarbons and distribution of unconventional hydrocarbons with emphasis on Indian resources.</td>
<td>3</td>
</tr>
<tr>
<td>Overall CO</td>
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<td>3</td>
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</tbody>
</table>
OBJECTIVES:
At the end of the course, the student is expected to
- understand and analyse the energy data of industries
- carryout energy accounting and balancing
- conduct energy audit and suggest methodologies for energy savings and
- utilise the available resources in optimal ways

UNIT I  INTRODUCTION
Energy - Power – Past & Present scenario of World; National Energy consumption
Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types,
Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II  ELECTRICAL SYSTEMS
Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors,
Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy
Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of
Encon in Illumination.

UNIT III  THERMAL SYSTEMS
Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon
measures. Steam: Distribution &U sage: 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

OUTCOMES:
Upon completion of this course, the students can able to analyze the energy data of industries.
CO1: Understand and analyze the energy data of industries
CO2: Carryout energy accounting and balancing
CO3: Understand the principles in thermal systems
CO4: Conduct energy audit and suggest methodologies for energy savings
CO5: Utilize the available resources in optimal ways

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

REFERENCES:
## Course Articulation Matrix: ENERGY CONSERVATION AND MANAGEMENT

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PROGRAM OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PO1</td>
</tr>
<tr>
<td>CO1</td>
<td>Understand and analyze the energy data of industries</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Carry out energy accounting and balancing</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand the principles in thermal systems</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Conduct energy audit and suggest methodologies for energy savings</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Utilize the available resources in optimal ways</td>
<td>3</td>
</tr>
<tr>
<td>OVERALL CO</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

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

This course enables the students to know

- The growing worldwide concern for conservation of energy has reawakened interest in ecologically sustainable, processes and sources of energy.
- The better ways to conserve the energy from energy audit concepts, Representations and energy conservation schemes.
- Management skills and communication of energy manager.
- Various operational problems and remedies of motor and electrical devices.
- Evaluation of life time of machine based on time value money and demand, economic analysis with respect to demand side management.

UNIT I  ENERGY AUDITING  9

UNIT II  ENERGY EFFICIENT MOTORS  9

UNIT III  POWER FACTOR IMPROVEMENT  9
Power Factor — Methods of Improvement, Location of Capacitors, Pf with Non Linear Loads, Effect of Harmonics on P.F., P.F Motor Controllers.

UNIT IV  LIGHTING AND ENERGY INSTRUMENTS  9
Good Lighting System Design and Practice, Lighting Control, Lighting Energy Audit - Energy Instruments- Watt Meter, Data Loggers, Thermocouples, Pyrometers, Lux Meters, Tongue Testers ,Application of PLC's

UNIT V  ENERGY ECONOMIC ANALYSIS& DEMAND SIDE MANAGEMENT  9

OUTCOMES

The student will have knowledge on the following concepts

- CO1  Gain the knowledge of Current energy scenario
- CO2  Understand the energy management, auditing.
- CO3  Apply the conservation economic analysis and demand side management
- CO4  Know the Systematic knowledge and skill about assessing the energy efficiency
- CO5  Evaluate the energy auditing and energy management.

TEXTBOOKS:

## Course Articulation Matrix: ENERGY CONSERVATION AND MANAGEMENT

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PSO1</th>
<th>PSO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Gain the knowledge of Current energy scenario</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>Understand the energy management, auditing.</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>Apply the conservation economic analysis and demand side management</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
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<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
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<tr>
<td>CO4</td>
<td>Know the Systematic knowledge and skill about assessing the energy efficiency</td>
<td>1</td>
<td></td>
<td></td>
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<td>1</td>
<td>1</td>
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<td>3</td>
<td>3</td>
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</tr>
<tr>
<td>CO5</td>
<td>Evaluate the energy auditing and energy management.</td>
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<td></td>
<td></td>
<td>1</td>
<td>1</td>
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<td>Overall CO</td>
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</tbody>
</table>

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

- To present a problem oriented in depth knowledge of fuel cell technology.
- To Comprehend the Physics, Chemistry and Engineering of fuel cell and hydrogen technologies and be able to apply this knowledge to solve complex problems;

UNIT I   INTRODUCTION TO FUEL CELLS

Introduction – working and types of fuel cell – low, medium and high temperature fuel cell, liquid and methanol types, proton exchange membrane fuel cell solid oxide, microbial fuel cells, hydrogen fuel cells – thermodynamics and electrochemical kinetics of fuel cells.

UNIT- II   HYDROGEN AND PRODUCTION TECHNIQUES


UNIT III   HYDROGEN STORAGE AND APPLICATIONS


UNIT IV   THE WORKINGS OF MICROBIAL FUEL CELLS

An introduction to microbial fuel cells-Electrochemical principles – characterization of bioelectrochemical systems-electron transfer mechanisms in biofilms

UNIT V   MATERIALS FOR MICROBIAL FUEL CELLS AND REACTOR DESIGN

Anode materials for microbial fuel cells – surface modification – membranes and separators for microbial fuel cells – cathodes for microbial fuel cells – reactor design and scale up.

COURSE OUTCOME

CO1  Gain the knowledge on the various types of fuel cell.
CO2  Apply the concepts involved hydrogen and production techniques
CO3  Understanding the skill in hydro storage and applications .
CO4  Understand the principle mechanism and working of microbial fuel cells
CO5  Evaluating the materials used for microbial fuel cells design

REFERENCES:

## Course Articulation Matrix: HYDROGEN AND MICROBIAL FUEL CELLS

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PROGRAM OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Gain the knowledge on the various types of fuel cell.</td>
<td>PO1  PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PSO1 PSO2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 1 1 1 - 3 3 - - - 2 2 2 2</td>
</tr>
<tr>
<td>CO2</td>
<td>Apply the concepts involved hydrogen and production techniques</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>Understanding the skill in hydrogen storage and applications</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>Understand the principle mechanism and working of microbial fuel cells</td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>Evaluating the materials used for microbial fuel cells design</td>
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<td><strong>OVERALL CO</strong></td>
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</table>

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

UNIT I  OVERVIEW OF BIOFUELS 9

UNIT II  BIODIESEL 9
Biodiesel – Microorganisms and raw materials used for microbial Oil production – Treatment of the feedstocks prior to production of the Biodiesel – Current technologies of biodiesel production – Purification of biodiesel; Industrial production of biodiesel – Biodiesel production from single cell oil.

UNIT III  BIOETHANOL 9

UNIT IV  BIOMETHANE AND BIOHYDROGEN 9

UNIT V  OTHER BIOFUELS 9

COURSE OUTCOME
CO1 Gain the knowledge on the various types of bio-fuel and its overview.
CO2 Apply the concepts involved in production techniques of biodiesel
CO3 Understanding the skill in manufacture the bioethanol
CO4 Understand the principle mechanism and production of biomethane and biohydrogen
CO5 Evaluating the various other fuels like biopropanol – bioglycerol and pyrolysis oil

TEXT BOOKS:

REFERENCES:
## Course Articulation Matrix: biofuels

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Gain the knowledge on the various types of bio-fuel and its overview.</td>
<td>PO1</td>
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<tr>
<td></td>
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<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Apply the concepts involved in production techniques of biodiesel</td>
<td>PO1</td>
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<td>3</td>
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<tr>
<td>CO3</td>
<td>Understanding the skill in manufacture the bioethanol</td>
<td>PO1</td>
</tr>
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<td></td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Understand the principle mechanism and production of biomethane and biohydrogen</td>
<td>PO1</td>
</tr>
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<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Evaluating the various other fuels like biopropanol – bioglycerol and pyrolysis oil</td>
<td>PO1</td>
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<tr>
<td>Overall CO</td>
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<td>PO1</td>
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<td>3</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
- To understand the geographic distribution of unconventional hydrocarbon resources
- To understand characterization of source and reservoir rocks
- To understand methodology to produce these reserves
- To understand environmental consequences of producing these reserves
- Demonstrate awareness related to environmental issues involved in the development of non-conventional hydrocarbon resources.

UNIT I NON-CONVENTIONAL OIL
Continuous Accumulation System
Introduction, geology of Heavy oil, extra heavy oil, Tar Sand and bituminous, oil shales, their origin and occurrence worldwide, resources, reservoir characteristics, new production technologies.

UNIT II SHALE GAS/ OIL RESERVOIR
Introduction to shale gas & basin centered gas, tight reservoirs. Shale gas geology, important occurrences in India, petrophysical properties, Development of shale gas, design of hydro fracturing job, horizontal wells, production profiles.

UNIT III COAL BED METHANE
Formation and properties of coal bed methane. Thermodynamics of coal bed methane. Exploration and Evaluation of CBM. Hydro-fracturing of coal seam. Production installation and surface facilities. Well operations and production equipment.

UNIT IV GAS HYDRATES

UNIT V COAL AND GAS CONVERSION TO OIL
Introduction, classification and principles, pyrolysis, theoretical aspect of processes involved in conversion. Technological development of direct conversion and indirect processes and sustainability of conversions.

OUTCOMES:
At the end of the course, the student will be able to
- Recognise and apply the concept of continuous accumulation system.
- Apply the concepts related to exploration and development of Shale Gas Reservoirs.
- Apply the concepts related to exploration and development of Coal Bed Methane.
- Understand and apply the concepts related to formation of gas hydrates.
- Understand and apply different conversion processes for the production of Hydrocarbons.

REFERENCES:
Course Articulation Matrix: UNCONVENTIONAL HYDROCARBON SOURCES

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<td>Apply the concepts related to exploration and development of Shale Gas Reservoirs</td>
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<td>Apply the concepts related to exploration and development of Coal Bed Methane</td>
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<td>Understand and apply different conversion processes for the production of Hydrocarbons</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
COURSE OBJECTIVES:
- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

UNIT II PLANNING

UNIT III ORGANISING

UNIT IV DIRECTING

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

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:
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, “Fundamentals of

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GE3752 TOTAL QUALITY MANAGEMENT

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COURSE OBJECTIVES:

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

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

UNIT II TQM PRINCIPLES

UNIT III TQM TOOLS & TECHNIQUES I

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

UNIT V QUALITY MANAGEMENT SYSTEM
Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000- ISO 9001 Requirements-Implementation- Documentation- Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM:

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to apply TQM concepts in a selected enterprise.

CO2: Ability to apply TQM principles in a selected enterprise.

CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.

CO4: Ability to understand Taguchi’s Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.

CO5: Ability to apply QMS and EMS in any organization.

TEXT BOOK:


REFERENCES:


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

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

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

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

TEXT BOOKS:

REFERENCES:

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

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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 acquire knowledge from experts
CO2: Understand the learning organization.
CO3: Use the knowledge management tools.
CO4: Develop knowledge management Applications.
CO5: Design and develop enterprise applications.

CO’s- PO’s & PSO’s MAPPING

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TOTAL: 45 PERIODS

187
TEXT BOOK:

REFERENCE:

GE3792 ININDUSTRIAL MANAGEMENT

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

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

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

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

UNIT – IV ORGANIZATION THEORY
Organizational Conflict: Positive Aspects; Individual; Role: Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow’s hierarchy of needs theory; Herzberg’s motivation-hygiene theory; McClelland’s three needs motivation theory; Vroom’s valence-expectancy theory – Change Management: Concept of Change; Lewin’s Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.
UNIT – V  PRODUCTIVITY AND MODERN TOPICS  
Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).

TOTAL: 45 PERIODS

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

TEXTBOOKS:

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MANDATORY COURSES I

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

COURSE OUTLINE

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

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

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

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

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

TOTAL : 45 PERIODS

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

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

1. COURSE CONTENTS
Introduction to Elements of Literature

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

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

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

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

3. READINGS:

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

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

5.*ASSESSMENT:
   5.1HA:
   5.2Quizzes-HA:
   5.3Periodical Examination: one
   5.4Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc.
   5.5Final Exam: TOTAL: 45 PERIODS

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

MX3083 FILM APPRECIATION L T P C 3 0 0 0

In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.
Theme - A: The Component of Films
   A-1: The material and equipment
   A-2: The story, screenplay and script
   A-3: The actors, crew members, and the director
   A-4: The process of film making… structure of a film

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

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

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

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

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

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

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

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

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

192
from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

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

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 9

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

TOTAL : 45 PERIODS

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

REFERENCES

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

CO’s – PO’s & PSO’s MAPPING

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Mandatory Courses II

MX3085 WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA 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 handbill every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

UNIT I  HEALTH AND ITS IMPORTANCE  2+4

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


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

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

UNIT II  DIET  4+6

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

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

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

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

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

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

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

MX3086 HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA

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

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

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

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

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

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

TOTAL : 45 PERIODS

MX3087 POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY

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

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

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

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

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

(Refs: Adam smith, J S Mill)

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

(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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<td><strong>TOTAL : 45 PERIODS</strong></td>
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OUTCOME:

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

MX3088 STATE, NATION BUILDING AND POLITICS IN INDIA

OBJECTIVE:

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

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

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

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

1857 and the national awakening.

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

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

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

**SUGGESTED READING:**

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 Limit Value (TLV) - Short Term Exposure Limit (STEL) - Immediately dangerous to life or health (IDLH) - acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS


UNIT III SAFETY ACTIVITIES


UNIT IV WORKPLACE HEALTH AND SAFETY

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

UNIT V HAZARD IDENTIFICATION TECHNIQUES

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

Course outcomes on completion of this course the student will be able:

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

TEXTBOOKS

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

REFERENCES

5. Society of Safety Engineers, USA

ONLINE RESOURCES

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<td>Understand the basic concept of safety.</td>
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<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>
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<td>CO4</td>
<td>Analyze on the impact of Occupational Exposures and their Remedies.</td>
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<td>CO5</td>
<td>Obtain knowledge of Risk Assessment Techniques.</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

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

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

UNIT IV SUPERVISED LEARNING 6

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

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

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

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

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

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

TOTAL PERIODS: 60
OCS352 IOT CONCEPTS AND APPLICATIONS

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

UNIT I INTRODUCTION TO INTERNET OF THINGS

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

UNIT III PROTOCOLS AND TECHNOLOGIES BEHIND IOT

UNIT IV OPEN PLATFORMS AND PROGRAMMING

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

PRACTICAL EXERCISES: 30 PERIODS
1. Introduction to Arduino platform and programming
2. Interfacing Arduino to Zigbee module
3. Interfacing Arduino to GSM module
4. Interfacing Arduino to Bluetooth Module
5. Introduction to Raspberry Pi platform and python programming

REFERENCES
6. Interfacing sensors to Raspberry PI
7. Communicate between Arduino and Raspberry PI using any wireless medium
8. Setup a cloud platform to log the data
9. Log Data using Raspberry PI and upload to the cloud platform
10. Design an IOT based system

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

TOTAL PERIODS: 60

TEXTBOOKS

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

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

UNIT I INTRODUCTION
Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data

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

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

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

TOTAL PERIODS:60

TEXT BOOKS

REFERENCES

CCS333  AUGMENTED REALITY/VIRTUAL REALITY  L T P C
2 0 2 3

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

UNIT I  INTRODUCTION

UNIT II  VR MODELING

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

UNIT IV  APPLICATIONS

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

PRACTICAL EXERCISES:
1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection types by handling camera.
3. Download objects from asset store and apply various lighting and shading effects.
4. Model three dimensional objects using various modelling techniques and apply textures over them.

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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 PERIODS: 60

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 ELCTIVE III

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

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

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

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

TOTAL: 45 PERIODS

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

CO-PO & PSO MAPPING

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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://www.educationobserver.com
http://www.cambridgeenglish.org/in/

OCE353 LEAN CONCEPTS, TOOLS AND PRACTICES

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

UNIT III CORE CONCEPTS IN LEAN 9
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 9

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

TOTAL: 45 PERIODS

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

REFERENCES:

OMG352 NGOS AND SUSTAINABLE DEVELOPMENT
COURSE OBJECTIVES
- To understand the importance of sustainable development
• to acquire a reasonable knowledge on the legal frameworks pertaining to pollution control and environmental management
• to comprehend the role of NGOs in attaining sustainable development

UNIT I ENVIRONMENTAL CONCERNS
Introduction to sustainable development goals, Global responsibility of environmental concern, Importance of environmental preservation, Environmental threats, Pollution and its types, Effects of Pollution, Pollution control, Treatment of wastes

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

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

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

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

TOTAL 45 : PERIODS

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

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

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

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

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

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

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

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

TOTAL 45 : PERIODS

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

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

UNIT – I  ENERGY SCENARIO  9
Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status-Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans

UNIT – II  SOLAR ENERGY  9

UNIT – III WIND ENERGY

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.

TEXT BOOKS:

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

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

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

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

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

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

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

TEXT BOOKS
1. Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
REFERENCES
1. https://www.ideou.com/pages/design-thinking#process
4. https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e
6. https://blog.forgeforward.in/star-tup-failure-is-like-true-lie-7812cdfe9b85

MF3003 REVERSE ENGINEERING LT P C 3 0 0 3

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

UNIT I INTRODUCTION & GEOMETRIC FORM

UNIT II MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION

UNIT III DATA PROCESSING

UNIT IV 3D SCANNING AND MODELLING

UNIT V INDUSTRIAL APPLICATIONS

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:

OPR351 SUSTAINABLE MANUFACTURING L TP C
3 0 0 3

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

UNIT – I ECONOMIC SUSTAINABILITY

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

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

UNIT – IV MANUFACTURING STRATEGY FOR SUSTAINABILITY

Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formulation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.

UNIT – V TRENDS IN SUSTAINABLE OPERATIONS


TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Discuss the importance of economic sustainability.
CO2: Describe the importance of sustainable practices.
CO3: Identify drivers and barriers for the given conditions.
CO4: Formulate strategy in sustainable manufacturing.
CO5: Plan for sustainable operation of industry with environmental, cost consciousness.

TEXT BOOKS:


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Mapping of COs with POs and PSOs

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

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

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

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

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

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

UNIT IV   AIRCRAFT STABILITY AND STRUCTURAL THEORY

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

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

TEXT BOOKS:

REFERENCE:

OIM351 INDUSTRIAL MANAGEMENT

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

UNIT I INTRODUCTION

UNIT II FUNCTIONS OF MANAGEMENT

UNIT III ORGANIZATIONAL BEHAVIOUR

UNIT IV GROUPDYNAMICS

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

TOTAL: 45 PERIODS

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

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OIE354 QUALITY ENGINEERING

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

UNIT I INTRODUCTION

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

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

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students will be able to:
CO1: Control the quality of processes using control charts for variables in manufacturing industries.
**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:

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OML351 INTRODUCTION TO NON-DESTRUCTIVE TESTING L T P C 3 0 0 3

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

UNIT I  
INTRODUCTION TO NDT & VISUAL TESTING  
9
Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting.

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

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

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

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

TOTAL: 45 PERIODS

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

REFERENCES:

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OMR351 MECHATRONICS

 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

225
Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC.

UNIT – V ACTUATORS AND MECHATRONICS SYSTEM DESIGN 9

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Select sensors to develop mechatronics systems.
CO2: Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.
CO3: Design appropriate interfacing circuits to connect I/O devices with microprocessor.
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

ORA351 FOUNDATION OF ROBOTICS L T P C
3 0 0 3

226
COURSE OBJECTIVES:
1. To study the kinematics, drive systems and programming of robots.
2. To study the basics of robot laws and transmission systems.
3. To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
4. To familiarize students with the various Programming and Machine Vision application in robots.
5. To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

UNIT – I FUNDAMENTALS OF ROBOT

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

UNIT – III ROBOT DRIVE SYSTEMS AND END EFFECTORS

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

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

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

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TEXT BOOKS:

REFERENCES:

OAE352   FUNDAMENTALS OF AERONAUTICAL ENGINEERING   L T P C
                             3 0 0 3

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
General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium,

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

TOTAL : 45 PERIODS

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

TEXT BOOKS

REFERENCE

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

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

UNIT I  REMOTE SENSING AND ELECTROMAGNETIC RADIATION  9

UNIT II  EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL  9

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

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:

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OEN351 DRINKING WATER SUPPLY AND TREATMENT L T P C
3 0 0 3

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

UNIT I SOURCES OF WATER
UNIT II  CONVEYANCE FROM THE SOURCE  9
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  9
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  9
Membrane Systems - Iron and Manganese removal - Defluoridation - Construction and Operation and
Maintenance aspects

UNIT V  WATER DISTRIBUTION AND SUPPLY  9
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.

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

TOTAL: 45 PERIODS

TEXTBOOKS :
   private limited, New Delhi, 2016.

REFERENCES :
1. Fair. G.M., Geyer.J.C., "Water Supply and Wastewater Disposal", John Wiley and Sons,
   1954.
4. Duggal. K.N., "Elements of public Health Engineering", S.Chand and Company Ltd,
   New Delhi, 1998.

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

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

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

UNIT I  ROTATING POWER CONVERTERS  

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

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

UNIT IV  HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS  

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

TOTAL: 45 PERIODS

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

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REFERENCES:

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

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

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

UNIT II PLC INSTRUCTIONS
PLC Basic Instructions: PLC Ladder Language- Function block Programming- Ladder/Function Block functions- PLC Basic Instructions, Basic Examples (Start Stop Rung, Entry/Reset Rung)- Configuration of Sensors, Switches, Solid State Relays-Interlock examples- Timers, Counters, Examples.

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

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

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

TOTAL:45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

1. Market survey of the recent PLCs and comparison of their features.
2. Summarize the PLC standards
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)
4. Market survey of Communication Network Used for PLC/SCADA.

COURSE OUTCOMES:

CO1 Know the basic requirement of a PLC input/output devices and architecture. (L1)
CO2 Ability to apply Basics Instruction Sets used for ladder Logic and Function Block Programming.(L2)
CO3 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.(L3)
CO4 Able to develop a PLC logic for a specific application on real world problem. (L5)
CO5 Ability to Understand the Concepts of Communication used for PLC/SCADA.(L1)

TEXT BOOKS:
1. Frank Petruzzula, Programmable Logic Controllers, Tata Mc-Graw Hill Edition
2. John W. Webb, Ronald A. Reis, Programmable Logic Controllers Principles and Applications, PHI publication

REFERENCES:
2. J. R. Hackworth and F. D. Hackworth, Programmable Logic Controllers Principles and Applications, Pearson publication

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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OFD352 TRADITIONAL INDIAN FOODS

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

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

UNIT II  TRADITIONAL METHODS OF FOOD PROCESSING  9

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

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

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

TOTAL: 45 PERIODS

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

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

TOTAL: 45 PERIODS

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

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

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

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

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

UNIT IV ENFORCEMENT AND PRACTICAL ASPECTS OF IPR 9

UNIT V INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY 9

TOTAL:45 PERIODS

TEXT BOOKS:

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

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

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

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

UNIT I RESIN FINISHING 9

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

UNIT III SOIL RELEASE AND ANTISTATIC FINISHES 9

UNIT IV MECHANICAL FINISHES 9

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

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

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

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

UNIT I INTRODUCTION
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. Work aids in sewing, Pitch diagram, Line balancing, Capacity planning, scientific method of training.

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

TOTAL: 45 PERIODS

TEXTBOOKS:

REFERENCES

Course Articulation Matrix:

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**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**  
9  
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**  
9  
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**  
9  
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**  
9  
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**  
9  

**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:

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
UNIT I  INTRODUCTION
General definition and size effects—important nano structured materials and nano particles—importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials—surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials—Ionic properties of nanomaterials- Nano catalysis.

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

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

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

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

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
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<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>
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<td>CO3</td>
<td>describes about the shape, size, structure of composite nano materials and their interference</td>
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<td>understand the different characterization techniques for nanomaterials</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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Overall CO: 3 2 2 1 3 3 1 1 1 1 3 2 1

OCH352 FUNCTIONAL MATERIALS

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

UNIT I INTRODUCTION

UNIT II MOLECULAR SELF ASSEMBLY
UNIT III  BIO-INSPIRED MATERIALS 9

UNIT IV  SMART OR INTELLIGENT MATERIALS 9
Criteria for Smartness, Significance of Smart Materials, Representative Examples like Smart Gels and Polymers, Electro/Magneto Rheological Fluids, Smart Electroceramics, Technical Limitations and Challenges, Functional Nanocomposites, Polymer-carbon nanotube composites.

UNIT V  MATERIALS FOR POLYMER ELECTRONICS 9
Polymers for Electronics, Organic Light Emitting Diodes, Working Principle of OLEDs, Illustrated Examples, Organic Field-Effect Transistors Operating Principle, Design Considerations, Polymer FETs vs Inorganic FETs, Liquid Crystal Displays, Engineering Aspects of Flat Panel Displays, Intelligent Polymers for Data Storage, Polymer-based Data Storage-Principle, Magnetic Vs. Polymer-based Data Storage.

TOTAL: 45 PERIODS

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:

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

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

UNIT I  INTRODUCTION TO PLASTICS PROCESSING 9
Introduction to plastic processing – Principles of plastic processing: processing of plastics vs. metals and ceramics. Factors influencing the efficiency of plastics processing: molecular weight, viscosity and rheology. Difference in approach for thermoplastic and thermostet processing. Additives for plastics compounding and processing: antioxidants, light stabilizers, UV stabilizers, lubricants, impact modifiers, flame retardants, antistatic agents,
stabilizers and plasticizers. Compounding: plastic compounding techniques, plasticization, pelletization.

UNIT II  EXTRUSION  9

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

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

UNIT V  BLOW MOLDING, THERMOFORMING AND CASTING  9

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

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

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

UNIT I  CLASSIFICATION OF SIGNALS AND SYSTEMS  9

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

UNIT III  LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS  9

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

UNIT V  LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS  9

TOTAL: 45 PERIODS

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

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

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

UNIT I SEMICONDUCTOR DEVICES 9
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 9
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 9
Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis – Tuned amplifiers – Gain and frequency response – Neutralization methods.

UNIT IV FEEDBACK AMPLIFIERS AND OSCILLATORS 9

UNIT V POWER AMPLIFIERS AND DC/DC CONVERTERS 9
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.

250
COURSE OUTCOMES:
At the end of the course the students will be able to
CO1: Explain the structure and working operation of basic electronic devices.
CO2: Design and analyze amplifiers.
CO3: Analyze frequency response of BJT and MOSFET amplifiers
CO4: Design and analyze feedback amplifiers and oscillator principles.
CO5: Design and analyze power amplifiers and supply circuits

TEXT BOOKS:

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

UNIT I BASICS OF PRODUCT DEVELOPMENT 9

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

UNIT III DESIGN AND TESTING 9

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

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

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:**

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**CBM333 ASSISTIVE TECHNOLOGY**

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**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  9
Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices.

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

TOTAL :45 PERIODS

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

TEXT BOOKS

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

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OMA352  OPERATIONS RESEARCH  L T P C
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OBJECTIVES:
This course will help the students to
- determine the optimum solution for Linear programming problems.
- study the Transportation and assignment models and various techniques to solve them.
- acquire the knowledge of optimality, formulation and computation of integer programming problems.
- acquire the knowledge of optimality, formulation and computation of dynamic programming problems.
• determine the optimum solution for non-linear programming problems.

UNIT I  LINEAR PROGRAMMING  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.

TEXT BOOKS:

REFERENCES:
OMA353 | ALGEBRA AND NUMBER THEORY | L T P C
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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.

TOTAL: 45 PERIODS

OUTCOMES:

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

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OMA354 LINEAR ALGEBRA

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.

TEXT BOOKS

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

COURSE OBJECTIVE:
- Enable the Non-biological student’s to understand about the basics of life science and their 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, Dengue, 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
Fermented products – Fermented Beverages, Curd, Cheese, Mushroom, Agricultural products – Biopesticide, Biofertilizers, Vermicompost, Pharmaceutical products - Antibiotics, Vaccines

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

TEXT BOOKS

OBT353 BASICS OF BIOMOLECULES

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

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

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

UNIT III AMINO ACIDS AND PROTEIN.

UNIT IV NUCLEIC ACIDS
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
Different types of vitamins, their diverse biochemical functions and deficiency related diseases. Overview of hormones. Hormone mediated signaling. Mechanism of action of steroid hormones,
epinephrine, glucagons and insulin. Role of vitamins and hormones in metabolism; Hormonal disorders; Therapeutic uses of vitamins and hormones.

TOTAL: 45 PERIODS

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.

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


UNIT II CELL ORGANELLES

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

UNIT III BIO-MEMBRANE TRANSPORT


UNIT IV CELL CYCLE


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 3 0 0 3

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

UNIT I 9

UNIT II 9

UNIT III 9
Structure of the Project Report: (Part 1) Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework.

UNIT IV 9
UNIT V


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.

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

REFERENCES


OCE354  BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT  L T P C

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  9
Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management - PPP experiences through case studies.

UNIT IV  RECENT TREND S IN WATER MANAGEMENT  9
River basin management - Ecosystem Regeneration – 5 Rs - WASH - Sustainable livelihood - Water management in the context of climate change.

UNIT V  IMPLEMENTATION OF IWRM  9
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.

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  L T P C
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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  9
UNIT II INTERPOLATION
Central difference: Stirling and Bessel's interpolation formulae; Piecewise spline interpolation: Piecewise linear, piecewise quadratic and cubic spline; Least square approximation for continuous data (upto 3rd degree).

UNIT III NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS

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

UNIT V FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS

TOTAL : 45 PERIODS

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 9

UNIT II RANDOM PROCESSES 9

UNIT III SPECIAL RANDOM PROCESSES 9

UNIT IV CORRELATION AND SPECTRAL DENSITIES 9

UNIT V LINEAR SYSTEMS WITH RANDOM INPUTS 9
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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**OBJECTIVES:**
- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the concept of queueing models and apply in engineering.
- To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.
- To study the system reliability and hazard function for series and parallel systems.
- To implement Markovian Techniques for availability and maintainability which opens up new avenues for research.

**UNIT I**
**RANDOM PROCESSES**

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

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

**UNIT IV**
**SYSTEM RELIABILITY**

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

**TOTAL: 45 PERIODS**

**OUTCOMES**
Upon successful completion of the course, students should be able to:
- Enable the students to apply the concept of random processes in engineering disciplines.
- Students acquire skills in analyzing various queueing models.
Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.

Students can analyze reliability of the systems for various probability distributions.

Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach.

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OMG354 PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS

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

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

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

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS
Process selection with PLC phases- Process simulation tools- Work Study – Significance – Methods, evolution of normal/ standard time – Job design and rating - Value Analysis
Plant Layout: meaning – characters — Plant location techniques - Types- MRP and Layout Design - Optimisation and Theory of Constraints (TOC)– Critical Chain Project Management (CCPM) - REL (Relationship) Chart – Assembly line balancing- – Plant design optimisation - Forecasting methods.

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

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

UNIT I INTRODUCTION
Uni-variate, Bi-variate and Multi-variate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation.
UNIT II PREPARING FOR MULTIVARIATE ANALYSIS 9
Conceptualization of research model with variables, collection of data — Approaches for dealing with missing data – Testing the assumptions of multivariate analysis.

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

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

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

TOTAL: 45 PERIODS

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

REFERENCES:

OME352 ADDITIVE MANUFACTURING L T P C 3 0 0 3

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

UNIT I INTRODUCTION 9

UNIT II VAT POLYMERIZATION AND MATERIAL EXTRUSION

UNIT III POWDER BED FUSION AND BINDER JETTING

UNIT IV MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION

UNIT V SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:
CME343 NEW PRODUCT DEVELOPMENT  

L T P C  
3 0 0 3  

COURSE OBJECTIVES  
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.)  

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  

TOTAL :45 PERIODS
4. Analyzing the New product qualification and Market Survey on similar products of new product development
5. Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

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

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

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

OME355  INDUSTRIAL DESIGN & RAPID PROTOTYPING TECHNIQUES L T P C
3 0 0 3

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

UNIT I  UI/UX

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

UNIT III  INDUSTRIAL DESIGN
Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation – Assembly - Product design and rendering basics - Dimensioning
UNIT IV MECHANICAL RAPID PROTOTYPING
Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Mechanical Prototyping; 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing

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

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

TEXT BOOKS

REFERENCES

MF3010 MICRO AND PRECISION ENGINEERING

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

UNIT I INTRODUCTION TO MICROSYSYEMS
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 MICROSYSYEMS:
Additive, subtractive, forming process, microsystems-Micro-pumps, micro- turbines, micro engines, micro-robot, and miniature biomedical devices
UNIT III  INTRODUCTION TO PRECISION ENGINEERING  
Machine tools, holding and handling devices, positioning fixtures for fabrication/assembly of microsystems. Precision drives: inch worm motors, ultrasonic motors, stick-slip mechanism and other piezo-based devices.

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

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

COURSE OUTCOMES:
Upon the completion of this course the students will be able to
- Select suitable precision machine tools and operate
- Apply the macro and micro components for fabrication of micro systems.
- Apply suitable machining process
- Able to work with miniature models of existing machine tools/robots and other instruments.
- Apply metrology for micro system

TEXT BOOKS:

REFERENCES:

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

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

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

UNIT – II  INTRODUCTION TO PROJECT MANAGEMENT  
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities. Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts
UNIT – III  PROJECT EXECUTION AND COSTING CONCEPTS
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing

UNIT – IV  COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL

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

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

TEXT BOOKS:

REFERENCES:

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

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

UNIT I  ADVANCED BATTERIES
Li-ion Batteries-different formats, chemistry, safe operating area, efficiency, aging. Characteristics-SOC,DOD, SOH. Balancing-Passive Balancing Vs Active Balancing. Other Batteries-NCM and NCA Batteries. NCR18650B specifications.
UNIT II  BATTERY PACK  
Battery Pack- design, sizing, calculations, flow chart, real and simulation Model. Peak power – definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging.

UNIT III  BATTERY MODELLING  
Battery Modelling Methods-Equivalent Circuit Models, Electrochemical Model, Neural Network Model. ECM Comparisons- Rint model, Thevenin model, PNGV model. State space Models-Introduction. Battery Modelling software/simulation frameworks

UNIT IV  BATTERY STATE ESTIMATION  

UNIT V  BMS ARCHITECTURE AND REAL TIME COMPONENTS  
Battery Management System- need, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex Ray-CANedge1 package.ARBIN Battery Tester. BMS Development with Modeling software and Model-Based Design.

COURSE OUTCOMES:
At the end of this course, students will be able to
  1. Acquire knowledge of different Li-ion Batteries performance.
  2. Design a Battery Pack and make related calculations.
  3. Demonstrate a Battery Model or Simulation.
  5. Approach different BMS architectures during real world usage.

TEXT BOOKS

REFERENCE BOOKS
1. Developing Battery Management Systems with Simulink and Model-Based Design - whitepaper
2. Panasonic NCR18650B- DataSheet
3. bq76PL536A-Q1- IC DataSheet
4. CC2662R-Q1- IC DataSheet

AU3008  SENSORS AND ACTUATORS  L T P C  3 0 0 3

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

UNIT I  INTRODUCTION TO MEASUREMENTS AND SENSORS  
UNIT II  VARIABLE RESISTANCE AND INDUCTANCE SENSORS  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, Magnetostriective, Hall Effect, semiconductor sensor- digital transducers-Humidity
Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.

UNIT IV  AUTOMOTIVE ACTUATORS  9
Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current
machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings
for electrical machines. Working principles, construction and location of actuators viz. Solenoid,
relay, stepper motor etc.

UNIT V  AUTOMATIC TEMPERATURE CONTROL ACTUATORS  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.

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

TEXT BOOKS:
4. Bosch Automotive Electrics and Automotive Electronics Systems and Components,

REFERENCES:
   International.
7th

OAS353 SPACE VEHICLES

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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  9
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  9
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  9

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

TOTAL: 45 PERIODS

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

• Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.
• Apply knowledge in selecting the appropriate rocket propulsion systems.
• interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.
• Analyze aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.
• Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.

OIM352 MANAGEMENT SCIENCE  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 familiarize with the concepts of human resources management.
4. To acquaint students with the concepts of project management and cost analysis.
5. To make students familiarize with the concepts of planning process and business strategies.

UNIT I  INTRODUCTION TO MANAGEMENT AND ORGANISATION  9
UNIT II  OPERATIONS AND MARKETING MANAGEMENT  
Principles and Types of Plant Layout-Methods of Production(Job, batch and Mass Production), Work Study - Basic procedure involved in Method Study and Work Measurement - Business Process Reengineering(BPR) - Statistical Quality Control: control charts for Variables and Attributes (simple Problems) and Acceptance Sampling, Objectives of Inventory control, EOQ, ABC Analysis, Purchase Procedure, Stores Management and Store Records - JIT System, Supply Chain Management, Functions of Marketing, Marketing Mix, and Marketing Strategies based on Product Life Cycle.

UNIT III  HUMAN RESOURCES MANAGEMENT  
Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Wage and Salary Administration, Promotion, Transfer, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating – Capability Maturity Model (CMM) Levels.

UNIT IV  PROJECT MANAGEMENT  
Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

UNIT V  STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES  

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

CO1: Plan an organizational structure for a given context in the organization to carry out production operations through Work-study.

CO2: Survey the markets, customers and competition better and price the given products appropriately.

CO3: Ensure quality for a given product or service.

CO4: Plan, schedule and control projects through PERT and CPM.

CO5: Evaluate strategies for business or service organization.

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TOTAL: 45 PERIODS

TEXTBOOKS:  

REFERENCES:  
COURSE OBJECTIVES:

- To understand the concept of production planning and control act work study,
- To apply the concept of product planning,
- To analyze the production scheduling,
- To apply the Inventory Control concepts.
- To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION

Objectives and benefits of planning and control- Functions of production control- Types of production- job- batch and continuous- Product development and design- Marketing aspect- Functional aspects- Operational aspect- Durability and dependability aspect- aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis- Economics of a new design.

UNIT II WORK STUDY

Method study, basic procedure- Selection- Recording of process- Critical analysis, Development- Implementation- Micro motion and memo motion study- work measurement- Techniques of work measurement- Time study- Production study- Work sampling- Synthesis from standard data- Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING

Product planning- Extending the original product information- Value analysis- Problems in lack of product planning- Process planning and routing- Pre requisite information needed for process planning- Steps in process planning- Quantity determination in batch production- Machine capacity, balancing- Analysis of process capabilities in a multi product system.

UNIT IV PRODUCTION SCHEDULING

Production Control Systems- Loading and scheduling- Master Scheduling- Scheduling rules- Gantt charts- Perpetual loading- Basic scheduling problems- Line of balance- Flow production scheduling- Batch production scheduling- Product sequencing- Production Control systems- Periodic batch control- Material requirement planning- kanban- Dispatching- Progress reporting and expediting- Manufacturing lead time- Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC

Inventory control- Purpose of holding stock- Effect of demand on inventories- Ordering procedures. Two bin system- Ordering cycle system- Determination of Economic order quantity and economic lot size- ABC analysis- Recorder procedure- Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS- Fundamentals of MRP II and ERP.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course,
- CO1: The students can able to prepare production planning and control act work study,
- CO2: The students can able to prepare product planning,
- CO3: The students can able to prepare production scheduling,
- CO4: The students can able to prepare Inventory Control.
- CO5: They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).
TEXT BOOKS:

REFERENCES
7. Samson Eillon, “Elements of Production Planning and Control”, Universal Book Corpn.1984

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OIE353 OPERATIONS MANAGEMENT

COURSE OBJECTIVE:
- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm’s competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
- Relate the interdependence of the operations function with the other key functional areas of a firm.
- Teach analytical skills and problem-solving tools to the analysis of the operations problems.
- Apply scheduling and Lean Concepts for improving System Performance.

UNIT I INTRODUCTION TO OPERATIONS MANAGEMENT
Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy – Strategic fit, framework; Supply Chain Management
UNIT II FORECASTING, CAPACITY AND FACILITY DESIGN


UNIT III DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS


UNIT IV MATERIALS MANAGEMENT


UNIT V SCHEDULING AND PROJECT MANAGEMENT

Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson’s Algorithm – Gantt charts; personnel scheduling in services.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: The students will appreciate the role of Production and Operations management in enabling and enhancing a firm’s competitive advantages in the dynamic business environment.

CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.

CO3: The students will be able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.

CO4: The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.

CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance.

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TEXT BOOKS


REFERENCES


OSF352 INDUSTRIAL HYGIENE

COURSE OBJECTIVES:
1. Demonstrate an understanding of how occupational hygiene standards are set and used in work health and safety.
2. Compare and contrast the roles of environmental and biological monitoring in work health and safety
3. Outline strategies for identifying, assessing and controlling risks associated with airborne gases, vapours and particulates
4. Discuss how personal protective equipment can be used to reduce risks associated with workplace exposures
5. Provide high-level advice on managing and controlling noise and noise-related hazards

UNIT I INTRODUCTION AND SCOPE

UNIT II MONITORING FOR SAFETY, HEALTH & ENVIRONMENT
Occupational Health and Environment Safety Management System, ILO and EPA Standards Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.

UNIT III OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION

UNIT IV OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT

UNIT-V INDUSTRIAL HAZARDS

TOTAL PERIODS: 45
COURSE OUTCOMES:
Students able to
CO1: Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems
CO2: Specify designs that avoid occupation related injuries
CO3: Define and apply the principles of work design, motion economy, and work environment design.
CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.
CO5: Acknowledge the impact of workplace design and environment on productivity

TEXT BOOKS:

REFERENCES:
2. Frank P Lees - Loss of prevention in Process Industries, Vol. 1 and 2,

CO’s- PO’s & PSO’s MAPPING

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OSF353 CHEMICAL PROCESS SAFETY L T P C
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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  9
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  9
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  9
Safety vs reliability—quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis. OSHAS 18001 and OSHMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students able to
CO1 Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.
CO2 Develop thorough knowledge about safety in the operation of chemical plants.
CO3 Apply the principles of safety in the storage and handling of gases.
CO4 Identify the conditions that lead to reaction hazards and adopt measures to prevent them.
CO5 Develop thorough knowledge about

TEXT BOOK

REFERENCES:
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OML352 ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS

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.

UNIT – II MAGNETIC MATERIALS
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriiction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis.

UNIT – III SEMICONDUCTOR MATERIALS
Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on specific superconducting materials; comments on fabrication and engineering applications.

UNIT – IV MATERIALS FOR ELECTRICAL APPLICATIONS
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetallic fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

UNIT – V OPTICAL AND OPTOELECTRONIC MATERIALS
Principles of photoconductivity - effect of impurities - principles of luminescence-laser principles - He-Ne, injection lasers, LED materials - binary, ternary photoelectronic materials - LCD materials -
photo detectors - applications of optoelectronic materials - optical fibres and materials - electro optic modulators - Kerr effect - Pockels effect.

**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  

**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  

Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.
UNIT II  THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS  9
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.

UNIT III  PROCESSING  9
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.

UNIT IV  STRUCTURAL CHARACTERISTICS  9
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis

UNIT V  APPLICATIONS  9
Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
1. Evaluate nanomaterials and understand the different types of nanomaterials
2. Recognise the effects of dimensionality of materials on the properties
3. Process different nanomaterials and use them in engineering applications
4. Use appropriate techniques for characterising nanomaterials
5. Identify and use different nanomaterials for applications in different engineering fields.

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COURSE OBJECTIVES:
1. To knowledge on fluid power principles and working of hydraulic pumps
2. To obtain the knowledge in hydraulic actuators and control components
3. To understand the basics in hydraulic circuits and systems
4. To obtain the knowledge in pneumatic and electro pneumatic systems
5. To apply the concepts to solve the trouble shooting

UNIT – I   FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS

UNIT – II   HYDRAULIC ACTUATORS AND CONTROL COMPONENTS

UNIT – III   HYDRAULIC CIRCUITS AND SYSTEMS
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT – IV   PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS

UNIT – V   TROUBLE SHOOTING AND APPLICATIONS

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO 1: Analyze the methods in fluid power principles and working of hydraulic pumps
CO 2: Recognize the concepts in hydraulic actuators and control components
CO 3: Obtain the knowledge in basics of hydraulic circuits and systems
CO 4: Know about the basics concept in pneumatic and electro pneumatic systems
CO 5: Apply the concepts to solve the trouble shooting hydraulic and pneumatics

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289
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


UNIT – V  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.

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TEXT BOOKS


REFERENCES

COURSE OBJECTIVES
1. To introduce mobile robotic technology and its types in detail.
2. To learn the kinematics of wheeled and legged robot.
3. To familiarize the intelligence into the mobile robots using various sensors.
4. To acquaint the localization strategies and mapping technique for mobile robot.
5. To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT – I   INTRODUCTION TO MOBILE ROBOTICS  9

UNIT – II   KINEMATICS  9

UNIT – III   PERCEPTION  9

UNIT – IV   LOCALIZATION  9

UNIT – V   PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS  9

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

CO1: Evaluate the appropriate mobile robots for the desired application.
CO2: Create the kinematics for given wheeled and legged robot.
CO3: Analyse the sensors for the intelligence of mobile robotics.
CO4: Create the localization strategies and mapping technique for mobile robot.
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.

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  BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS**

- law of floatation - Basics principle of propulsion - Earlier methods of propulsion - ship propulsion machinery - boiler, Marine steam engine, diesel engine, ship power transmission system, ship dynamic structure, Marine propulsion equipment - shaft tunnel, Intermediate shaft and bearing, stern tube, stern tube sealing etc. degree of freedom, Modern propelling methods - water jet propulsion, screw propulsion.

**UNIT II  SHIPS MOVEMENTS AND SHIP STABILIZATION**

- Thrust augmented devices, Ship hull, modern ship propulsion design, bow thruster - Advantages, various methods to stabilize the ship - passive and active stabilizer, fin stabilizer, bilge keel - stabilizing and securing ship in port - effect of tides on ship - effect of river water and sea water sailing vessel, Load line and load line of marking - draught markings.

**UNIT III  SHIPS SPEED AND ITS PERFORMANCE**

- Ship propulsion factors, factors affecting ships speed, various velocities of ship, hull drag, effects of fouling on ships hull, ship wake, relation between powers, Fuel consumption of ship, cavitations - effects of cavitation’s, ship turning radius.

**UNIT IV  BASICS OF PROPeller**

- Propeller dimension, Propeller and its types - fixed propeller, control pitch propeller, kort nozzle, ducted propeller, voith schneider, Parts of propeller, 3 blade - 5 blade - 6 blade propellers and its advantages, propeller boss hub, crown nut, propeller skew, pitch of propeller - Thrust creation by propeller. Propeller Material - Propeller balancing- static and dynamic.

**UNIT V  BASICS OF RUddER**

- Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings - Rudder pintle - Rudder types - Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits of various types of rudders, Propeller and rudder interaction, Rudder stopper, movement of rudders, Basic construction of Rudder

**COURSE OUTCOMES:**

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

CO1: Explain the basics of propulsion system and ship dynamic movements
CO2: Familiarize with various components assisting ship stabilization.
CO3: Demonstrate the performance of the ship.
CO4: Classify the Propeller and its types, Materials etc.
CO5: Categories the Rudder and its types, design criteria of rudder.

TOTAL: 45 PERIODS
TEXT BOOKS:
1. GP. Ghose, “Basic Ship propulsion”, 2015

REFERENCES BOOKS:

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OMV351 MARINE MERCHANT VESSELS LT P C
3 0 0 3

OBJECTIVES:
At the end of the course, students are expected to acquire
1. Knowledge on basics of Hydrostatics
2. Familiarization on types of merchant ships
3. Knowledge on Shipbuilding Materials
4. Knowledge on marine propeller and rudder
5. Awareness on governing bodies in shipping industry

UNIT I INTRODUCTION TO HYDROSTATICS 9

UNIT II TYPES OF SHIP 10
General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers- Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gascarriers - Chemical tankers - Passenger ships

UNIT III SHIPBUILDING MATERIALS 9
Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys, Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced Composites

UNIT IV MARINE PROPELLER AND RUDDER 8
Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its effects on propeller

UNIT V GOVERNING BODIES FOR SHIPPING INDUSTRY 9
Role of IMO (International Maritime Organization), SOLAS (International Convention for the Safety of Life at Sea), MARPOL (International Convention for the Prevention of Pollution from
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 3 0 0 3

OBJECTIVES:
At the end of the course, students are expected to
1. Understand the role of Marine machinery systems
2. Be familiar with Marine propulsion machinery system
3. Acquaint with Marine Auxiliary machinery system
4. Have acquired basics of Marine Auxiliary boiler system
5. Be aware of ship propellers and steering system

UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS 9
Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems

UNIT II MARINE PROPULSION MACHINERY SYSTEM 9
Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system

UNIT III MARINE AUXILIARY MACHINERY SYSTEM 9
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine. Difference between slow speed and medium speed engines – advantages, limitations and applications
UNIT IV  MARINE BOILER SYSTEM
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories

UNIT V  SHIP PROPELLERS AND STEERING MECHANISM
Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear

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 propellors and steering system

TEXT BOOKS:

REFERENCES:
1. Alan L.Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006
2. A.S.Tambwekar, “Naval Architecture and Ship Construction”, The Institute of Marine Engineers (India), Mumbai, 2015

CRA332  DRONE TECHNOLOGIES  L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To understand the basics of drone concepts
2. To learn and understand the fundamentals of design, fabrication and programming of drone
3. To impart the knowledge of an flying and operation of drone
4. To know about the various applications of drone
5. To understand the safety risks and guidelines of fly safely

UNIT – I  INTRODUCTION TO DRONE TECHNOLOGY
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:

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TEXT BOOKS

REFERENCES
OBJECTIVES:
- To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.

UNIT I  FUNDAMENTALS OF GIS  9

UNIT II  SPATIAL DATA MODELS  9

UNIT III DATA INPUT AND TOPOLOGY  9

UNIT IV DATA QUALITY AND STANDARDS  9
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  9
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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<td>Engineering problems and innovations</td>
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<td>PSO 3</td>
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OAI352  AGRICULTURE ENTREPRENEURSHIP DEVELOPMENT  L T P C  3 0 0 3

OBJECTIVES
- To introduce the importance of Agri-business management, its characteristics and principles
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.

UNIT I  ENTREPRENEURIAL ENVIRONMENT IN INDIAN CONTEXT  9
Entrepreneur Development(ED): Concept of entrepreneur and entrepreneurship assessing overall business environment in Indian economy- Entrepreneurial and managerial characteristics- Entrepreneurship development programmers (EDP)-Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment.

UNIT II  AGRIPRNEURSHIP IN GLOBAL ARENA: LEGAL PERSPECTIVE  9
Importance of agribusiness in Indian economy - International trade-WTO agreements- Provisions related to agreements in agricultural and food commodities - Agreements on Agriculture (AOA)- Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS).

UNIT III  ENTREPRENEURSHIP MANAGEMENT: FINANCIAL PERSPECTIVE  9
UNIT IV  ENTREPRENEURIAL OPPORTUNITIES: ECONOMIC GROWTH PERSPECTIVE
Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country- Overview of Indian social, political system and their implications for decision making by individual entrepreneurs- Economic system and its implication for decision making by individual entrepreneurs.

UNIT V  ENTREPRENEURIAL PROMOTION MEASURES AND GOVERNMENT SUPPORT
Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis- Government schemes and incentives for promotions of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract framing (CF) and Joint Venture (JV), public-private partnerships (PPP) - overview of agricultural engineering industry, characteristics of Indian farm machinery industry.

TOTAL: 45 PERIODS

COURSE OUTCOMES
1. Judge about agricultural finance, banking and cooperation
2. Evaluate basic concepts, principles and functions of financial management
3. Improve the skills on basic banking and insurance schemes available to customers
4. Analyze various financial data for efficient farm management
5. Identify the financial institutions

TEXT BOOKS

REFERENCES

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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
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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OEE353 INTRODUCTION TO CONTROL SYSTEMS

OBJECTIVES
- To impart knowledge on various representations of systems.
- To familiarize time response analysis of LTI systems and steady state error.
- To analyze the frequency responses and stability of the systems
- To analyze the stability of linear systems in frequency domain and time domain
- To develop linear models mainly state variable model and transfer function model

UNIT I MATHEMATICAL MODELS OF PHYSICAL SYSTEMS
Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction – Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS & ROOTLOCUSTECHNIQUE
UNIT III FREQUENCY RESPONSE ANALYSIS 9
Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV STABILITY CONCEPTS & ANALYSIS 9

UNIT V STATE VARIABLE ANALYSIS 9
Concept of state – State Variable & State Model – State models for linear & continuous time systems—Solution of state & output equation—controllability & observability.

TOTAL : 45 PERIODS

OUTCOMES:
Ability to
CO1: Design the basic mathematical model of physical System.
CO2: Analyze the time response analysis and techniques.
CO3: Analyze the transfer function from different plots.
CO4: Apply the stability concept in various criterion.
CO5: Assess the state models for linear and continuous Systems.

TEXTBOOKS

REFERENCES
2. Control System Dynamics" by Robert Clark, Cambridge University Press, 1996 USA.

OEI354 INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS LT P C 3 0 03

COURSE OBJECTIVES:
1. To educate on design of signal conditioning circuits for various applications.
2. To Introduce signal transmission techniques and their design.
3. Study of components used in data acquisition systems interface techniques
4. To educate on the components used in distributed control systems
UNIT I  
INTRODUCTION  

UNIT II  
AUTOMATION COMPONENTS  
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT III  
COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS  
Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

UNIT IV  
PROGRAMMABLE LOGIC CONTROLLERS  
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT V  
DISTRIBUTED CONTROL SYSTEM  
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation/ Quiz/ Surprise Test / Solving GATE questions/ etc)  
1. Market survey of the recent PLCs and comparison of their features.  
2. Summarize the PLC standards  
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)  

COURSE OUTCOMES:  
Students able to  
CO1 Design a signal conditioning circuits for various application (L3).  
CO2 Acquire a detail knowledge on data acquisition system interface and DCS system (L2).  
CO3 Understand the basics and Importance of communication buses in applied automation Engineering (L2).  
CO4 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.(L3)  
CO5 Able to develop a PLC logic for a specific application on real world problem. (L5)

TEXT BOOKS:  

REFERENCES:  

List of Open Source Software/Learning website:
1. https://archive.nptel.ac.in/courses/108/105/108105062/
2. https://nptel.ac.in/courses/108105063

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OFD354                                       FUNDAMENTALS OF FOOD ENGINEERING
L T P C  3 0 0 3

OBJECTIVES
The course aims to
- acquaint and equip the students with different techniques of measurement of engineering properties.
- make the students understand the nature of food constituents in the design of processing equipment

UNIT I
Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.

UNIT II
Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foammat dryers

UNIT III
Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger’s, Kick’s and Bond’s equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping)

UNIT IV
Mixing: theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for low- or
medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids.

UNIT V

Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine, Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids, Membrane separation: General considerations, materials for membrane construction, ultra-filtration, microfiltration, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, 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.

COURSE OUTCOMES:
CO1 Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments
CO2 Awareness on regulatory and statutory bodies in India and the world

REFERENCES:
1. Handbook of food toxicology by S. S. Deshpande, 2002
2. The food safety information handbook by Cynthia A. Robert, 2009
4. Microbiological safety of Food by Hobbs BC, 1973

OPY353 NUTRACEUTICALS L T P C
3 0 0 3

OBJECTIVES:
- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease.

UNIT I INTRODUCTION AND SIGNIFICANCE
Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoochemicals and microbes in food, plants, animals and microbes.

UNIT II PHYTOCHEMICALS AS NUTRACEUTICALS
Phytoestrogens in plants; isoflavones: flavonols, polyphenols, tannins, saponins, lignans, lycopene, chitin, carotenoids. Manufacturing practice of selected nutraceuticals such as lycopene, isoflavonoids, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals - stability, analytical and labelling issues.
UNIT III  ASSESSMENT OF ANTIOXIDANT ACTIVITY  

In vitro and in vivo methods for the assessment of antioxidant activity, Comparison of different in vitro methods to evaluate the antioxidant, antioxidant mechanism, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

UNIT IV  ROLE IN HEALTH AND DISEASE  

The health benefit of - Soy protein, Spirulina, Tea, Olive oil, plant sterols, Broccoli, omega3 fatty acid and eicosanoids. Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and synbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

UNIT V  SAFETY ISSUES  

Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues International and national.

TOTAL: 45 PERIODS

TEXT BOOKS:

3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006

REFERENCES:

1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007

COURSE OUTCOME - NUTRACEUTICALS

| CO 1 | acquire knowledge about the Nutraceuticals and functional foods, their classification and benefits. |
| CO 2 | acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes |
| CO 3 | attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods. |
| CO 4 | distinguish the various In vitro and In vivo assessment of Antioxidant activity of compounds from plant sources. |
| CO 5 | gain information about the health benefits of various functional foods and nutraceuticals in the prevention and treatment of various lifestyle diseases. |
| CO 6 | Attain the knowledge of the regulatory and safety issues of nutraceuticals at national and international level. |
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
Impurities present in different fibres, Inspection of grey goods and lot preparation. Shearing,

UNIT II     PRE TREATMENT

UNIT III    DYEING

UNIT IV     PRINTING
Definition of printing – Difference between printing and dying- Classification thickeners – Requirements to be good thickener, printing paste Preparation - different styles of printing.

UNIT V      MACHINERIES

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to Understand the
CO1: Basics of grey fabric
CO2: Basics of pre treatment
CO3: Concept of Dyeing
CO4: Concept of Printing
CO5: Machinery in processing industry
TEXT BOOKS:

REFERENCES:
2. Dr. N N Mahapatra., “Textile dyeing”, Wood head publishing India, 2018
4. Bleaching & Mercerizing – BTRA Silver Jubilee Monograph series

Course Articulation Matrix:

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

FT3201 FIBRE SCIENCE

COURSE OBJECTIVES
- To enable the students to learn about the types of fibre and its properties

UNIT I INTRODUCTION TO TEXTILE FIBRES
Definition of various forms of textile fibres - staple fibre, filament, bicomponent fibres. Classification of Natural and Man-made fibres, essential and desirable properties of Fibres. Production and
cultivation of Natural Fibers: Cotton, Silk, Wool - Physical and chemical structure of the above fibres.

UNIT II REGENERATED FIBRES 9
Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocell, Tencel

UNIT III SYNTHETIC FIBRES 9
Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass, carbon. Introduction to spin finishes and texturization

UNIT IV SPECIALITY FIBRES 9
Properties and end uses of high tenacity and high modulus fibres, high temperature and flame retardant fibres, Chemical resistant fibres

UNIT V FUNCTIONAL SPECIALITY FIBRES 9
Properties and end uses: Fibres for medical application – Biodegradable fibres based on PLA, Super absorbent fibres elastomeric fibres, ultra-fine fibres, electrospun nano fibres, metallic fibres – Gold and Silver coated.

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the student would be able to
- Understand the process sequence of various fibres
- Understand the properties of various fibres

TEXT BOOKS:

REFERENCES:

OTT355 GARMENT MANUFACTURING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:
- To enable the students to understand the basics of pattern making, cutting and sewing.
- To expose the students to various problems & remedies during garment manufacturing
UNIT I  PATTERN MAKING, MARKER PLANNING, CUTTING  9
Anthropometry, specification sheet, pattern making – principles, basic pattern set drafting, grading, marker planning, spreading & cutting

UNIT II  TYPES OF SEAMS, STITCHES AND FUNCTIONS OF NEEDLES  9
Different types of seams and stitches; single needle lock stitch machine – mechanism and accessories; needle – functions, special needles, needlepoint

UNIT III  COMPONENTS AND TRIMS USED IN GARMENT  9
Sewing thread-construction, material, thread size, packages, accessories – labels, linings, interlinings, wadding, lace, braid, elastic, hook and loop fastening, shoulder pads, eyelets and laces, zip fasteners, buttons

UNIT IV  GARMENT INSPECTION AND DIMENSIONAL CHANGES  9
Raw material, in process and final inspection; needle cutting; sewability of fabrics; strength properties of apparel; dimensional changes in apparel due to laundering, dry-cleaning, steaming and pressing.

UNIT V  GARMENT PRESSING, PACKING AND CARE LABELING  9
Garment pressing – categories and equipment, packing; care 312abelling of apparels

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to Understand
CO1: Pattern making, marker planning, cutting
CO2: Types of seams, stitches and functions of needles
CO3: Components and trims used in garment
CO4: Garment inspection and dimensional changes
CO5: Garment pressing, packing and care labeling

TEXT BOOKS:
2. Gerry Cooklin, “Introduction to Clothing Manufacture” Blackwell Science Ltd., 1995. 64

REFERENCES:

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UNIT I INTRODUCTION
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources

UNIT II CONVENTIONAL ENERGY
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III NON-CONVENTIONAL ENERGY
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV BIOMASS ENERGY
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT V ENERGY CONSERVATION
Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.

OUTCOMES:
On completion of the course, the students will be able to
CO1: Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.
CO2: Students will excel as professionals in the various fields of energy engineering
CO3: Compare different renewable energy technologies and choose the most appropriate based on local conditions.
CO4: Explain the technological basis for harnessing renewable energy sources.
CO5: Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.

TEXT BOOKS

REFERENCES
Course articulation matrix

| Course Outcomes | Program Outcomes | Statements                                                                 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|-----------------|------------------|----------------------------------------------------------------------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| CO1             |                  | Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels. | 2    | 3    | 2    | 3    | 3    | -    | -    | -    | 1    | 1     | -     | 3     | 1     | 1     | 3     |
| CO2             |                  | Students will excel as professionals in the various fields of energy engineering | 2    | 3    | 1    | 3    | 3    | -    | -    | -    | 1    | 1     | -     | 3     | 2     | 1     | 3     |
| CO3             |                  | Compare different renewable energy technologies and choose the most appropriate based on local conditions. | 2    | 2    | 2    | 3    | 3    | 1    | 1    | -    | 1    | 1     | -     | 3     | 2     | 1     | 3     |
| CO4             |                  | Explain the technological basis for harnessing renewable energy sources. | 2    | 2    | 1    | 3    | 3    | 1    | 1    | 1    | 1    | -     | 1     | 3     | 1     | 1     | 3     |
| 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 | 2    | 2    | 1    | 3    | 3    | 1    | 1    | 1    | 1    | -     | 1     | 3     | 2     | 1     | 3     |
| OVERALL CO      |                  |                                                                          | 2    | 2    | 1    | 3    | 3    | 2    | 2    | 1    | 1    | 1     | 1     | 3     | 2     | 1     | 3     |

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

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
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

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UNIT III LIQUID INTERFACES
Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells

UNIT IV HETEROGEOUS CATALYSIS
Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, Fishcher-Tropsch and Automotive catalysis, Role of promoters and poisons, Bimetallic surfaces, surface functionalization and clusters in catalysis, Role of Sabatier principle in catalyst design, Rate oscillations and spatiotemporal pattern formation

UNIT V EPITAXIAL GROWTH AND NANO SURFACE-STRUCTURES

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:

OPT352 PLASTIC MATERIALS FOR ENGINEERS L T P C
3 0 0 3

COURSE OBJECTIVES
- Understand the advantages, disadvantages and general classification of plastic materials
- To know the manufacturing, sources, and applications of engineering thermoplastics
- Understand the basics as well as the advanced applications of various plastic materials in the industry
- To understand the preparation methods of thermosetting materials
- Select suitable specialty plastics for different end applications

UNIT I INTRODUCTION TO PLASTIC MATERIALS
Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermosetting behavior, amorphous polymers, crystalline polymers and cross-linked structures. General purpose thermoplastics/ Commodity plastics: manufacture, structure, properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene, polystyrene, chlorinated styrene, polyethylene terephthalate (PET), polyethylene terephthalate (PET), polyesters and applications of polyethylene oxide (PE), polypropylene, polyethylene terephthalate (PET), polyethylene terephthalate (PET)

UNIT II ENGINEERING THERMOPLASTICS AND APPLICATIONS
Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides, PMMA, polyethylene oxide, thermoplastic polyurethane (PU)
UNIT III THERMOSETTING PLASTICS
Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.

UNIT IV MISCELLANEOUS PLASTICS FOR END APPLICATIONS
Miscellaneous plastics- Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbazole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers- their synthesis, properties and applications

UNIT V PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS
Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers- poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications

TOTAL : 45 PERIODS

COURSE OUTCOMES
- To study the importance, advantages and classification of plastic materials
- Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics
- To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins
- Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU
- To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

REFERENCES

OPT353 PROPERTIES AND TESTING OF PLASTICS

COURSE OBJECTIVES
- To understand the relevance of standards and specifications as well as the specimen preparation for polymer testing.
- To study the mechanical properties and testing of polymer materials and their structural property relationships.
- To understand the thermal properties of polymers and their testing methods.
- To gain knowledge on the electrical and optical properties of polymers and their testing methods.
- To study about the environmental effects and prevent polymer degradation.
UNIT I  INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS  9

UNIT II  MECHANICAL PROPERTIES  9
Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact strength, resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic fatigue, ageing properties, Basic concepts of stress and strain, short term tests: Viscoelastic behavior (simple models: Kelvin model for creep and stress strain, Maxwell-Voigt model, strain recovery and dynamic response), Effect of structure and composition on mechanical properties, Behavior of reinforced polymers

UNIT III  THERMAL RHEOLOGICAL PROPERTIES  9
Thermal properties: Transition temperatures, specific heat, thermal conductivity, co-efficient of thermal expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness temperature, thermal stability and flammability. Product testing: Plastic films, sheeting, pipes, laminates, foams, containers, cables and tubes.

UNIT IV  ELECTRICAL AND OPTICAL PROPERTIES  9
Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and power factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric co-efficient, dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive index, haze, gloss, clarity, birefringence.

UNIT V  ENVIRONMENTAL AND CHEMICAL RESISTANCE  9

TOTAL HOURS: 45

COURSE OUTCOMES

- Understand the relevance of standards and specifications.
- Summarize the various test methods for evaluating the mechanical properties of the polymers.
- To know the thermal, electrical & optical properties of polymers.
- Identify various techniques used for characterizing polymers.
- Distinguish the processability tests used for thermoplastics, thermosets and elastomers.

REFERENCES

OBJECTIVES:

- Understand the fundamentals of IC technology components and their characteristics.
- Understand combinational logic circuits and design principles.
- Understand sequential logic circuits and clocking strategies.
- Understand Interconnects and Memory Architecture.
- Understand the design of arithmetic building blocks.

UNIT I MOS TRANSISTOR PRINCIPLES

MOS logic families (NMOS and CMOS), Ideal and Non Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor DC transfer Characteristics, small signal analysis of MOSFET.

UNIT II COMBINATIONAL LOGIC CIRCUITS


UNIT III SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES


UNIT IV INTERCONNECT, MEMORY ARCHITECTURE

Interconnect Parameters – Capacitance, Resistance, and Inductance, Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks.

UNIT V DESIGN OF ARITHMETIC BUILDING BLOCKS

Arithmetic Building Blocks: Data Paths, Adders-Ripple Carry Adder, Carry-Bypass Adder, Carry Select Adder, Carry-Look Ahead Adder, Multipliers, Barrel Shifter, power and speed tradeoffs.

OUTCOMES:

Upon successful completion of the course the student will be able to

CO1: Understand the working principle and characteristics of MOSFET
CO2: Design Combinational Logic Circuits
CO3: Design Sequential Logic Circuits and Clocking systems
CO4: Understand Memory architecture and interconnects
CO5: Design of arithmetic building blocks.

TEXTBOOKS


REFERENCES

OBJECTIVES:
The student should be made to:
- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT I
INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS

UNIT II
SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES
Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III
WIRELESS HEALTH SYSTEMS

UNIT IV
SMART TEXTILE

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

OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Describe the concepts of wearable system.
CO2: Explain the energy harvestings in wearable device.
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile

TOTAL PERIODS: 45
CO5: Compare the various wearable devices in healthcare system

TEXT BOOKS

REFERENCES

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CBM356 MEDICAL INFORMATICS L T P C
PREAMBLE:
1. To study the applications of information technology in health care management.
2. This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

UNIT I INTRODUCTION TO MEDICAL INFORMATICS 9
Introduction - Structure of Medical Informatics –Internet and Medicine - Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics

UNIT II COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING 9
Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III COMPUTERISED PATIENT RECORD 9
Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.
UNIT IV  COMPUTER ASSISTED MEDICAL DECISION-MAKING  
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 incclinical 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  
L T P C 3 0 0 3

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
Perspective of biofuels from wastes - Bioethanol production – Biohydrogen Production – dark and photofermentative process - Biobutanol production – Biogas and Biomethane production - Single stage anaerobic digestion, Two stage anaerobic digestion - Biodiesel production - Enzymatic hydrolysis technologies

UNIT IV  CHEMICALS AND ENZYME PRODUCTION FROM WASTES
Production of lactic acid, succinic acid, citric acid – Biopolymer synthesis – Production of Amylases - Lignocellulolyltic enzymes - Pectinolytic enzymes - Proteases – Lipases

UNIT V  BIOCOMPOSTING OF ORGANIC WASTES
Overview of composting process - Benefits of composting, Role of microorganisms in composting - Factors affecting the composting process - Waste Materials for Composting, Fundamentals of composting process - Composting technologies, Composting systems – Nonreactor Composting, Reactor composting - Compost Quality

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 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

TOTAL: 45 PERIODS

TEXT BOOKS:
Publications, 2003

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
Definition and Concept of Public Health, Historical aspects of Public Health, Changing Concepts of
Public Health, Public Health versus Medical Care, Unique Features of Public Health, Determinants
of Health (Social, Economic, Cultural, Environmental, Education, Genetics, Food and Nutrition).
Indicators of health, Burden of disease, Role of different disciplines in Public Health.

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

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
Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of money - Risk and return concepts.

UNIT II SOURCES OF FINANCE
Long term sources of Finance - Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc.

UNIT III INVESTMENT DECISIONS:
Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV FINANCING AND DIVIDEND DECISION
Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - Determinants of Dividend Policy

UNIT V WORKING CAPITAL DECISION

TOTAL : 45 PERIODS
TEXT BOOKS

REFERENCES
2. Prasanna Chandra, Financial Management,

CMG332 FUNDAMENTALS OF INVESTMENT LT P C
3003

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
OBJECTIVES
- Understand the Banking system in India
- Grasp how banks raise their sources and how they deploy it
- Understand the development in banking technology
- Understand the financial services in India
- Understand the insurance Industry in India

UNIT I  INTRODUCTION TO INDIAN BANKING SYSTEM
Overview of Banking system – Structure – Functions – Banking system in India - Key Regulations in Indian Banking sector – RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT II  MANAGING BANK FUNDS/ PRODUCTS

UNIT III  DEVELOPMENT IN BANKING TECHNOLOGY

UNIT IV  FINANCIAL SERVICES

UNIT V  INSURANCE

REFERENCES:

TOTAL : 45 PERIODS
UNIT II  INTRODUCTION TO CRYPTOCURRENCY

UNIT III  ETHEREUM
Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network

UNIT IV  WEB3 AND HYPERLEDGE

UNIT V  EMERGING TRENDS

REFERENCE
2. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018

CMG335  FINTECH PERSONAL FINANCE AND PAYMENTS

UNIT I  CURRENCY EXCHANGE AND PAYMENT

UNIT II  DIGITAL FINANCE AND ALTERNATIVE FINANCE
A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity., Introduction to the concept of Initial Coin Offering

UNIT III  INSURETECH
InsurTech Introduction, Business model disruption AI/ML in InsurTech ● IoT and InsurTech ● Risk Modeling ● Fraud Detection Processing claims and Underwriting Innovations in Insurance Services

UNIT IV  PEER TO PEER LENDING
UNIT V  REGULATORY ISSUES

TOTAL : 45 PERIODS

REFERENCE
5. IIBF, Digital Banking, Taxmann Publication, 2016

CMG336  INTRODUCTION TO FINTECH

OBJECTIVES:
1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I  INTRODUCTION
Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II  PAYMENT INDUSTRY
FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III  INSURANCE INDUSTRY

UNIT IV  FINTECH AROUND THE GLOBE
UNIT 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

UNIT III FUNDAMENTALS OF TECHNOPRENEURSHIP
Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends

UNIT IV APPLICATIONS OF TECHNOPRENEURSHIP
Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing
Technology based Product / Service entrepreneurship — Success Stories of Technopreneurs - Case Studies

UNIT V  EMERGING TRENDS IN ENTREPRENEURSHIP  9

OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1  Learn the basics of Entrepreneurship
CO 2  Understand the business ownership patterns and environment
CO 3 Understand the Job opportunities in Industries relating to Technopreneurship
CO 4 Learn about applications of tehnopreneurship and successful technopreneurs
CO 5 Acquaint with the recent and emerging trends in entrepreneuruship

TEXT BOOKS:

REFERENCES:
4) David Sheff 2002, China Dawn: The Story of a Technology and Business Revolution,
7) Basics of Technoprenuership: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP
8) Journal articles pertaining to Entrepreneurship

CMG338  TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS  L T P C
3 0 0 3

COURSE OBJECTIVES
• To develop and strengthen the Leadership qualities and motivation of learners.
• To impart the Leadership skills and traits essential to become successful entrepreneurs.
• To apply the principles and theories of Team Building in managing Technology oriented businesses.
• To empower the learners to build robust teams for running and leading a business efficiently and effectively

UNIT I  INTRODUCTION TO MANAGING TEAMS  9
Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) -Multicultural Teams.
UNIT II  MANAGING AND DEVELOPING EFFECTIVE TEAMS 9
Team-based Organisations- Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.

UNIT III  INTRODUCTION TO LEADERSHIP 9
Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership - Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment.

UNIT IV  LEADERSHIP IN ORGANISATIONS 9

UNIT V  LEADERSHIP EFFECTIVENESS 9

OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of managing teams for business.
CO 2 Understand developing effective teams for business management.
CO 3 Understand the fundamentals of leadership for running a business.
CO 4 Learn about the importance of leadership for business development.
CO 5 Acquaint with emerging trends in leadership effectiveness for entrepreneurs.

REFERENCES:

CMG339  CREATIVITY & INNOVATION IN ENTREPRENEURSHIP 3 0 0 3
COURSE OBJECTIVES
- To develop the creativity skills among the learners
- To impart the knowledge of creative intelligence essential for entrepreneurs
- To know the applications of innovation in entrepreneurship.
- To develop innovative business models for business.
UNIT I CREATIVITY
Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- Creative Personality and Motivation.

UNIT II CREATIVE INTELLIGENCE
Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training--Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III INNOVATION

UNIT IV INNOVATION AND ENTREPRENEURSHIP

UNIT V INNOVATIVE BUSINESS MODELS

OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of creativity for developing Entrepreneurship
CO 2 Understand the importance of creative intelligence for business growth
CO 3 Understand the advances through Innovation in Industries
CO 4 Learn about applications of innovation in building successful ventures
CO 5 Acquaint with developing innovative business models to run the business efficiently and effectively

Suggested Readings:
Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand
Strategic Innovation: Building and Sustaining Innovative Organizations- Course Era, Raj Echambadi.

CMG340 PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS
COURSE OBJECTIVES:
To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.

To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.

UNIT I 
INTRODUCTION TO MARKETING MANAGEMENT 9

UNIT II 
MARKETING ENVIRONMENT 9

UNIT III 
PRODUCT AND PRICING MANAGEMENT 9

UNIT IV 
PROMOTION AND DISTRIBUTION MANAGEMENT 9

UNIT V 
CONTEMPORARY ISSUES IN MARKETING MANAGEMENT 9

TOTAL 45 : PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to :
CO1 Have the awareness of marketing management process
CO 2 Understand the marketing environment
CO 3 Acquaint about product and pricing strategies
CO 4 Knowledge of promotion and distribution in marketing management.
CO 5 Comprehend the contemporary marketing scenarios and offer solutions to marketing issues.

REFERENCES:
OBJECTIVES:

- 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


Upon completion of this course the learners will be able:

CO 1 To understand the Evolution of HRM and Challenges faced by HR Managers
CO 2 To learn about the HR Planning Methods and practices.
CO 3 To acquaint about the Recruitment and Selection Techniques followed in Industries.
CO 4 To known about the methods of Training and Employee Development.
CO 5 To comprehend the techniques of controlling human resources in organisations.

REFERENCES

COURSE OBJECTIVES

- To develop the basics of business venture financing.
- To impart the knowledge essential for entrepreneurs for financing new ventures.
- To acquaint the learners with the sources of debt and equity financing.
- To empower the learners towards fund raising for new ventures effectively.

UNIT I  ESSENTIALS OF NEW BUSINESS VENTURE

UNIT II  INTRODUCTION TO VENTURE FINANCING

UNIT III SOURCES OF DEBT FINANCING

UNIT IV SOURCES OF EQUITY FINANCING
Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.

UNIT V METHODS OF FUND RAISING FOR NEW VENTURES

OUTCOMES:
Upon completion of this course, the students should be able to:
CO 1  Learn the basics of starting a new business venture.
CO 2  Understand the basics of venture financing.
CO 3  Understand the sources of debt financing.
CO 4  Understand the sources of equity financing.
CO 5  Acquaint with the methods of fund raising for new business ventures.

REFERENCES:
1) Principles of Corporate Finance by Brealey and Myers et al.,12TH ed, McGraw Hill Education (India) Private Limited, 2018

VERTICAL 3: PUBLIC ADMINISTRATION

CMG343 PRINCIPLES OF PUBLIC ADMINISTRATION

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

REFERENCES:
3. Johari J.C.: Indian Politics, Vishal Publications Ltd, New Delhi
4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi

TOTAL: 45 PERIODS

CMG345
PUBLIC PERSONNEL ADMINISTRATION
L T P C
3 0 0 3

UNIT-I
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

UNIT-II
1. Generalist Vs Specialist
2. Civil Servants’ Relationship with Political Executive
3. Integrity in Administration.

UNIT-III
1. Recruitment: Direct Recruitment and Recruitment from Within
2. Training: Kinds of Training
3. Promotion

UNIT-IV
1. All India Services
2. Service Conditions
3. State Public Service Commission

UNIT-V
1. Employer Employee Relations
2. Wage and Salary Administration
3. Allowances and Benefits

REFERENCES:
1. Stahl Glean O: Public Personnel Administration

TOTAL: 45 PERIODS
4. Dwivedi, O.P and Jain, R.B: India's Administrative state.
7. Davar, R.S: Personnel Management & Industrial Relations

CMG346      ADMINISTRATIVE THEORIES

UNIT I
Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration

UNIT II
Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory

UNIT III
Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design

UNIT IV
Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making

UNIT V
Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard, Peter Drucker

TOTAL: 45 PERIODS

REFERENCES:
1. Crozier, M: The Bureaucratic phenomenon (Chand)
3. Presthus, R: The Organizational Society (MAC)
5. Keith Davis: Organization Theory (MAC)

CMG347      INDIAN ADMINISTRATIVE SYSTEM

UNIT I
Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India

UNIT II
Role & Functions of the District Collector, Relationship between the District Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government

UNIT III
Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992

UNIT IV
Coalition politics in India, Integrity and Vigilance in Indian Administration
CMG348                            PUBLIC POLICY ADMINISTRATION                            L T P C
                                                                 3 0 0 3
UNIT-I

UNIT-II
Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System’s Approach – Dror’s Optimal Model

UNIT-III

UNIT-IV
Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.

UNIT-V
Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.

REFERENCES:
4. Pradeep Saxena : Public Policy Administration and Development

TOTAL: 45 PERIODS

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

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:
UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES
Classification, Association, Clustering.

UNIT V MACHINE LEARNING AND AI
Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization

TOTAL: 45 PERIODS

OUTCOMES:
1. Learn to apply various data mining techniques into various areas of different domains.
2. Be able to interact competently on the topic of data mining for business intelligence.
3. Apply various prediction techniques.
4. Learn about supervised and unsupervised learning technique.
5. Develop and implement machine learning algorithms

REFERENCES:
1. Jiawei Han and Micheline Kamber, Data Mining concepts and techniques, Kaufmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
7. G. K. Gupta, Introduction to Data mining with Case Studies, Prentice hall of India, 2011
9. Elizabeth Vitt, Michael Luckevich Stacia Misner, Business Intelligence, Microsoft, 2011

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

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.

OUTCOME:
- The Learners will understand social media, web and social media analytics and their potential impact.

REFERENCES:
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004

CMG353    OPERATION AND SUPPLY CHAIN ANALYTICS

OBJECTIVE:
- To treat the subject in depth by emphasizing on the advanced quantitative models and methods in operations and supply chain management and its practical aspects and the latest developments in the field.

UNIT I    INTRODUCTION
Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains.

UNIT II    WAREHOUSING DECISIONS
P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.

UNIT III    INVENTORY MANAGEMENT
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV    TRANSPORTATION NETWORK MODELS

UNIT V    MCDM MODELS
Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic an Techniques, the analytical network process (ANP), TOPSIS.

OUTCOME:
- To enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.
REFERENCES:

CMG354 FINANCIAL ANALYTICS

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.

OUTCOME
- The learners should be able to perform financial analysis for decision making using excel, Python and R.

REFERENCES:
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

UNIT IV  SUSTAINABLE CONSTRUCTION MATERIALS  9

UNIT V  SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS  9
Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity

**TOTAL:** 45 PERIODS

**OUTCOME:**
On completion of the course, the student is expected to be able to
- **CO1** Understand the environment sustainability goals at global and Indian scenario.
- **CO2** Understand risks in development of projects and suggest mitigation measures.
- **CO3** Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
- **CO4** Explain Life Cycle Analysis and life cycle cost of construction materials.
- **CO5** Explain the new technologies for maintenance of infrastructure projects.

**REFERENCES:**

**CO’s- PO’s & PSO’s MAPPING**

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OBJECTIVES:

- To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.

UNIT I AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS

Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT

Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT III WATER MANAGEMENT

Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT IV ENERGY AND WASTE MANAGEMENT

Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS

Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

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

TOTAL: 45 PERIODS

**CO – PO Mapping - SUSTAINABLE AGRICULTURE PRACTICES**

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**CES333 SUSTAINABLE BIOMATERIALS**

**OBJECTIVES**

- To Impart knowledge of biomaterials and their properties
- To learn about Fundamentals aspects of Biopolymers and their applications
- To learn about 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)-Poly(lactic acid) (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

**UNIT III ** BIO CERAMICS AND BIOCOMPOSITES

General properties- Bio ceramics -Silicate glass - Alumina (Al2O3) -Zirconia (ZrO2)-Carbon-Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites-Polymer Matrix Composite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)–glass ceramics - Orthopedic implants-Tissue engineering scaffolds

**UNIT IV ** METALS AS BIOMATERIALS

Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys-Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties
of metal implants for osteointegration – medical application – corrosion of metallic implants – biological tolerance of implant metals

UNIT V  NANOBIO MATERIALS

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.
- Students gain knowledge on the importance of nanobiomaterials in biomedical applications.

REFERENCES
6. Vasif Hasirci, Nesrin Hasirci “Fundamentals of Biomaterials” Springer, 2018
materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy

UNIT II ELECTROCHEMICAL DEVICES
Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O₂ battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO₂, LiFePO₄, LiMn₂O₄) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)

UNIT III FUEL CELLS

UNIT IV PHOTOVOLTAICS

UNIT V SUPERCAPACITORS
Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitriles, and nitrides.

TOTAL : 45 PERIODS

OUTCOMES
• Students will acquire knowledge about energy sustainability.
• Students understand the principles of different electrochemical devices.
• Students learn about the working of fuel cells and their application.
• Students will learn about various Photovoltaic applications and the materials used.
• The students gain knowledge on different types of supercapacitors and the performance of various materials

REFERENCES
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh

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

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
OBJECTIVES:

- To understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.

UNIT I  ENVIRONMENTAL MONITORING AND STANDARDS


UNIT II  MONITORING OF ENVIRONMENTAL PARAMETERS


UNIT III  ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING

Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods -Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT IV  ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISKASSESSMENT


UNIT V  AUTOMATED DATA ACQUISITION AND PROCESSING

Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks -Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion of this course, the students will know

| CO1  | Basic concepts of environmental standards and monitoring. |
| CO2  | the ambient air quality and water quality standards; |
| CO3  | the various instrumental methods and their principles for environmental monitoring |
| CO4  | The significance of environmental standards in monitoring quality and sustainability of the environment. |
| CO5  | the various ways of raising environmental awareness among the people. |
CO6 Know the standard research methods that are used worldwide for monitoring the environment.

TEXTBOOKS
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and 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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CES337 INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT L T P C 3 0 0 3

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 9
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 9
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

UNIT III SUSTAINABLE DEVELOPMENT 9
UNIT IV RENEWABLE ENERGY TECHNOLOGY

UNIT V ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the world and Indian energy scenario
2. Analyse energy projects, its impact on environment and suggest control strategies
3. Recognise the need of Sustainable development and its impact on human resource development
4. Apply renewable energy technologies for sustainable development
5. Fathom Energy policies and planning for sustainable development.

REFERENCES:
7. https://www.niti.gov.in/verticals/energy

CES338 ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT L T P C 3 0 0 3

COURSE OBJECTIVES:
1. To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
2. To create awareness on energy audit and its impacts
3. To acquaint the techniques adopted for performance evaluation of thermal utilities
4. To familiarise on the procedures adopted for performance evaluation of electrical utilities
5. To learn the concept of sustainable development and the implication of energy usage

UNIT I ENERGY AND ENVIRONMENT
Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT II ENERGY AUDITING
Need and types of energy audit. Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments
UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES
Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters.
Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator,
heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression

UNIT IV ENERGY CONSERVATION IN ELECTRICAL UTILITIES
Demand side management - Power factor improvement – Energy efficient transformers - Energy
conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination
systems and cooling towers

UNIT V SUSTAINABLE DEVELOPMENT
Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG).
Globalization and Economic growth. Economic development: Economic inequalities, Income and
growth. Social development: Poverty, conceptual issues and measures, impact of poverty.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the prevailing energy scenario
2. Familiarise on energy audits and its relevance
3. Apply the concept of energy audit on thermal utilities
4. Employ relevant techniques for energy improvement in electrical utilities
5. Understand Sustainable development and its impact on human resource development

REFERENCES: