PROGRAMME OUTCOMES (POs):
Graduates of Food Technology will be able to:

1. **PO1 Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **PO2 Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **PO3 Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **PO4 Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **PO5 Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **PO6 The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **PO7 Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **PO8 Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **PO9 Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **PO10 Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **PO11 Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **PO12 Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

2. PROGRAM SPECIFIC OUTCOMES (PSOs):

   By the completion of Food Technology B.Tech program, the student will have following program specific outcomes:
   - Apply basic skills and knowledge in Engineering to develop innovative food processing techniques and food products.
   - Adapt multidisciplinary approaches to solve food industry problems and ensure food quality and safety.
   - Develop critical thinking and problem-solving skills in the domain of food technology with professional integrity and ethical values.
### 3. MAPPING OF COURSE OUTCOMES AND PROGRAMME OUTCOMES

<table>
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<th>SEMESTER 1</th>
<th>COURSE NAME</th>
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YEAR 2 SEMESTER 3
| SEMESTER 4 | Equations | Biochemistry and Nutrition | 2.2 | 2.4 | 2 | 2.2 | 2.6 | 2.6 | 2.2 | 0 | 0 | 0 | 1.2 | 2 | 1.6 | 0 | 1.6 |
| Probability and Operations Research | 3 | 3 | 1 | 0.8 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | - | - | - | - |
| Food Additives and Flavors | 1.6 | 1.8 | 2 | 1.6 | 2.6 | 2.6 | 1.6 | 0 | 0 | 0 | 1.6 | 2 | 1.6 | 2 | 0 |
| Environmental Sciences and Sustainability | 2.8 | 1.8 | 1 | 1 | - | 2.2 | 2.4 | - | - | - | - | - | 1.8 | - | - | - |
| Heat and Mass Transfer in Food Processes | 2.4 | 2.4 | 1.8 | 2.4 | 2.4 | 2.4 | 1.4 | 0 | 0 | 0 | 1.4 | 2.6 | 1.8 | 0 | 2 |
| Principles of Thermodynamics | 2.6 | 2.2 | 2.6 | 2.4 | 2.4 | 2.4 | 1.6 | 0 | 0 | 0 | 1.2 | 2.4 | 1.8 | 0 | 2 |
| Biochemistry and Nutrition Laboratory | 1.8 | 2.4 | 1.6 | 2.5 | 2 | 2.5 | 1 | 0 | 0 | 0 | 1.2 | 2.6 | 0 | 2 | 1.6 |
| Unit Operations Laboratory | 1.8 | 1.8 | 2.4 | 2.2 | 2 | 2.8 | 1.4 | 0 | 0 | 0 | 2 | 2.6 | 2.2 | 0 | 2 |

| SEMESTER 5 | Food Processing and Preservation | 2.4 | 2.4 | 1.8 | 2.4 | 2.4 | 2.4 | 1.4 | 0 | 0 | 0 | 1.4 | 2.6 | 2.2 | 2 | 2 |
| Food Analysis | 2.2 | 2.2 | 2 | 2.6 | 3 | 2.2 | 2 | 0 | 0 | 0 | 1.2 | 2.6 | 2 | 2 | 0 |
| Food Processing and Preservation Laboratory | 1.2 | 1.8 | 3 | 2.8 | 3 | 2 | 0 | 0 | 0 | 1.8 | 2 | 3 | 1.8 | 2 | 0 |
| Food Analysis Laboratory | 2.2 | 2.2 | 2 | 2.6 | 3 | 2.2 | 2 | 0 | 0 | 0 | 1.2 | 2.6 | 2 | 2 | 0 |

<p>| SEMESTER 6 | Food Process Engineering | 2.4 | 2.6 | 2 | 2.4 | 2.2 | 0 | 1.6 | 0 | 0 | 0 | 1.6 | 2.4 | 2.2 | 2 | 2 |
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| Refrigeration and | 3 | 2.8 | 2.4 | 2.2 | 2.6 | 2.4 | 2.4 | 0 | 0 | 0 | 1.4 | 2.6 | 1.6 | 0 | 2 |</p>
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<th>Food Plant Equipment Design</th>
<th>Dairy Chemistry and Microbiology</th>
<th>Processing of Dairy Products</th>
<th>Value added dairy products</th>
<th>Precision fermentation for dairy alternatives</th>
<th>Cheese Technology</th>
<th>Quality and Safety Monitoring in Dairy industry</th>
<th>Introduction to Food Biotechnology</th>
<th>Enzymes in food and feed industry</th>
<th>Food allergens and Toxicology</th>
<th>Genetic Engineering and Genetically Modified Foods</th>
<th>Functional Foods and Nutraceuticals</th>
<th>Introduction to meat, marine and poultry</th>
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<td>Marine Foods Processing</td>
<td>Technology of packaging meat and marine products</td>
<td>Quality, Laws, and regulations in Meat industries</td>
<td>Fat and Oil Technology</td>
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$ Skill Based Course

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**TOTAL** 14 1 16 31 23

# 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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$ 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.

*Two weeks industrial training/internship carries one credit. Industrial training/Internship during IV Semester Summer Vacation will be evaluated in V semester

|        |             |                                                   |          | 17| 2 | 0 | 21| 23|

# 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.

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

* Two weeks industrial training/internship carries one credit. Industrial training/Internship during IV Semester Summer Vacation will be evaluated in V semester

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

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

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

## NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
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**TOTAL** 20 0 0 20 22

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

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

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

* Elective- Management shall be chosen from the Elective Management courses

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

### SEMESTER VIII/IX

**PRACTICALS**

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<tr>
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**TOTAL** 0 0 20 20 10

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

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

**TOTAL CREDITS: 167**

### ELECTIVE – MANAGEMENT COURSES

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<tr>
<th>SL. NO.</th>
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* Mandatory Courses are offered as Non–Credit Courses

### MANDATORY COURSES II*

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* Mandatory Courses are offered as Non–Credit Courses
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<td>DAIRY AND BEVERAGE TECHNOLOGY</td>
<td>FOOD BIOTECHNOLOGY</td>
<td>MEAT, MARINE AND POULTRY TECHNOLOGY</td>
<td>CEREALS, PULSES AND GRAIN TECHNOLOGY</td>
<td>NEXT GENERATION TECHNOLOGIES IN FOOD INDUSTRY</td>
<td>FRUIT AND VEGETABLE TECHNOLOGY</td>
<td>FOOD PACKAGING TECHNOLOGY</td>
<td>BAKING AND CONFECTIONERY TECHNOLOGY</td>
<td>SPICES AND PLANTATION TECHNOLOGY</td>
<td>FOOD SAFETY MANAGEMENT SYSTEM</td>
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<td>Dairy chemistry and microbiology</td>
<td>Introduction To Food Biotechnolog y</td>
<td>Introduction To Meat, Marine, Poultry</td>
<td>Fat and oil Technology</td>
<td>High Performance Computing</td>
<td>Technology Of Fruit And Vegetable Processing</td>
<td>Packaging Design and Sustainable Development</td>
<td>Introduction to baking &amp; bakery products</td>
<td>Processing, Storage of spices &amp; plantation crops</td>
<td>Introduction to food safety Analysis and Quality Risk Management</td>
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<td>Processing of Dairy Products</td>
<td>Enzymes in Food and Feed Industry</td>
<td>Meat and Poultry Processing</td>
<td>Processing Of Cereals, Oil Seeds And Pulses</td>
<td>Food materials science</td>
<td>Fruits And Vegetables as Nutraceutical</td>
<td>Package Printing inks and Coatings</td>
<td>Flour chemistry &amp; Rheology</td>
<td>Blending and Value Addition</td>
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<td>Value added dairy products</td>
<td>Food Fermentation Technology</td>
<td>Byproducts In Meat Processing</td>
<td>Enrichment And Fortification Of Cereals And Oils</td>
<td>Food structuring techniques</td>
<td>Advances In Fruit And Vegetable Processing Technologie s</td>
<td>Glass Wood and Metal Processing and Packaging</td>
<td>Confectionery products</td>
<td>Processing of Coffee</td>
<td>FSMS &amp; Food Product and Supply Chain Management</td>
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<td>Precision fermentation for dairy alternatives</td>
<td>Biological Instrumentation and Process Control</td>
<td>Preservation Technology of Eggs, Meat, Poultry And Seafood</td>
<td>Milling And Fractionation Technologie s</td>
<td>Concepts on experimental design and modelling</td>
<td>Beverage Technology</td>
<td>Plastics and Polymers in Packaging</td>
<td>Industrial production of cookies and biscuits</td>
<td>Processing of Tea</td>
<td>Food laws – Indian and International</td>
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<td>Food Allergens and Toxicology</td>
<td>Marine Food Processing</td>
<td>Technology of Malting and Brewing</td>
<td>Statistical tool in data analysis</td>
<td>Fruit And Vegetable Storage</td>
<td>Paper, CFB and Paper Board based Packaging</td>
<td>Industrial production of bun, bread, cakes and pastries</td>
<td>Processing of cocoa and chocolate</td>
<td>Food Safety in Hospitality industry &amp; GLP in Food Industries</td>
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**Registration of Professional Elective Courses from Verticals:**

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

### VERTICAL I: DAIRY AND BEVERAGE TECHNOLOGY

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### VERTICAL II: FOOD BIOTECHNOLOGY

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VERTICAL V: NEXT GENERATION TECHNOLOGIES IN FOOD INDUSTRIES

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VERTICAL VI: FRUIT AND VEGETABLE TECHNOLOGY

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### VERTICAL VIII: BAKING AND CONFECTIONERY TECHNOLOGY

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## Vertical IX: Spices and Plantation Technology

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## Vertical X: Food Safety Management System

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**OPEN ELECTIVES**

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

**OPEN ELECTIVE I AND II**

**(EMERGING TECHNOLOGIES)**

To be offered other than Faculty of Information and Communication Engineering

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

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

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

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

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

**Verticals FOR MINOR DEGREE (IN ADDITIONS TO ALL THE VERTICALS OF OTHER PROGRAMMES)**

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

**VERTICAL 1: FINTECH AND BLOCK CHAIN**

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

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

(v) Proficiency Modules
This would address some lacunas that students might have, for example, English, computer familiarity etc.

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

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

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

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

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

REFERENCES:
Guide to Induction program from AICTE

HS3152 PROFESSIONAL ENGLISH I

OBJECTIVES:
- To improve the communicative competence of learners
- To learn to use basic grammatic structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners’ ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION
What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C’s of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

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

UNIT II NARRATION AND SUMMATION 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

TOTAL : 45 PERIODS

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

REFERENCE BOOKS:

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

**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
Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M.I –moment of inertia of continuous bodies –

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

UNIT III OSCILLATIONS, OPTICS AND LASERS

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

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

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.

TOTAL: 45 PERIODS

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

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

### CY3151 ENGINEERING CHEMISTRY

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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 foot print.

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

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GE3151  PROBLEM SOLVING AND PYTHON PROGRAMMING  L T P C
3 0 0 3

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

UNIT I  COMPUTATIONAL THINKING AND PROBLEM SOLVING  9

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

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

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

UNIT V  FILES, MODULES, PACKAGES  9
Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter’s age validation, Marks range validation (0-100).

TOTAL : 45 PERIODS

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

TEXT BOOKS:

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

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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 Kootheru, 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. கைவிழாங்கர் - மகாகளம் பார்வைகள் - க.சோ.பி. பீல் பூனையன் (தமிழ்ப் புதக்கும்: கைவிழாங்கர் பார்வைகள் மகாகளம் பார்வைகள் கல்வியுள்ள குழு).
2. கல்வியுள்ள கைவிழாங்கர் – கல்வியுள்ள புத்தககள் (தமிழ்ப் புதக்கும்).
3. கைவிழாங்கர் பார்வைகள் குறித்த நூற்றாண்டு தக்கால் தக்காலியுள்ள (தமிழ்ப் புதக்கும் தக்கால் தக்காலியுள்ள).
4. மகாகளத்தை ஆல்காலியுள்ள நூற்றாண்டு தக்காலியுள்ள (தமிழ்ப் புதக்கும் தக்கால் தக்காலியுள்ள).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
OBJECTIVES:
- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures – lists, tuples, dictionaries.
- To do input/output with files in Python.

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

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

12. Developing a game activity using Pygame like bouncing ball, car race etc.

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

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

COs- PO’s & PSO’s MAPPING

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BS3171  PHYSICS AND CHEMISTRY LABORATORY

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

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

**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.

**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)**

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

**TOTAL : 30 PERIODS**
OUTCOMES:
- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques.
- To analyse and determine the composition of alloys.
- To learn simple method of synthesis of nanoparticles.
- To quantitatively analyse the impurities in solution by electroanalytical techniques.

TEXT BOOK:

CO-PO & PSO MAPPING

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

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

TOTAL : 30 PERIODS

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

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

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.

HS3252  PROFESSIONAL ENGLISH -II

OBJECTIVES:
• To engage learners in meaningful language activities to improve their reading and writing skills
• To learn various reading strategies and apply in comprehending documents in professional context.
• To help learners understand the purpose, audience, contexts of different types of writing
• To develop analytical thinking skills for problem solving in communicative contexts
• To demonstrate an understanding of job applications and interviews for internship and placements
UNIT I  MAKING COMPARISONS  6
Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases

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

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

UNIT IV  REPORTING OF EVENTS AND RESEARCH  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.

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.

ASSESSMENT PATTERN
Two internal assessments and an end semester examination to test students’ reading and writing skills along with their grammatical and lexical competence.
MA3251 STATISTICS AND NUMERICAL METHODS L T P C 3 1 0 4

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

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

TEXT BOOKS:

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PH3258 PHYSICS OF MATERIALS

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


UNIT II ELECTRICAL PROPERTIES OF MATERIALS


UNIT III SEMICONDUCTING PROPERTIES MATERIALS


UNIT IV DIELECTRIC AND MAGNETIC MATERIALS


UNIT V NEW MATERIALS AND APPLICATIONS


TOTAL: 45 PERIODS

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

CO1 : Acquire knowledge of phase diagram, and thin film and nanomaterial preparation techniques
CO2 : Familiarize with conducting materials, basic quantum mechanics, and properties and applications of superconductors.
CO3 : Gain knowledge on semiconducting materials based on energy level diagrams, its types, temperature effect. Also, fabrication methods for semiconductor devices will be understood.
CO4 : Realize with theories and applications of dielectric and ferromagnetic materials
CO5 : Familiarize with ceramics, composites, metallic glasses, shape memory alloys, biomaterials and their important applications.

TEXT BOOKS:
REFERENCES:

CO’s-PO’s & PSO’s MAPPING

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

BE3252 BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING 3 0 0 3

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  9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completing this course, the students will be able to
CO1: Compute the electric circuit parameters for simple problems
CO2: Explain the concepts of domestics wiring and protective devices
CO3: Explain the working principle and applications of electrical machines
CO4: Analyze the characteristics of analog electronic devices
CO5: Explain the types and operating principles of sensors and transducers

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

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

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

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

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

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

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

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

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

TEXT BOOK:

REFERENCES:

Publication of Bureau of Indian Standards:

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

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

TOTAL : 15 PERIODS
Tamil Nadu)  
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay)  
(Published by: The Author)  
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)  

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<td>TAMILS AND TECHNOLOGY</td>
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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 - Chettiar 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  
2. கல்லுரிமை சமுனி – பலராமல் குடிய குறிப்பிட்டு (சிறை பிரசாரம்).  
3. சிறை – கல்லுரிமைக் குறிப்பிட்டு குடிய குறிப்பிட்டு (சிறை பிரசாரம் குறிப்பிட்டு).  
4. வடிவமான சான்றாக்கல் (குவித்தால் குறிப்பிட்டு).  
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).  
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8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
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NCC Credit Course Level 1*
NX3251 (ARMY WING) NCC Credit Course Level - I

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TOTAL : 30 PERIODS

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NX3252 (NAVAL WING) NCC Credit Course Level - I

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### SOCIAL SERVICE AND COMMUNITY DEVELOPMENT

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**TOTAL : 30 PERIODS**
COURSE OBJECTIVES:
- Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in 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:
- Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
- Preparing plumbing line sketches.
- Laying pipe connection to the suction side of a pump.
- Laying pipe connection to the delivery side of a pump.
- Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

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

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

PART II ELECTRICAL ENGINEERING PRACTICES 15

- Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
- Staircase wiring
- Fluorescent Lamp wiring with introduction to CFL and LED types.
- Energy meter wiring and related calculations/calibration
- Study of Iron Box wiring and assembly
- 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 PRACTICE 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 air conditioner.

SHEET METAL WORK:
  a) Making of a square tray

FOUNDRY WORK:
  a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

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

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

ELECTRONIC EQUIPMENT STUDY:
  a) Study an element of a 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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BE3272 BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING LABORATORY

COURSE OBJECTIVES:
- To train the students in conducting load tests electrical machines
- To gain practical experience in experimentally obtaining the characteristics of electronic devices and rectifiers
- To train the students to measure three phase power and displacement

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

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

CO’s, PO’s & PSO’s MAPPING

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OBJECTIVES

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To be able to communicate effectively through formal and informal writing.
- To be able to use appropriate language structures to write emails, reports and essays.
- To give instructions and recommendations that are clear and relevant to the context.

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

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

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

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

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

TOTAL: 60 PERIODS

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

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

Assessment Pattern

- One online/app based assessment to test speaking and writing skills.
- Proficiency certification is given on successful completion of speaking and writing.

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### MA3351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

**L T P C**

3 1 0 4

#### OBJECTIVES

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

#### UNIT I  PARTIAL DIFFERENTIAL EQUATIONS

9+3

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

#### UNIT II  FOURIER SERIES

9+3

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

#### UNIT III  APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

9+3

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

#### UNIT IV  FOURIER TRANSFORMS

9+3


#### UNIT V  Z - TRANSFORMS AND DIFFERENCE EQUATIONS

9+3


**TOTAL: 60 PERIODS**

#### OUTCOMES

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

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

**TEXT BOOKS:**

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**FD3301 FLUID MECHANICS AND MECHANICAL OPERATIONS**

**COURSE OBJECTIVES:**
To enable the students to understand the
- The mechanics of fluids through a thorough understanding of the properties of the fluids, behaviour of fluids under static conditions.
- Dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy.
- Applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on vanes.
- Mechanical and Contact equilibrium separation processes of the components and their series of unit operations.

**UNIT I PROPERTIES OF FLUIDS**
laws for a system; continuity equation - in Cartesian co-ordinates - Euler's equation of motion, momentum balance equation-Introduction to Navier Stoke’s and Euler’s Equation, Types of fluid flow- Introduction to rotational and irrotational flow, momentum correction factor. Fluid pressure and measurement –simple, differential and micro manometers - Mechanical gages – calibration. Pressure diagram – total pressure on curved surface. Archimedes principles

UNIT II FLOW MEASUREMENTS & OPEN CHANNEL FLOW
Introduction; flow of incompressible fluid in circular pipe; laminar flow for Newtonian fluid; Hagen-Poiseuille equation; introduction to turbulent flow in a pipe-Prandtl mixing length; energy consideration in pipe flow, Bernoulli’s equation–kinetic energy correction factor; Reynolds's experiment, Darcy – Weisbach equation for friction head loss – Chezy's formula – Manning's formula – Hazen-Williams's formula - Major and minor losses in pipes; friction factor-Fanning and Darcy, Moody diagram; major and minor losses; Pipe fittings and valves, equivalent diameter. Flow measurement: Introduction; general equation for internal flow meters; Orifice meter; Venturi meter; Weirs, concept of area meters: rotameter; Local velocity measurement: Pitot tube. Hot wire anemometer, mass flowmeter.

UNIT III DIMENSIONAL ANALYSIS & PUMPS
Dimensional analysis – concept of geometric, kinematic and dynamic similarity. Important nondimensional numbers – Reynolds, Froude, Euler, Mach and Weber. Fluidization: Introduction; different types of fluidizations; minimum fluidization velocity; governing equation; pneumatic conveying and other industrial uses. Fluid moving machines: Basic classification of pumps: Non-Mechanical Pumps-steam jet ejector, air lift pump, Mechanical pump: Centrifugal pumps-cavitation, NPSH, Positive displacement pumps (rotary, piston, plunger, diaphragm pumps); pump specification; basic characteristics curves for centrifugal pumps; fan, blower and compressor.

UNIT IV SEPARATION AND SIZE REDUCTION

UNIT V CONTACT EQUILIBRIUM SEPARATION

TOTAL: 60 PERIODS

COURSE OUTCOMES:
On completion of the course,
• The students will be able to get a basic knowledge of fluids in static, kinematic and dynamic equilibrium.
• The students will also gain the knowledge of the applicability of physical laws in addressing problems in hydraulics.

TEXT BOOKS:
OBJECTIVES
The course aims to enable the students to
- develop the knowledge in the basic area of Food Chemistry such as the composition and properties of food and the chemical changes of nutrients during handling, processing, and storage.
- effectively understand food processing and technology.
- appreciate the similarities and complexities of the chemical components in foods.

UNIT I CARBOHYDRATES 10
The principal carbohydrates in the human diet. Chemical properties of carbohydrates dehydration, caramelization, Maillard reaction. Types Simple Sugars mono and disaccharides, solubility; Artificial sweeteners; Glucose syrup, fructose syrup, Sugar alcohols; Oligosaccharides structure, nomenclature, occurrence, uses in foods. Polysaccharides Starch- amylose and amylopectin- properties, thickening & gelatinization, modified starches, resistant starch, Dextrins and dextrans, Starch hydrolysates – Maltodextrins and dextrins; Structure of glycogen. Fiber_Cellulose & hemicellulose Pectins Gums & seaweeds- gel formation & viscosity.

UNIT II PROTEINS 9
The principal proteins in the human diet. Review of protein structure & conformation; Optical activity, solubility, hydration, swelling, foam formation & stabilization, gel formation; emulsifying effect, thickening & binding, amino acids in Maillard reaction, denaturation; Properties & reactions of proteins in food systems and Food enzymes and its role in food spoilage, application of food enzymes; Texturized proteins; Functional role and uses in foods.

UNIT III LIPIDS 10
Review of structure, composition and nomenclature of fats. Properties of fats & oils Edible oil refining processes, winterization, melting points, plasticity, isomerisation, hydrolysis of triglycerides, Saponification number, iodine value, Reichert-Meissl number. Types of fatty acids; Modification of fats hydrogenation- cis and trans isomers, inter-esterification, acetylation, Hydrolytic rancidity & oxidative rancidity; Shortening power of fats, tenderization, frying - smoke point, auto oxidation, polymerization, lipids having emulsifying properties, itsapplication in food industry and detergents; Shortening power of fats, chemistry of steroids, types of fat substitute.

UNIT IV FOOD COMPOSITION, WATER, MINERALS AND VITAMINS 7
Proximate composition of food, water activity in food, moisture content of food, water quality for food processing. Mineral & vitamin content of foods- stability & degradation during food processing.
UNIT V AROMA & IMPORTANT PHYTOCHEMICALS IN FOOD

Naturally occurring colours/pigments in food and impact on antioxidant level, Synthetic food grade Colours, enzymatic browning of food, flavour & aroma components present in herbs, spices, coffee, tea, cocoa, fruits, vegetables & fermented products; and Naturally similar /artificial flavours, Threshold values, off flavours & food taints. Naturally occurring toxic substances, protease inhibitors, bioactive components phytates, polyphenols, saponins.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)

At the end of the course the students would have the knowledge to
1. Apply the structural changes in carbohydrates during processing and predict their physiological effects in the body
2. Analyze the functional and nutritional properties of proteins
3. Evaluate the properties and physico-chemical changes of fats and oil during processing and their industrial importance
4. Justify the importance of vitamins and minerals and their physiological role in the human body
5. Assess the aroma and phytochemicals in food matrices

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TEXT BOOKS:

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FD3303 FOOD MICROBIOLOGY L T P C 3 0 0 3

OBJECTIVES:
- The course aims to develop the knowledge of students in the basic area of Food Microbiology.
• This is necessary for effective understanding of food processing and technology subjects as well as food safety.
• This course will enable the students to appreciate the role of microbes in food spoilage, preservation of foods and food borne infections.

UNIT I       ROLE OF MICROBES IN SPOILAGE OF FOODS  9
Factors affecting spoilage of foods, Microbial flora associated with various food groups their spoilage potential. Microbiological spoilage problems associated with typical food products.

UNIT II      CONTROL OF MICROBES IN FOODS  9
Use of antimicrobial chemicals- organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, benzoates, sorbates / propionates naturally occurring antimicrobials; physical methods- low and high temperatures, drying, radiation and high pressure; tolerance of microbes to chemical and physical methods in various foods.

UNIT III     MICROBES IN FOOD FERMENTATIONS  9
Microbes of importance in food fermentations – homo & hetero-fermentative bacteria, yeasts & fungi; biochemistry of fermentations – pathways involved, lactic acid bacteria fermentation and starter cultures, alcoholic fermentations -yeast fermentations - characteristics and strain selection, fungal fermentations. microbes associated with typical food fermentations- yoghurt, cheese, fermented milks, breads, idli, soy products, fermented vegetables and meats.

UNIT IV      MICROBIAL AGENTS OF FOOD BORNE ILLNESS  9
Food borne infections and food poisoning, microbial toxins, Gram Negative and Gram-positive food borne pathogens; toxigenic algae and fungi; Food borne viruses; helminths, nematodes and protozoa.

UNIT V       MICROBIAL EXAMINATION OF FOODS  9
Detection & Enumeration of microbes in foods; Indicator organisms and microbiological criteria; Rapid and automated microbial methods - development and impact on the detection of food borne pathogens; Applications of immunological, techniques to food industry; Detection methods for E. coli, Staphylococci, Yersinia, Campylobacter, B. cereus, Cl. Botulimum & Salmonella, Listeria monocytogenes Norwalk virus, Rotavirus, Hepatitis A virus from food samples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students would have the knowledge to
1. Classify the microorganism and identify the microorganism associated with foods
2. Apply the preservation methods to control the spoilage and assess the microbial growth in foods
3. Analyze the importance of microorganism in food fermentation and fermented products
4. Assess the cause for food borne illness and understand the quality control for safety of foods
5. Evaluate the microorganism responsible for spoilage of foods and its assessments

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TEXT BOOKS:

REFERENCES:

FD3304 FOOD PROCESS CALCULATIONS L T P C
3 1 0 4

OBJECTIVE:
• To introduce the students to basic principles of stoichiometry and its calculations.

UNIT I 9+3
Units and dimensions, Basic and derived units, use of model units in calculations, Methods of expression, compositions of mixture and solutions. Ideal and real gas laws – Gas constant - calculations of pressure, volume and temperature using ideal gas law

UNIT II 9+3
Fundamental Calculations and Humidity, Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.

UNIT III 9+3
Basic Principles of Stoichiometry - Importance of material balance and energy balance in a process Industry-Dimensions, nits, conversion factors and their use –Data sources, Humidity and applications. Material Balance: Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallization, drying, extraction, Leaching.

UNIT IV 9+3
Energy Balance: Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy

UNIT V 9+3
Enthalpy Changes: Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction - Energy balance for systems without chemical reaction.

TOTAL: 45+15=60 PERIODS

(Use of Psychometric chart is permitted in the examination)

COURSE OUTCOMES:
At the end of the course the students would have the knowledge to
1. Explain the basic units in food processing.
2. Analyze basic humidity calculations.
3. Infer material balance for process operations.
4. Explain energy balance in food technology.
5. Explain the heat content and enthalpy in food processing.

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TEXT BOOKS:

REFERENCES:

FD3305 POST HARVEST ENGINEERING L T P C 3 0 0 3

OBJECTIVES
The course aims to
- Develop the knowledge of students in the area of post-harvest processing of various foods and related technology.
- Enable students to appreciate the application of scientific principles in the processing of post harvesting materials.

UNIT I INTRODUCTION
Post-harvest engineering of crops – objectives - post harvest systems and losses in agricultural commodities structure, engineering properties of agricultural materials, optimum stage of harvest, importance of loss reduction; Post Harvest Handling operations. Pre-drying operation, Moisture content, RH measurement, air-grain measurement.

UNIT II CLEANING, THRESHING AND GRADING
Threshing and shelling operation - principles and operation - various decorticators/dehullers/shellers, description of groundnut decorticators, maize shellers, etc. Cleaning – principles and machineries – Cleaning of grains, washing of fruits and vegetables, types of cleaners, screens, types of screens - rotary screens, vibrating screens, machinery for cleaning of fruits and vegetables (air cleaners, washers), cleaning efficiency, care and maintenance; Peeling, Sorting and Grading - grain grading system, effectiveness of separation and performance index., hydrothermal treatment and conditioning of grains, Size grading, colour grading, specific gravity grading; screening, equipment for grading of fruits and vegetables, grading efficiency. Separation - Magnetic separator, de-stoners, electrostatic separators, pneumatic separator

UNIT III MATERIAL HANDLING
Introduction to different conveying equipment used for handling of grains, fruits and vegetables;
Scope and importance of material handling devices Classification, principles of operation, conveyor system selection/design. Belt conveyor Principle, characteristics, design, relationship between belt speed and width, capacity, inclined belt conveyors, idler spacing, belt tension, drive tension, belt tripper. Chain conveyor -Principle of operation, advantages, disadvantages, capacity and speed, conveying chain. Screw conveyor Principle of operation, capacity, power, troughs, loading and discharge, inclined and vertical screw conveyors. Bucket elevator Principle, classification, operation, advantages, disadvantages, capacity, speed, bucket pickup, bucket discharge, relationship between belt speed, pickup and bucket discharge, buckets types, power requirement. Pneumatic conveying system types, air/product separators; Gravity conveyor design considerations, capacity and power requirement.

UNIT IV PRINCIPLES AND PRACTICE OF STORAGE 10
Importance of scientific storage systems, post-harvest physiology of semi-perishables and perishables. Damages Direct damages, indirect damages, causes of spoilage in storage (moisture, temperature, humidity, respiration loss, heat of respiration, sprouting), destructive agents (rodents, birds, insects, etc.), sources of infestation and control. Storage structures Traditional storage structures, improved storage structures, modern storage structures; Farm silos Horizontal silos, tower silos, pit silos, trench silos, size and capacity of silos. Storage of perishables Cold storage, controlled and modified atmospheric storage, hypobaric storage, evaporative cooling storage, conditions for storage of perishable products, control of temperature and relative humidity inside storage

UNIT V PEST CONTROL 8
Primary and secondary insect pests, rodents and microorganisms of stored food grains and their control, integrated pest management, Fumigation and controlled atmosphere storage of food grains, Rodent Control.

OUTCOMES:
At the end of the course the students would have the knowledge to
1. Apply the post-harvest engineering to prevent loss.
2. Infer the different cleaning, threshing and grading operations involved in food industry.
3. Utilize the conveyors in the food industry
4. Apply the storage principles in extending the shelf-life of commodity.
5. Identify the suitable pest control and management method for agricultural produce.

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TEXTBOOKS:
FD3311  FOOD CHEMISTRY LABORATORY  L T P C  0 0 4 2

COURSE OBJECTIVES
The course aims to practically
• Study and understand the chemical properties of foods.
• Study the physical, chemical, thermal properties of various food constituents

LIST OF EXPERIMENTS
1. Experiment to study the properties of carbohydrates- caramelization, Maillard reaction.
2. Experiment on enzymatic and acid hydrolysis of sucrose
3. Preparation of emulsions and study its stability
4. Determination of Foaming properties of proteins
5. Determination of Solubility, specific gravity and Refractive index of oils
6. Estimation of free fatty acid content of oil
7. Determination of peroxide value and Anisidine value of fats.
8. Experiment to study the effect of heat on proteins.
9. Determination of Iso-electric point of casein & experiment to study effect of rennin on milk proteins
10. Experiments to study the gelling properties of starch
11. Experimental study of gluten formation using wheat flour
12. Experimental study on enzymatic Browning in foods

TOTAL: 60 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Identify the important reactions in food chemistry and their consequences.
2. Understand the methods to measure these reactions.
3. Capable of reporting the results in an appropriate format.
4. Designing and conducting an experiment to understand a simple food chemistry problem.
5. Analyze the complex interactions between the different components of foods.

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REFERENCES

FD3312  FOOD MICROBIOLOGY LABORATORY  L T P C  0 0 4 2

COURSE OBJECTIVES
The course aims to enable the students to understand
• Methods of isolating and characterizing various microbes associated with foods and food
groups.
• Using of a various microbiological techniques for the study of foods.
• Understand the methods used to detect pathogens in foods.

LIST OF EXPERIMENTS
1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques; Culture Media-Types and Use; Preparation of Nutrient broth and agar
2. Culture Techniques, Isolation and Preservation of Cultures- Broth flask, test tubes; Solid Pour plates, streak plates, slants, stabs
3. Microscopy – Working and care of Microscope; Microscopic Methods in the Study of Microorganisms; Staining Techniques - Simple, Differential- Gram’s Staining
4. Quantification of Microbes Sampling and Serial Dilution; Bacterial count in food products TVC
5. Microbiological quality of water (MPN)
6. Microbiological quality of milk
7. Enumeration of Lactic acid bacteria from fermented foods
8. Yeast & Mould count from fruits
9. Enumeration of spores from pepper
10. Inhibitory effect of spices on microbial load in fish & flesh foods
11. Enumeration & Isolation of E. coli from processed meat/chicken
12. Thermal destruction of microbes TDT & TDP
13. Enumeration & Isolation of Staphylococci from ready to eat street foods
14. Effect of cleaning and disinfection on microbial load

TOTAL: 60 PERIODS

Course Outcomes (COs)
At the end of the course the students would have the knowledge to
1. Prepare the microbial growth media and sterilize it.
2. Isolate pure culture and preserve them.
3. Operate microscope and use it for detection of microbes.
4. Isolate and enumerate spoilage organisms.
5. Detect the presence of food borne pathogens.

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REFERENCES
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  

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**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  

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**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  

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**TOTAL: 30 PERIODS**

**OUTCOMES:**  
On successful completion the students will be able to  
- Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements  
- Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding  
- Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.
UNIT I  PROBABILITY AND RANDOM VARIABLES  9+3
Axioms of probability – Conditional probability – Baye’s theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions - Functions of a random variable.

UNIT II  TWO - DIMENSIONAL RANDOM VARIABLES  9+3
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III  LINEAR PROGRAMMING  9+3

UNIT IV  TRANSPORTATION AND ASSIGNMENT PROBLEMS  9+3

UNIT V  NON - LINEAR PROGRAMMING PROBLEMS  9+3

TOTAL: 60 PERIODS

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COURSE OBJECTIVES:
The course aims to
- Ensure students have a strong grounding in structures and reactions of biomolecules.
- Introduce them to metabolic pathways of the major biomolecules
- Enable the students to understand roles of each nutrients in growth and metabolism

UNIT I INTRDUCtion TO BIOMOLECULES 5
Basic principles of organic chemistry, role of carbon, types of functional groups, biomolecules, chemical nature of water, pH and biological buffers.

UNIT II STRUCTURE AND PROPERTIES OF IMPORTANT BIOMOLECULES 18

UNIT III AN OVERVIEW OF NUTRITION AND ENERGY BALANCE 5
Definition, six classes of nutrients, calculating energy values from food, using the RDA, nutritional status, nutritional requirement, malnutrition, nutritional assessment of individuals and populations, dietary recommendations, Balanced diet planning Diet planning principles, dietary guidelines; Glycemic and Non-glycemic carbohydrates, health effects of fiber and starch intake food groups, exchange lists, personal diet analysis; Digestion, Absorption and Transport Anatomy and physiology of the digestive tract, mechanical and chemical digestion, absorption of nutrients. Energy balance; body weight and body composition; health implications; obesity, BMR and BMI calculations.

UNIT IV VITAMINS AND MINERALS 4
Water Soluble Vitamins B vitamins examined individually (Thiamine, Riboflavin, Niacin, Pyridoxine, Biotin, folate B12, choline, pantothenic acid, and carmine) and in concert; B vitamin deficiencies, toxicities, and food sources; vitamin C roles and recommended intake, deficiency, toxicity and food sources. Fat Soluble Vitamins A, D, E, and K Function, recommended intakes, toxicities, food sources of vitamin A, D, E, and K; Water and Major Minerals Water balance and recommended intakes; fluid/electrolyte balance, acid-base balance; function, recommended intakes, and regulation of sodium, potassium, and calcium. Trace Minerals Food sources, function, recommended intakes, toxicities, deficiencies and transport of iron and zinc; importance of selenium, copper, fluoride, and chromium.

UNIT V INTERMEDIARY METABOLISM AND REGULATION 13
Enzymes, introduction to biocatalysts, metabolic pathways, primary and secondary metabolites. Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt, glycolate shunt, fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, Bioenergetics - High energy compounds, electronnegative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.

TOTAL: 45 PERIODS
Course Outcomes (COs)
At the end of the course the students would have the knowledge to
1. Apply knowledge of nutrition in diet planning.
2. Analyze the dietary recommendations for non-communicable diseases.
3. Assess the quality of proteins and lipids from various sources.
4. Comprehend the physiological and toxicological effects of vitamins and minerals.
5. Apply the learnt techniques to assess the intermediate metabolism in lifestyle.

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TEXT BOOKS:

REFERENCES:

GE3451 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY L T P C 2 0 0 2

OBJECTIVES:
- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.
UNIT I  ENVIRONMENT AND BIODIVERSITY  6

UNIT II  ENVIRONMENTAL POLLUTION  6

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

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

UNIT V  SUSTAINABILITY PRACTICES  6

TOTAL: 30 PERIODS

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

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

REFERENCE BOOKS:

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FD3402 FOOD ADDITIVES AND FLAVOURS

OBJECTIVES:
- To expose the students to the use of different chemical additives in foods during food processing and preservation.
- To make the students understand the flavour compounds involved in development of flavor.
- To make the students understand the analytical techniques involved in flavor analysis.

UNIT I ACIDITY REGULATORS, ANTIOXIDANTS AND ANTIMICROBIAL AGENTS
Acidity Regulators – definition, chemical structure, role and importance, pH modulation and taste, acidity profile, permitted acidity regulators, levels of usage and food applications. Antioxidants - Chemistry of oxidative deterioration of food and its constituents and its effect on the quality; defining antioxidant; water soluble and oil soluble antioxidants and their chemical structure, permitted antioxidants; mechanism of action, permitted levels and food application. Preservatives of chemical and microbial origin; mode of action on spoilage organisms and pathogens, factors affecting the performance of preservatives, active forms of preservatives, necessity in a food and levels of usage; permitted preservatives and food applications. Case studies / illustrations.

UNIT II EMULSIFIERS, STABILIZERS AND THICKENERS
Emulsion, surface tension, oil in water and water in oil emulsion, Hydrophilic and Lipophilic balance (HLB), role of emulsifiers, different classes of emulsifiers and their chemical structure, their HLB values and role in emulsion stabilization; role of different stabilizers and other substances in emulsion stability; emulsion formation process and equipment; measurement of emulsion stability; permitted emulsifiers and stabilizers and food applications. Optimisation of emulsifiers and stabilizers – case study. Thickener – definition, chemical structure, role in food processing and production.
product end characteristics, list of permitted thickeners and food applications.

UNIT III COLORS, FLAVORS, FLAVOR ENHANCERS AND SWEETENERS 9
Color – Natural and synthetic food colors, their chemical structure, shades imparted, stability, permitted list of colors, usage levels and food application. Flavouring agents- natural and synthetic flavourings, Flavours from vegetables, cocoa, chocolate, coffee, vanilla beans and Spices. Evaluation tests for flavours. Stability of flavours during food processing, Extraction techniques of flavours, Flavour emulsions; Essential oils and Oleoresins; Flavour enhancers- Chemical properties, Functions in foods, Glutamate in foods, Biochemicals & Toxicology Sweeteners – list, structure, taste profile, permitted list, usage levels and food applications.

UNIT IV FLAVOUR PERCEPTION AND FLAVOUR ANALYSIS 9
Flavour and taste perception, smell and taste sensation, olfaction, flavour compounds, volatile flavour compounds, chemesthesia and chemesthetic responses, tactile response, Aromacompounds, flavour profile, bio-flavour and reconstituted flavour Subjective versus Objective methods of analysis; psychophysics and sensory evaluation; Instrumental analysis; sample handling and artifacts; data handling.

UNIT V OTHER FOOD ADDITIVES & FOOD INGREDIENTS 9
Anticaking agents, Antifoaming, Glazing agents, Bulkng agents, Humectants, Firming agents, Softening agents, Crystal modifiers, Flour improvers, Flour treatment agents, Dough conditioners, and Enzymes – definition, role and mode of action, permitted list of agents and food application. Proteins, starches and lipids as functional ingredient; isolation, modification, specifications, functional properties and applications in foods.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Comprehend the laws related to food additives for preservation of foods
2. Assess the safety level of food additives as emulsifier and thickening agents
3. Utilize the additives for novel product development.
4. Contribution of different compounds for the development of flavor and Analytical techniques involved in flavor analysis.
5. Analyze the effect of food additives on food matrix.

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TEXTBOOKS:

REFERENCES:

FD3403 HEAT AND MASS TRANSFER IN FOOD PROCESSES LT P C 3 1 0 4

OBJECTIVES
The course aims to enable the students to

• learn the principles and applications of heat and mass transfer operations in food industries.
• understand the mechanisms and concept of heat transfer effectively.
• Investigate the mass transfer operational approaches.

UNIT I HEAT TRANSFER – CONDUCTION 12

UNIT II HEAT TRANSFER – CONVECTION 12
Heat transfer - convection – free and forced convection - factors affecting the heat transfer coefficient in free and forced convection heat transfer – overall heat transfer coefficient - solving problems in foods.

UNIT III HEAT TRANSFER – RADIATION AND HEAT EXCHANGER 12

UNIT IV MASS TRANSFER - DIFFUSION, EVAPORATION AND CONCENTRATION 12
coefficients for gases - molecular diffusion in liquids, solids, biological solutions and gels.

UNIT V MASS TRANSFER – DISTILLATION
Vapour liquid equilibria - Raoult’s law- Principle of distillation - flash distillation, differential distillation, steam distillation, multistage continuous rectification, Number of ideal stages by Mc.Cabe -Thiele method.

TOTAL: 60 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Apply the basic concepts of heat flow.
2. Assess the mode of heat transfer.
3. Discuss the radiation mode of heat transfer.
4. Interpret mass transfer operations in food processing.
5. Elaborate distillation operations.

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TEXT BOOKS:

REFERENCES:

FD3404 PRINCIPLES OF THERMODYNAMICS L T P C
3 0 0 3

OBJECTIVES
The course aims to
• train the students on the basics and applications of energy in Mechanical Engineering
• impart knowledge on thermodynamics and thermal engineering power generating units such as engines and theory of machines

UNIT I BASIC CONCEPTS
Basic concepts - concept of continuum, comparison of microscopic and macroscopic approach.Path and point functions. Intensive and extensive, Total and specific quantities.System and their types.Thermodynamic Equilibrium State, path and process. Quasi_static, reversible and
irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work. P-V diagram.

UNIT II  LAWS OF THERMODYNAMICS  9

UNIT III  PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE  9

UNIT IV  IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS  9

UNIT V  GAS MIXTURES AND PSYCHROMETRY  9
Mole and Mass fraction, Dalton’s and Amagat’s Law. Properties of gas mixture – Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the laws, concepts and principles of thermodynamics.
2. Apply first law of thermodynamics to closed and open systems.
4. Calculate the thermodynamic properties of pure substances, its phase change processes and understand the working of steam boilers.
5. Apprise the working of principles of Carnot, Vapour compression, vapour absorption and air refrigeration systems.
**TEXT BOOKS:**

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**PERSONALITY DEVELOPMENT**

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

**LEADERSHIP**

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

**DISASTER MANAGEMENT**

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

**ENVIRONMENTAL AWARENESS & CONSERVATION**

| EA 1 Environmental Awareness and Conservation | 3 |

**GENERAL AWARENESS**

| GA 1 General Knowledge | 4 |

**ARMED FORCES**

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

**ADVENTURE**

| AD 1 Introduction to Adventure Activities | 1 |

**BORDER & COASTAL AREAS**

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

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

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

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

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

## DISASTER MANAGEMENT  
**DM 1**  
Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation  
3  
**DM 2**  
Initiative Training, Organising Skills, Do's & Don'ts, Natural Disasters, Man Made Disasters  
9  
**DM 3**  
Fire Service & Fire Fighting  
1  

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

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

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

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

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

**TOTAL: 45 PERIODS**

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# NCC Credit Course Level 2*  

**NX3453**  
(AIR FORCE WING) NCC Credit Course Level - II  
**L T P C**  
3 0 0 3  

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

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

## DISASTER MANAGEMENT  
**DM 1**  
Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation  
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**DM 2**  
Initiative Training, Organising Skills, Do's & Don'ts, Natural Disasters, Man Made Disasters  
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**OBJECTIVES**

The course aims to enable the students to practically understand
- Principles behind the qualitative and quantitative estimation of biomolecules.
- The quantitative methods in assessing nutritional status of individuals and groups.

**LIST OF EXPERIMENTS**

1. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
2. Preparation of buffer—titration of a weak acid and a weak base.
3. Qualitative tests for carbohydrates—distinguishing reducing from non-reducing sugars and keto from aldo sugars.
5. Protein estimation by Biuret and Lowry’s methods.
6. Protein estimation by Bradford and spectroscopic methods.
7. Extraction of lipids and analysis by TLC.
8. Enzymatic assay phosphatase from potato.
10. Techniques of measuring height, weight, head, chest and arm circumference, waist to hip ratio, skin-fold thickness, Calculation of percent Body fat using skin folds callipers
11. Calculation of the calories from nutrient composition of foods
12. Comparison of Food Composition data bases

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES (COs)**

At the end of the course the students would have the knowledge to
1. Understand the basic measurement in food processing.
2. Discuss the basic chemical analysis
3. Apply the learnt basic chemistry involved in food testing.
4. Assess the nutritional anthropometry
5. Assess the clinical status of the individuals.
TEXT BOOKS:

REFERENCES:

FD3412                  UNIT OPERATIONS LABORATORY  L T P C
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OBJECTIVE:
•To develop knowledge in handling basic operation equipment’s

EXPERIMENTS:
1. Flow measurement a) Orifice meter b) Venturimeter, c) Rotameter
2. Determination of economy and thermal efficiency of rotary flash evaporator
3. Solving problems on single and multiple effect evaporator
5. Determination of collection efficiency in cyclone separator.
7. Determination of absorption efficiency in a packing tower
8. Determination of porosity, coefficient of friction and angle of repose of grains.
10. Determination of performance characteristics in size reduction using the burr mill.
11. Determination of energy requirement in size reduction using the ball mill and hammer mill.
13. Performance evaluation of a steam distillation process.
14. Visit to a solvent extraction, sugar industry.

Course Outcomes (COs)
At the end of the course the students would have the knowledge to
1. Interpret the application of different types of evaporators and understand the drying of principles.

TOTAL: 60 PERIODS
2. Assess the suitable process technology such as sedimentation, filtration, cyclone and membrane for separation of different particles present in foods.
3. Select the mixing equipment for dry powders, low or high viscosity liquids and acquire knowledge to importance of size reduction and energy requirement.
4. Organize the transformation of raw materials to quality food products using different processing technologies.
5. Apply the mechanism of crystallization and distillation process in food industries.

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FD3513 INDUSTRIAL TRAINING / INTERNSHIP I* L T P C 0 0 0 1

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: 02

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

FD3501 FOOD PROCESSING AND PRESERVATION L T P C 3 0 0 3

OBJECTIVE:
To expose the students to the principles and different methods of food processing and preservation.

93
UNIT I PRINCIPLES OF MASS AND ENERGY BALANCE
Transport phenomena with respect to foods; Factors affecting heat and mass transfer; Study of heat transfer and its application in the design of thermal processes and freezing. Thermal processing; calculation of process time temperature-schedules.

UNIT II CANNING OF FOOD PRODUCTS
Newer methods of thermal processing; batch and continuous; application of infra-red microwaves; ohmic heating; control of water activity; preservation by concentration and dehydration; osmotic methods.

UNIT III DRYING PROCESS FOR TYPICAL FOODS
Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychrometric chart, freezing and cold storage. freeze concentration, dehydrofreezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages.

UNIT IV NON-THERMAL METHODS
Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology.

UNIT V FOOD PACKAGING
Basic packaging materials, types of packaging, packaging design, packaging for different types of foods, retort pouch packing, costs of packaging and recycling of materials.

TOTAL: 45 PERIODS

Course Outcomes (COs)
At the end of the course the students would have the knowledge to
1. Classify the principles of food processing and preservation.
2. Interpret the role of different methods the processing of different foods.
3. Comprehend the impact on the shelf life, quality, and other physical and sensory characteristics of foods.
4. Identify the recent methods of minimal processing of foods.
5. Appraise the materials and types of packaging for foods.

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TEXT BOOKS:
REFERENCES:

FD3502 FOOD ANALYSIS

OBJECTIVES
The course aims to
- expose the students to the principles, methods and techniques of food analysis.
- make the students to handle different chemical and instrumental methods of food analysis.

UNIT I SAMPLING METHODS FOR FOOD ANALYSIS

UNIT II LIPIDS AND PROTEINS ANALYSIS
Determination of Total fat in foods by different methods; Analysis of oils and fats for physical and chemical parameters, Quality standards, and adulterants.
Determination of Proteins Concentration- Colorimetric methods, Determination of Total nitrogen, Spectrophotometric determination; Protein Characterization- Electrophoresis and Isoelectric focussing; Analysis of Protein quality – Protein Efficiency Ratio (PER), Net Protein Utilization (NPU), Biological Value, Protein Digestibility- Corrected Amino acid Score (PDCAAS), In vitro Protein digestibility for C-PER; Measurement of Functional properties of proteins- Protein hydration properties, Surface properties of protein, Protein gel properties. Calculation of proximate and ultimate composition of foods.

UNIT III CARBOHYDRATE ANALYSIS, REFRACTOMETRY AND POLARIMETRY
Refractometry- Basic Principles and Instrumentation, and Applications-Brix Value of Fruit juices, Total soluble solids in fruit products. Carbohydrate analysis- Colorimetric Quantification methods of Mono and Di-Saccharides, HPLC of Mono and D-Saccharides using refractive index detection; Starch- Enzymatic quantification and Determination of Total amylose content; Cell wall polysaccharides-Determination of uronic acid content and β-Glucan content, Degree of Methylation and Acetylation of pectin. Polarimetry- Basic principles, Instrumentation and Applications- Determination of specific rotations of sugars; Estimation of simple sugars and disaccharides.

UNIT IV SPECTROSCOPIC AND CHROMATOGRAPHIC TECHNIQUES IN FOOD ANALYSIS
Spectrophotometry Basic Principles, Spectrophotometric analysis of food additives and food Components -IR Spectroscopy in online determination of components in foods; AAS and ICPAES in mineral elements and toxic metals analysis; use of fluorimeter in vitamin assay- specific use of Tintometer in Vanaspati analysis. Chromatography Basic Principles, Detection of adulterants in foods by paper chromatography and thin layer chromatography, Column chromatography for purification of pigments, Analysis of food additives, phytochemicals and aflatoxins, contaminants and other food components by HPLC, GC analysis of fatty acids, cis, trans Isomers - volatile oils, flavours and pesticides, contaminants and other volatile derivatives of food components; Significance MS detector in HPLC and GC. Ion Exchange Chromatography for amino acid purification, Affinity chromatography for protein purification, Problem solving using chromatogram.
UNITV SENSORY EVALUATION TECHNIQUES

Introduction to quality attributes of food:
- Appearance, flavour, textural factors and additional quality factors;
- Gustation importance of gustation, Mechanism of taste perception, Chemical dimensions of basic tastes - sweet, salt, sour, bitter and umami, Taste measurement - Electronic Tongue;
- Olfaction: definition and importance of odour and flavour, Mechanism of odour perception, Theories of odour classification, chemical specificity of odour, Odour measurement technique - e-nose;
- Colour: importance of colour, Dimensions of colour and attributes of colour and gloss, Perception of colour, Colour Measurement;
- Texture: definition and importance of texture, Phases of oral processing, Texture perception, Rheology of foods, Texture classification, Texture measurement and recent advances in texture evaluation.

Sensor Evaluation Objectives, Type of food panels, Characteristics of panel member, Layout of sensory evaluation laboratory, Sensitivity tests, Threshold value, Paired comparison test, Duo trio test, Triangle test, Hedonic scale.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)

At the end of the course the students would have the knowledge to:
1. Assess the appropriate sampling methods for food analysis.
2. Analyse lipids & proteins for its quality & characteristics.
3. Analyse carbohydrates for its quality & characteristics.
4. Apply spectroscopic & chromatographic techniques for analysis of food components.
5. Apply sensory evaluation technique for food quality analysis.

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TEXT BOOKS:

REFERENCES:
OBJECTIVES:
To develop skills related to
• Preservation of foods
• Use of various techniques and additives for food processing and Preservation

EXPERIMENTS:
1. Heat transfer studies in a plate heat exchanger (Parallel and counter flow)
2. Refrigeration and Freezing of vegetables and fruits
3. Drying of vegetables and fruits with and without additives - Drying rate studies including, constant rate and falling rate periods and the effects of various factors on them.
4. Osmotic drying of foods with salt and sugar.
5. Canning & bottling of vegetable and fruit products
6. Filtration and concentration of fruit juices
7. Production of extruded products.
8. Spray drying of juices/milk
9. Pasteurization of milk
10. Retort processing of foods
11. Determination of Water vapor transmission rate of different packaging materials
12. Determination of migration characteristics of packaging materials
13. Determination of tensile and burst strength of given packaging material

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Demonstrate the food processing in terms of unit operations, both conceptually and in the pilot plant.
2. Apply the mass and energy balances for food processing,
3. Operate the food processing equipment’s at the pilot plant scale.
4. Analyze the effect of processing conditions on safety and quality of resulting food products.
5. Evaluate the properties of food packaging materials.

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REFERENCES:
OBJECTIVES
The course aims to
- Equip students with characterization and estimation of chemical compounds in food for its compliance with standards.
- Learn the analysis of foods for the detection of adulterants in foods.

LIST OF EXPERIMENTS
1. Determination of moisture in spices powder by distillation method and Hot air oven method.
2. Determination of Total fat, protein in milk and milk products.
3. Rancidity test for fried foods to assess primary and secondary oxidative products.
4. Determination of Vitamin C in fruit juices.
   a. Titrimetric method using dichlorophenolindophenol dye
   b. Spectrophotometric method using dinitrophenylhydrazine
   c. HPLC method
5. Extraction and identification of synthetic Food colour in sweets, confectioneries and beverages.
7. Determination of Iodine content in iodized salt.
10. Determination of soluble and insoluble fibre in foods.
11. Detection of adulterants in edible oil and ghee.
12. Column chromatographic separation of carotenoids
13. The identification of sugars in fruit juice using TLC.

TOTAL: 60 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the analysis of foods and food products for chemical components.
2. Learn standards for food products.
3. Obtain knowledge of adulterants in foods.
4. Apply spectroscopic & chromatographic techniques for analysis of food components.
5. Apply sensory evaluation technique for food quality analysis.

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TEXT BOOKS:

REFERENCES:
OBJECTIVES
The course aims to
- Understand basic engineering properties of food.
- Understand different thermal and non-thermal processes used in Food Industry.

UNIT I  PROPERTIES OF FOOD                              11
Engineering properties of food materials - Rheological and textural Properties, Thermal Properties, Thermodynamic Properties, surface and gas exchange properties, electric and dielectric properties
Water activity and states a thermodynamic quantity, water sorption isotherms, hysteresis, theories of sorption hysteresis, water activity measurement methods, water binding, control of water activity and moisture, principles of IMF and their application

UNIT II  SEDIMENTATION AND CENTRIFUGATION               7
The velocity of particles moving in a fluid - terminal velocity - drag coefficient terminal velocity magnitude, Sedimentation - sedimentation equipment, Flotation, Sedimentation of Particles in a Gas Settling Under Combined Forces Cyclones- optimum shape, efficiency Impingement, separators Classifiers, Centrifugal separations - centrifugal force particle velocity Liquid Separation radial variation of pressure radius of neutral zone Centrifuge Equipment

UNIT III  DRYING AND FREEZING                          10
Freezing -Freezing curve for Homogenous and Non-homogenous food system. Freezing point depression, Freezing rate, Effect of freezing Physical and chemical changes in Foods, Enzyme activity, Microbe inactivation and Food quality sensory quality, nutritional aspects, freeze drying and freeze concentration

UNIT IV  THERMAL PROCESSING                           9

UNIT V  FOOD MATERIAL PROCESSING                     8
Membrane processes Ultra filtration, Reverse osmosis, Electrodialysis, per-evaporation and micro filtration – principles - application in food industry, Extrusion - Extrusion cookers - cold extrusion, single and twin-screw extrusion - Low pressure and high-pressure extrusion - properties of Food materials and its significance in equipment design - processing and handling application in food industry; Baking Principles, baked foods, baking equipment; Roasting Principles of roasting, roasting equipment.

Total: 60 Periods

Course Outcomes (COs)
At the end of the course the students would have the knowledge to
1. Apply the knowledge of physical properties of foods during the processing.
2. Evaluate time temperature required to achieve desired shelf life of foods.
3. Explain the principles and current practices of mixing and the effects of processing parameters on product quality.
4. Interpret the encapsulation technology available in the field of processing.
5. Develop novel products using extrusion cooking.
TEXTBOOKS:

REFERENCES:

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

ARMED FORCES
AF 2 Modes of Entry to Army, CAPF, Police 4

COMMUNICATION
C 1 Introduction to Communication & Latest Trends 2

INFANTRY
INF 1 Organisation of Infantry Battalion & its weapons 3

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

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

### NX3652
**NAVAL WING** NCC Credit Course - III

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### NAVIGATION

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### SEAMANSHIP

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### FIRE FIGHTING FLOODING & DAMAGE CONTROL

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**TOTAL : 45 PERIODS**

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## NCC Credit Course Level 3*

### NX3653
**AIR FORCE WING** NCC Credit Course Level - III

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### BASIC FLIGHT INSTRUMENTS

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101
FD3611  FOOD PROCESS ENGINEERING LAB  L T P C  0 0 4 2

OBJECTIVES
The course aims to
• analyse applications of heat and mass transfer principles.
• enable students to develop models for optimization of process conditions for different food application.

LIST OF EXPERIMENTS
2. Rheology of Liquid and Semisolid Foods.
8. Membrane Processing of Liquid Foods.
10. Spray, Drum Drying, Convective Drying of Foods.
12. Microwave Heating of Foods.

COURSE OUTCOMES (COS)
At the end of the course the students would have the knowledge to
1. Understand heat, mass and momentum transfer analysis.
2. Validation of a thermal process
3. Analyze industrial problems along with appropriate approximations and boundary conditions
4. Interpret the encapsulation technology available in the field of processing.
5. Develop novel products using extrusion cooking.

TOTAL: 60 PERIODS
REFERENCES

FD3711 INDUSTRIAL TRAINING / INTERNSHIP II  

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

FD3701 REFRIGERATION AND COLD CHAIN MANAGEMENT

OBJECTIVES:
- To understand the underlying principles of operation in different Refrigeration & cold storage systems and its components.
- To provide knowledge on design aspects of cold storage systems
UNIT I \hspace{1cm} REFRIGERATION PRINCIPLES \hspace{1cm} 9

UNIT II \hspace{1cm} VAPOUR COMPRESSION REFRIGERATION AND COMPONENTS \hspace{1cm} 9
Vapour compression system - refrigeration components – compressor and condenser – types, construction and working - expansion device and evaporators – types, construction and working.

UNIT III \hspace{1cm} REFRIGERANTS AND VAPOUR ABSORPTION CYCLE \hspace{1cm} 9

UNIT IV \hspace{1cm} SHELF – LIFE OF FOOD PRODUCTS \hspace{1cm} 9
Defining overall Shelf-life, remaining shelf life in the context of Chilled & Frozen foods; - Deterioration modes of food items; Models of quality deterioration- Kinetic model; shelf-life model: Q10/q10 model; TTT model for the remaining shelf – life; General procedure for shelf – life testing – the 11 steps procedure.
Storge of frozen foods; - Basic design requirements of storage to uphold the shelf –life – size , insulation, entry –exit position, palletization, proper disk-space for air-circulation, automatic door – closing, proper lighting, temperature monitoring and recording facility; stacking systems, emergency exits, material handling devices like fork-lifts, pallet trucks, etc floor heaters, vapour barriers, etc.

UNIT V \hspace{1cm} COLD CHAIN \hspace{1cm} 9
What is cold chain? Need for the chain for chilled / frozen food item, various links of the chain; importance of shelf- life; just – in-time deliveries; Temperature limits;in various countries-Europe, US, Australia etc; Chilling and freezing:- Chilling injury, cook-chilling systems; cold – shortening; PPP and TTT concepts; Temperature monitoring; -Critical temperatures; Temperature –time indicators(TTI); Time –temperature –correlation-the kinetic approach, effective temperature; Transportation regulations; Role of packaging in cold chain– MAS, MAP, CAS, CAP etc; Thaw indicators.

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Illustrate the fundamental principles and applications of refrigeration system.
2. Obtain cooling capacity and coefficient of performance by conducting test on vapour compression system.
3. Present the properties, applications and environmental issues of different refrigerants.
4. Demonstrate the predictive modelling for shelf life assessment of foods.
5. Identify challenges to the future of food retailing as well as challenges in international food supply chains.

TOTAL: 45 PERIODS
FD3702 FOOD PLANT EQUIPMENT DESIGN

OBJECTIVES
The course aims to
- understand the engineering properties of different materials for the development of food plant equipment
- understand the design of different processing requirement for food industry.

UNIT I MATERIALS AND PROPERTIES
Materials for fabrication, mechanical properties, ductility, hardness, corrosion, protective coatings, corrosion prevention linings equipment, choice of materials, material codes

UNIT II DESIGN CONSIDERATIONS
Stresses created due to static and dynamic loads, combined stresses, design stresses and theories of failure, safety factor, temperature effects, radiation effects, effects of fabrication method, economic considerations

UNIT III DESIGN OF STORAGE VESSEL AND EXCHANGERS
Design of pressure and storage vessels Operating conditions, design conditions and stress; Design of shell and its component, stresses from local load and thermal gradient, mountings and accessories.
UNIT IV  DESIGN OF DRYER, FREEZER AND FERMENTERS  9
Design of freezing equipment Design of icecream freezers and refrigerated display system Design of dryers Design of tray dryer, tunnel dryer, fluidized dryer, spray dryer, vacuum dryer, freeze dryer and microwave dryer Design of fermenters Design of fermenter vessel, design problems

UNIT V  EXTRUDERS AND EQUIPMENT SAFETY  9
Extrusion cookers - cold extrusion, single and twin screw extrusion- Low pressure and high pressure extrusion - properties of Food materials and its significance in equipment design - processing and handling - Cold and hot extruder design, design of screw and barrel, design of twin screw extruder. Hazards in process industries, analysis of hazards, safety measures, safety measures in equipment design, pressure relief devices

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Analyse the engineering properties of different materials for the development of food plant equipment
2. Determine the design and economic considerations
3. Design the storage vessels and exchangers
4. Design the dryers, freezers, fermenters and extruders
5. Demonstrate the hazards in process industries and safety measures in equipment design

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TEXTBOOKS:

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

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

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

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

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

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

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

TOTAL: 30 PERIODS

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

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

FD3811 PROJECT WORK / INTERNSHIP# L T P C 0 0 20 10

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.

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.

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

COURSE OBJECTIVES:
- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business.
UNIT I  INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

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.

TOTAL: 45 PERIODS

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

TEXT BOOKS:

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GE3752 TOTAL QUALITY MANAGEMENT L T P C
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COURSE OBJECTIVES:
Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM. Explain the TQM Principles for application. Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA. Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR. Illustrate and apply QMS and EMS in any organization.

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

UNIT II TQM PRINCIPLES

UNIT III TQM TOOLS & TECHNIQUES I

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

UNIT V QUALITY MANAGEMENT SYSTEM

TOTAL: 45 PERIODS

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

GE3753 ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING L T P C 3 0 0 3

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 9
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 9

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

UNIT IV FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT) 9
Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative
UNIT V  CAPITAL BUDGETING (ELEMENTARY TREATMENT)  9
Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.

TOTAL: 45 PERIODS

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

TEXT BOOKS:

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

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GE3754  HUMAN RESOURCE MANAGEMENT  L T P C

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
The importance of human resources – Objective of Human Resource Management - Human
resource policies - Role of human resource manager.

UNIT II            HUMAN RESOURCE PLANNING
Importance of Human Resource Planning – Internal and External sources of Human Resources -
Recruitment - Selection – Socialization.

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

UNIT IV            EMPLOYEE COMPENSATION
Compensation plan – Reward – Motivation – Career Development - Mentor – Protege
relationships.

UNIT V            PERFORMANCE EVALUATION AND CONTROL
Performance evaluation – Feedback - The control process – Importance – Methods – grievances –
Causes – Redressal methods.

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

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GE3755            KNOWLEDGE MANAGEMENT
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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TEXT BOOK:
REFERENCE:

GE3792 INDUSTRIAL 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:

REFERENCES:

MAPPING OF COS AND POS:
OBJECTIVES:

- To impart the basic knowledge on all aspects of milk components.
- To understand microbiology of dairy products, significance of different food microorganisms, their control and other related aspects.
- To Provide insights on the quality control in relation to dairy industry and impart basic knowledge on all aspects of chemical quality assurance.
- To impart the advanced knowledge on the use of analytical techniques in Dairy Chemistry and microbiology.

UNIT I
CHEMISTRY OF MILK PROTEINS AND LIPIDS

Major milk proteins: caseins (acids and micellar), methods of isolation; fractionation of casein and heterogeneity, physico-chemical properties, glycosylation, phosphorylation, amino acid composition, primary and secondary structure of different fractions; casein micelle models; Distribution and fractionation of different nitrogen fractions of milk proteins; Denaturation of milk proteins, various factors affecting denaturation; casein-whey protein interactions. Milk lipids: classification, gross composition and physical properties; neutral and polar lipids and their role in milk and milk products. Fatty acids profile: composition, properties and factors affecting them. Unsaponifiable matter: composition with special reference to sterols and fat-soluble vitamins and carotenoids, chemistry, physiological functions and levels of milk.

UNIT II
CHEMISTRY OF MILK CARBOHYDRATES, VITAMINS, AND MINERALS

Lactose: occurrence, isomers; molecular structure, Physical properties: crystalline habits; hydrate; lactose glass; equilibrium of different isomers in solution; solubility; density sweetness; Chemical properties: hydrolisis; pyrolysis; oxidation; reduction; degradation with strong bases; derivatives, dehydration and fragmentation browning reaction; oligosaccharides in milk Minerals: major and minor minerals; factors associated with variation in salt composition Physical equilibrium amongst milk salts; partitioning of salt constituents and factors affecting it; effect of various treatments on salt equilibrium, Salt balance and its importance in the processing of milk; protein mineral interactions; distribution and importance of trace elements in milk; Water soluble vitamins: thiamine; riboflavin; niacin; pantothenic acid; pyridoxine; biotin; folacin (folic acid) and cyanocobalamnin; Molecular structure; levels in milk and milk products; biological significance; factors affecting their levels; ascorbic acid structure; relation to Redox potential (Eh) of milk and milk products.

UNIT III
MICROBIOLOGY OF PROCESSED DAIRY FOODS

Introduction to microbes in processed dairy foods, history and development of processed foods. Microorganisms important in processed foods: spoilage and pathogens, Food borne new emerging pathogens, Microbial ecology of processed foods and food ecosystem, biofilm formation, Factors influencing microbial growth in foods: Intrinsic factors, Extrinsic factors. Rapid assessment of dairy food for microbial and non-microbial contaminants; Enumeration principles in detection methods of predominant spoilage organisms, pathogens and indicator organisms like, E.coli, Salmonella, Shigella, Staphylococcus aureus, Bacillus cereus.

UNIT IV
ANALYTICAL TECHNIQUES IN DAIRY CHEMISTRY AND MICROBIOLOGY

Electrophoresis: principle and types, isoelectric focussing. Column Chromatography, TLC, GLC, HPLC, gel-permeation, ion-exchange, affinity chromatography Spectrophotometry: UV, visible, IR and flame photometry; potentiometry: principle, various electrodes; buffers. Immunobased analytical techniques such as ELISA & Lateral flow assay Separation of bio-molecules using membranes; ultracentrifugation.

UNIT V
CHEMICAL QUALITY ASSURANCE IN DAIRY INDUSTRY

Concept of quality assurance and quality control in relation to dairy industry; quality management
systems - ISO 9000; total quality management (TQM); hazard analysis of critical control points (HACCP); good manufacturing practices (GMP); role of international organisations such as ISO: IDF; CAC; AOAC; WTO and national organisations like BIS; CCFS; Good laboratory practices (GLP); laboratory Accreditation PFA and Agmark; significance of milk and milk products order (MMPO) and APEDA (Agricultural and Processed Foods Export Development Authority) in dairy industry; Instrumentation in analysis of milk and milk products; detection of adulterants in milk and milk products; Quality of packaging material for dairy products, Chemical contaminants /residues: pesticides; antibiotics; heavy metals; radionuclides etc. in dairy products.

**TOTAL:** 45 PERIODS

**Course Outcomes (COs)**
At the end of the course the students would have the knowledge to
1. Describe the composition of milk, physicochemical characteristics of the main components and identify the beneficial and spoilage microorganisms.
2. Apply advanced analytical techniques to understand the various chemical and microbiological components.
3. Integrate the knowledge of food chemistry/engineering/microbiology and physical properties of foods with processing of dairy products.
4. Apply the analytical techniques in Dairy Chemistry and microbiology

**TEXTBOOKS/REFERENCES**
6. ISI Handbook of Food Analysis S.P. 18 (Part II) Dairy Products. 1981 ISI Specifications (concerned) (ISI)

**FD3002 PROCESSING OF DAIRY PRODUCTS**

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**UNIT I EVAPORATION & MIXING**
Basic principles of evaporators, construction and operation, Different types of evaporators used in dairy industry, Calculation of heat transfer area and water requirement of condensers, Basic concepts of multiple effect evaporators, Operations and various feeding systems, Economy of operation, Thermo processor and MVR system, Care and maintenance of evaporators.

**UNIT II DRYING**
Introduction to principle of drying, Equilibrium moisture constant, bound and unbound moisture, Rate of drying- constant and falling rate, Effect of Shrinkage, Classification of dryers-spray and
drum dryers, spray drying, etc., air heating systems, Atomization and feeding systems. Factors affecting bulk density of power, spray dryer controls, Theory of solid gas separation, cyclone separators, Bag Filters, Care and Maintenance of drum and spray dryers. Fluidization: Mechanisms of fluidization characteristics of gas-fluidization systems, Minimum Porosity, Bed Weight, Pressure drop in fluidized bed, Application of fluidization in drying, Batch fluidization, Fluidized bed dryers.

UNIT III PROCESSING EQUIPMENTS

UNIT IV MECHANICAL SEPARATION
Fundamentals involved in separation. Sedimentation, Principles involved in filtration, Types, rates of filtration, pressure drop calculations. Gravity setting, principles of centrifugal separation, different types of centrifuges. Application in Dairy Industry, clarifiers, tri processors, cream separator, self-desludging centrifuge, cold and hot separators: Bactofuge, in-line standardization system, care and maintenance of separators and clarifiers. Homogenization: Classification, single stage and two stage homogenizer pumps, power requirement, care and maintenance of homogenizers, aseptic homogenizers.

UNIT V THERMAL PROCESSING
Pasteurization: Batch, flash and continuous (HTST) pasteurizers, Flow diversion valve, Pasteurizer control, Care and maintenance of pasteurizers. Sterilization: Different type of sterilizers, in bottle sterilizers, autoclaves, continuous sterilization plant, UHT sterilization, Aseptic packaging and equipment. Care and maintenance of Sterilizers. Packaging machines: Pouch filling machine pre-pack and aseptic filling bulk handling system Principles and working of different types of bottle filters and capping machine, Blow molding machines, Aseptic PET bottle filling machine. Cup filling system. Care and maintenance.

Course Outcomes (COs)
At the end of the course the students would have the knowledge to
1. Understand the composition of milk and physical and chemical properties of milk
2. Apply the principles of different thermal processing of milk
3. Apply the principles and process of Homogenization and cream separation in milk processing
4. Analyse the process flow for the preparation of different dairy products.
5. Analyse the process and equipments used for the manufacturing of ice-cream and milk powder production

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TEXT BOOK
FD3003 VALUE ADDED DAIRY PRODUCTS L T P C 3 0 0 3

OBJECTIVE

- To project the significance and status of traditional and value added dairy products in Indian dairy industry.
- To explain the current status of traditional milk products in India. Place of milk products in the dietary regime in Indian population.

UNIT I NATIVE DAIRY PRODUCTION 9

UNIT II HEAT ACID COAGULATED PRODUCTS 9

UNIT III THERMALLY PROCESSED MILK COMMODITY 9

UNIT IV MILK CHEESE CURD-BASED BY-PRODUCTS 9

UNIT V CONVENIENT TRADITIONAL DAIRY PRODUCTS & NEW PACKAGING TECHNOLOGIES 9

TOTAL:45 PERIODS
COURSE OUTCOMES (COs)

At the end of the course the students would have the knowledge to

1. Understand common terminology used in packaging of milk and milk products.
2. Assess how to increase the selling of milk and milk products by attractive packages.
3. Analyse how to increase products claim in market by using different package techniques, and legal requirements.
4. Discuss methods sterilization and traditional way of processing the value-added milk products.
5. Distinguish the importance of coding and labelling of packages.

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TEXTBOOKS/REFERENCES


FD3004 PRECISION FERMENTATION FOR DAIRY ALTERNATIVES

OBJECTIVES:

- To introduce the basics of fermentation for plant based ingredients.
- To give insights on precision fermentation

UNIT I FERMENTATION BASICS

Fermentative products - enzymes, flavoring agents, vitamins, natural pigments, and fats. Benefits of precision fermentation based dairy alternatives over plant based dairy alternatives

UNIT II DAIRY & FERMENTED DAIRY PRODUCTS

Dairy products, texture, physico-chemical property, functional properties, Probiotic delivering
ability, Sensorial features, geography specific dairy products.

UNIT III  CRITICAL CONSIDERATIONS IN PRECISION FERMENTATION  9
Critical considerations in precision fermentation, Target selection and design, strain development, feedstock optimization strategies, Applications of food bio-informatics, AI, ML for food ingredient discovery, bio-mimicry strategies in precision fermentation.

UNIT IV  PRE-REQUISITES IN PRECISION FERMENTATION  9
Bioprocess design, feed stock identification for commercial application, Safety and standard regulations, Regulatory approval bodies, Ethical considerations.

UNIT V  PRECISION FERMENTATION PRODUCTS AND APPLICATION IN ALTERNATE DAIRY PRODUCT DEVELOPMENTS  9

TOTAL:45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the concepts, principles and procedures involved in the fermentation of plant based products.
2. Acquire knowledge to fermented dairy products
3. Examine the precision fermentation technology.
4. Assess the basics of fermentation for plant based ingredients and insights on precision fermentation

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TEXTBOOKS/REFERENCES
1. Microbiology and Technology of Fermented Foods by Robert W. Hutkins, Blackwell Publishing TP371.44 .H88 2006eb ebook
OBJECTIVE

- To impart knowledge on different types of cheese production
- To provide insight of both pre and post coagulation techniques in cheese production.
- To impart knowledge about the cheese ripening metabolism

UNIT I INTRODUCTION 9
Introduction – origin of cheese production, scope & status of cheese manufacturing in India, types of cheese, milk and starter culture quality in cheese production. Additives used in cheese processing. Nutritional aspects of cheese.

UNIT II PRETREATMENT OF CHEESE MILK 9

UNIT III CHEESE RIPENING CHEMISTRY 9

UNIT IV CHEESE PRODUCTION 9
Manufacture of Mozzarella, Cheddar, Gouda, Swiss, Cottage, Blue, & Processed cheese, cheese spread and processed cheese foods. Cheese from different milk sources – goat, Ewe, buffalo. Mechanization and automation in cheese processing.

UNIT V MICROBIAL PATHAGEN AND MYCOTOXIN IN CHEESE 9
Introduction – growth and survival of bacterial pathogens, Production of toxins in cheese, growth and survival of mold. Factor influencing the microbial spoilage of cheese. control measure for microbial contamination in cheese.

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the concepts, principles and procedures involved in the fermentation of plant-based products.
2. Acquire knowledge to fermented dairy products
3. Assess the precision fermentation technology.
4. Evaluate the insights coagulation techniques in cheese production and cheese ripening metabolism

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TEXTBOOKS/REFERENCES

FD3006  INNOVATIVE PACKAGING OF DAIRY PRODUCTS  L T P C
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UNIT I  INTRODUCTION

UNIT II
Working principles of various type batch type filling machine, working principles of FFS machine, Identification of packaging materials; Flame Hot wire test, Testing of papers/ paperboards: Percentage moisture, Grease resistance, Water absorbiveness, Grammage, Tearing resistance, Bursting strength, Testing of glass bottle – resistance to thermal shock, Testing of plastics and laminates – Thickness, Water vapour transmission rate (WVTR), Grease resistance

UNIT III
Packaging of milk and dairy products such as pasteurized milk, UHT-sterilized milk, aseptic packaging, fat rich products-ghee and butter, coagulated and desiccated indigenous dairy products and their sweetmeades, concentrated and dried milks including baby foods. Packaging of functional dairy/food products.

UNIT IV
Modern Packaging Techniques; Vacuum Packaging, Modified atmosphere packaging (MAP), Eco-friendly packaging, Principles and methods of package sterilization, Coding and Labelling of Food packages, Aseptic Packaging (AP), Scope of AP and pre-requisite conditions for AP, Description of equipments (including aseptic tank) and machines- Micro-processor controlled systems employed for AP, Package conditions and quality assurance aspects of AP

UNIT V
Microbiological aspects of packaging materials. Disposal of waste package materials, Packaging Systems. Hazards from packaging materials in food

TOTAL:45 PERIODS

TEXTBOOKS/REFERENCE BOOKS
OBJECTIVES:
- To familiarize the concepts of quality control and safety management in dairy processing.
- To impart knowledge on the microbiological risk analysis specific to dairy products.
- To explain the role of biosensors in the quality control of dairy industry.
- To brief the dairy plant and equipment hygiene practices.

UNIT I INTRODUCTION
Consumer Awareness about Microbiological Quality and Safety of Dairy Foods: Changing scenario; Concepts of quality control, quality assurance and food safety; Global quality and food safety standards, integrated food law, its main features and functions.

UNIT II FOOD SAFETY MANAGEMENT SYSTEM IN DAIRY INDUSTRY

UNIT III MICROBIOLOGICAL RISK ANALYSIS
Risk assessment, risk management and risk communication; risk profiling of dairy products; Microbiological criteria and two and three class sampling plan / guidelines; Bio-safety concepts in handling of dairy pathogens and setting up of a microbiological/ pathogen lab in a dairy plant. Rapid Enumeration Techniques: Enumeration principles and procedure for rapid detection of predominant hygiene indicator organisms and pathogens like E. coli (E. coli 0157:H7), Salmonella, Shigella, Staphylococcus aureus, Bacillus cereus and Listeria monocytogenes.

UNIT IV BIOSENSORS IN DAIRY QUALITY ANALYSIS
Role of Biosensors for monitoring hygiene and safety of dairy foods: Detection of antibiotic residues in milk – Delvo SP, MDR test, penzyyme test, charm assay, lateral flow assay (ROSA test) etc. Detection of aflatoxins, pesticides other inhibitors etc. and their public health importance in dairy foods.

UNIT V PLANT AND EQUIPMENT HYGIENE
Concepts of hygiene and sanitation, microbial quality of water and environmental hygiene in dairy plant, chlorination of dairy water supply, quality of air, personnel hygiene, treatment and disposal of waste water and effluents.

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the concepts of quality control and safety management in dairy processing
2. Appraise the microbiological risk analysis of dairy products
3. Conceive the role of biosensors in the quality control of dairy industry
4. Apply the dairy plant and equipment hygiene practices

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TOTAL: 45 PERIODS
TEXTBOOKS/REFERENCES

FD3008 INTRODUCTION TO FOOD BIOTECHNOLOGY

OBJECTIVES
The course aims to
- acquaint with the fundamentals of biotechnology in relation to raw materials for food processing.
- enable the students to learn about food fermentations, waste utilization and use better genetic resources in food industry.

UNIT I FOOD BIOTECHNOLOGY
Fermentative production of enzymes used in food industry; solid state fermentation; recovery of enzymes from natural sources; cheese making and whey processing, impact of enzyme technology (bioethanol, protein hydrolysates, bioactive peptides); enzymatic processing of fruit juices. Role of enzymes in baking, meat and meat processing; comparative methods of toxicity test in (novel) foods; biosensors; enzymatic approach to tailor made fats; catabolic processes and oxygen-dependent reactions in food; use of lipases and reactions in organic solvents and two phases

UNIT II OVERVIEW OF GENETICS
Chemical structure of nucleic acids, proteins; introduction to Genetics, DNA replication, transcription and translation; cell division, cell cycle, mitosis, meiosis; introduction to human genetics; Mendelian genetics; single cell disorders; complex traits; mutation, types of mutations DNA repair mechanism; modifying enzymes; mutation and polymorphism and their detection; family based and case control study designs; pedigree analysis; linkage analysis and association studies.

UNIT III GENETIC ENGINEERING
Overview of recombinant DNA technology and its applications. Characteristics and importance: Cloning vector and expression vector, Transformation, Transfection and Transduction – Principle and differences. Plasmid vector: Cloning site, Selection, Screening, PCR, RT-PCR, electrophoresis, electro blotting and capillary blotting, applications to produce genetically modified foods

UNIT IV CELL CULTURE TECHNOLOGY
Introduction to plant and animal tissue cultures and cell cultures in general. Cell culture lab design and equipment, Media and reagents. Animal, mammalian, and other cell lines for in-vitro testing of drugs, toxicity of environmental pollutants, production of vaccines and therapeutic proteins & production of stem cells. Principles of cryobiology and molecular diagnostics, Technological aspects for commercial utilization of cell cultures: Reactor studies, scale up and biosafety.

UNIT V TRANSGENIC TECHNOLOGY & APPLICATIONS IN FOODS
DNA microinjection, Retroviral vectors, Transgenic animals – Knock in and knock out animals, Transgenic plants – Ti plasmid. Genetically engineered proteins Bovine Somatotropin in Milk;
Genetically engineered bacteria Chymosin Lite beer; Tryptophan; Transgenic plants CalgeneFlavrSavrTM tomato, Monsanto Round-Up TM Ready, Ciba Geigy Basta TM resistant crops; Edible vaccines Cholera vaccine in potatoes; Transgenic Fish Atlantic salmon.

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Apply the principles of biotechnology in Food processing industries to improve the quality of foods
2. Execute the production of commercially important metabolites
3. Apply the principle of downstream processing and explain various stages involved in downstream processing
4. Evaluate the diagnostic techniques for food borne pathogens and toxins
5. Assess the safety aspects and social issues related to applications and implications of genetically modified foods

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TEXTBOOKS
4. Oliver Brandenberg, Zephaniah Dhlamini, Alessandra Sensi, Kakoli Ghosh and Andrea.

REFERENCES
extraction of oil.

- To analyze the role of specific enzymes in processing of meat, seafood and poultry products, waste management, animal feed industry.
- To analyze the role of specific enzymes as biosensors, additives, in packaging, and describe the concept of recombinant enzymes and safety of enzymes.

UNIT I  INTRODUCTION TO ENZYMES  9

UNIT II  ENZYMES IN FOOD INDUSTRY  9
Introduction to enzymes used in Food industry, Objectives of using enzymes in food processing and in food product development, Merits and demerits of using enzymes, Sources of enzymes, Microbial enzymes and their advantages/ disadvantages. Commercially important enzymes used in Food industry and their mode of action, Overview of applications of enzymes in the Food industry, Newer enzymes and their actual and potential applications. Fermentative production of enzymes used in food industry by SSF or SmF, Recovery and purification of enzymes.

UNIT III  ENZYME APPLICATIONS IN FOODS  9
Use of enzymes in: Dairy, Bakery, Brewery, Fruit and Vegetable Processing, Plantation Products, Starch industry and confectionery, Protein hydrolysis for protein hydrolysate and bioactive peptides, Oilseeds processing, formation of TAGs, extraction of fish oil, meat, seafood (surimi product), poultry, eggs, treatment of wastes from food industry, flavor biotransformations.

UNIT IV  APPLICATIONS OF ENZYMES IN FEED INDUSTRY  9
The benefits of supplementation of exogenous enzymes to feed. Use of enzymes in poultry and animal feed.

UNIT V  ADVANCES IN UTILIZATION OF ENZYMES  9
Enzymes in biosensors, Enzymes as additives e.g. antioxidant or antimicrobial, Novel food applications of enzymes. Enzymes in active packaging and in edible coatings and films, safety of enzymes used in foods, food grade enzymes, Immobilization of enzymes for food applications, Recombinant enzymes from GMO.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to

1. Highlight the action and mechanism of microbial enzymes and fermentative production of enzymes followed by isolation and purification.
2. Analyze the role of specific enzymes in the processing of dairy, bakery, brewery, fruit and vegetable products, plantation crops.
3. Analyze the role of specific enzymes in starch industry, confectionary, protein hydrolysis, extraction of oil.
4. Analyze the role of specific enzymes in processing of meat, seafood and poultry products, waste management, animal feed industry.
5. Analyze the role of specific enzymes as biosensors, additives, in packaging, and describe the concept of recombinant enzymes and safety of enzymes.
TEXTBOOKS

FD3010 FOOD FERMENTATION TECHNOLOGY

OBJECTIVES
The course aims to
• impart knowledge and skills related to process technologies in fermented food products
• learn about the different equipment used for the production of various fermented food products.

UNIT I HISTORICAL PERSPECTIVE OF FOOD FERMENTATION
History of food fermentations; types of fermented foods and substrates/raw materials used, traditional fermented foods, biotransformation of raw materials

UNIT II FERMENTING ORGANISMS AND THEIR ROLE
Principles of food and industrial fermentations; microorganisms of importance in food fermentations, Biochemistry of fermentations/fermentation pathways. Lactic Acid Bacteria and starter cultures (Taxonomy, ecology, physiology, genetics and biotechnology, phage control) Brewers and Bakers yeasts, Yeast starter culture maintenance, Moulds used in food fermentations; Genetic manipulation of fermenting microbes, Strain specific traits

UNIT III TECHNOLOGY OF FERMENTED FOODS
Dairy fermentations - Yeast fermentations - Wine and beer fermentations, bread making, Mould fermentations – soy based fermented foods – miso, tempeh, soy sauces Manufacture of cheese, yoghurt, wine, beer, bread, soy sauce; processes and equipment used for manufacture; bottling / packaging, aging, storage and shelf life of fermented foods; Prevention of spoilage of fermentations.

UNIT IV PRODUCTS OF MIXED FERMENTATIONS
Meats, sausages, fish sauces, sauerkraut, idli, Manufacture of different types of sausages, fish sauces, sauerkraut, idli batter- processes and equipment used for manufacture; packaging, aging, storage and shelf life of the products; Prevention of spoilage of fermentations.

UNIT V OTHER PRODUCTS FROM FERMENTATION
Fermentation production of flavor components, acids, alcohol, enzymes, pigments/colours.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1 Understanding concepts, principles and procedures involved in the area of fermented food production.
CO2 Familiarizing with different fermenter types and their design criteria.

TEXT BOOKS
OBJECTIVE
The course aims to:

- Introduce the dynamic response of open and closed loop systems, control loop components and stability of control systems.
- Learn instrumentation for the measurement of key process variables in food processing
- Update the applications of sensors in food processing Industry

UNIT I OPTICAL SPECTROSCOPY

UNIT II CHROMATOGRAPHY

UNIT III STRUCTURAL ELUCIDATION

UNIT IV MASS SPECTROMETRY

UNIT V ELECTROCHEMICAL MEASUREMENTS
Different types of electrochemical apparatus – Measuring Electrode potentials- Red-Ox proteins – Porous Silicon.

TOTAL: 45 PERIODS

COURSE OUTCOME:
CO1 To provide to the students the fundamentals of instrument knowledge and their applications in biology.

TEXTBOOKS
FD3012 FOOD ALLERGENS AND TOXICOLOGY

OBJECTIVES
The course aims to
• familiarize with hazards, and toxicity associated with food and their implications for health.
• know the various kinds of allergens and basis of allergic reactions • familiarize with various natural toxins in food.

UNIT I  INTRODUCTION
Definition and need for understanding food toxicology; Hazards - Microbiological, nutritional and environmental. Basics of immune resources - humoral and cell media resources. Allergen and mechanism of allergic resources.

UNIT II  FOOD ALLERGY AND SENSITIVITY
Chemistry of food allergens, celiac disease, food disorders associated with metabolism, lactose intolerance, and asthma

UNIT III  PRINCIPLES OF TOXICOLOGY
Natural food toxicants - toxicity of mushroom alkaloids, seafood, vegetables, fruits, pulses, and antinutritional compounds. Biological factors that influence toxicity, toxin absorption in the G.I.tract, Industrial microflora, blood, brain barrier, storage and excretion of toxins

UNIT IV  DETERMINATION OF TOXICANTS IN FOOD SAMPLING
Quantitative and qualitative analysis of toxicants in foods; Biological determination of toxicants Assessment of food safety – Risk assessment and risk benefit indices of human exposure, acute toxicity, mutagen city and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioural effect, immunotoxicity.

UNIT V  TOXICANTS FORMED DURING FOOD PROCESSING
Intentional direct additives, preservatives, nitrate, nitrite, and N- nitroso compound flavour enhancers, food colours, indirect additives, residues and contaminants, heavy metals, other organic residues and packaging materials. Toxicity of heated and processed foods, food carcinogens and mutagens - Polycyclic aromatic hydrocarbons, N - nitrosamines, Acrylamide and their mode of action

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Find the hazards and the toxicity associated with food and their implications for health
2. Analyse the chemistry of food allergens and disorders associated with food
3. Assess the risk and exposure of toxins in food sampling
4. Determine the toxicants in foods by the qualitative and quantitative analysis
5. Critique the formation of toxins during post harvest processing or else during storage

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TEXTBOOKS

REFERENCES

FD3013 GENETIC ENGINEERING AND GENETICALLY MODIFIED FOODS

OBJECTIVES:
Introduction to GM foods and their methods of production, advantages
• To study genetically modified plants which are commercially available
• To study transgenic animals and their engineering method
• To understand genetically modified microorganisms and their applications in foods
• To know about Pharmaceutical applications of genetically engineered plants
• To understand Risk and safety assessment of the GM foods and their labeling

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY
Manipulation of DNA and RNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction of recombinant DNA in to host cells and selection methods.

UNIT II DNA LIBRARIES
Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Screening of DNA libraries using nucleic acid probes and antisera.

UNIT III SEQUENCING AND AMPLIFICATION OF DNA
Maxam Gilbert’s and Sanger’s methods of DNA sequencing. Inverse PCR, Nested PCR, AFLP PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, inverse PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

UNIT IV TRANSGENIC TECHNOLOGY
DNA microinjection, Retroviral vectors, Transgenic animals – Knock in and knock out animals, Transgenic plants – Ti plasmid.

UNIT V APPLICATIONS OF RDNA TECHNOLOGY IN FOODS
Genetically engineered proteins: Bovine Somatotropin in Milk; Genetically engineered bacteria: ChymosinLite beer; Tryptophan; Transgenic plants: Calgene Flavr Savr TM tomato, Monsanto Round-Up TM Ready, Ciba GeigyBasta TM resistant crops; Edible vaccines: Cholera vaccine in potatoes; Transgenic Fish: Atlantic salmon.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Better understanding of genetically modified plants, animals and modified microorganisms
2. Familiarize in Pharmaceutical applications of genetically engineered plants
3. Obtain knowledge in Risk and safety assessment of the GM foods and their label.
4. Apply the genetically modified microorganisms and their applications in foods

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**TEXTBOOKS**

**REFERENCE**

FD3014 FUNCTIONAL FOODS AND NUTRACEUTICALS

**OBJECTIVES:**
- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease

**UNIT I INTRODUCTION AND SIGNIFICANCE**
Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoo chemicals and microbes in food, plants, animals and microbes.

**UNIT II ANALYSIS OF PHYTOCHEMICALS**
Qualitative and quantitative methods: phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, Chitin; Carotenoids - Factors affecting bioavailability, chemical and histochemical characterization of cell wall polysaccharides in almond seed in relation to lipid bioavailability.

**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, 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**
Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and symbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.
UNIT V        SAFETY ISSUES
Health Claims, regulations and safety issues- International and national.

Course Outcomes (COs)
At the end of the course the students would have the knowledge to
1. Understand the basics of nutraceuticals and phytochemicals
2. Analyse the soluble component of food products using qualitative and quantitative methods
3. Evaluate the methods used for assess the activity of antioxidants
4. Apply and analyse the role of Nutraceuticals and Functional foods in health aspects
5. Apply the suitable food safety regulations in food industry sector for getting healthy food

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TEXT BOOKS
5. Tipnis, H.P. “Bioavailability and Bioequivalence : An Update” New Age International,

REFERENCES

FD3015       INTRODUCTION TO MEAT, MARINE , POULTRY
UNIT I        INTRODUCTION TO MEAT INDUSTRY
Scope of meat & meat products industry in India, Sources of meat and meat products in India, its importance in national economy; Effect of feed, breed and management on meat production and quality

UNIT II      INTRODUCTION TO POULTRY
Definition of Poultry, Importance of Poultry Farming, and Poultry development in India. Present status and future prospectus of poultry Industry. Origin of the chicken and Classification of Poultry based on Genetics utility. Classification of chicken as per international standards. Commonly Occurring Anti-Nutrients, and Antibiotics in Poultry Feed Ingredients and its Effect on Egg and
Meat Nutrition.

UNIT III        INTRODUCTION TO SEA FOOD  
Introduction, Seafood spoilage, Seafood hazards, Pre-mortem handling, Post-mortem handling.

UNIT IV      SLAUGHTERING OF ANIMALS AND POULTRY  
Common and commercially important meats; pre and post slaughter handling, meat inspection and grading; animal welfare and safety in slaughter plant; Factors affecting post-mortem changes, properties and shelf-life of meat; Meat quality evaluation; Mechanical deboning, meat tenderization.

UNIT V        RECENT TRENDS IN MEAT PROCESSING  

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand different variety of meats and its handling.
2. Familiarize with the concept of meat processing.
3. Get insights into basics of marine food processing.
4. Understand the basics of poultry processing.
5. Discuss egg processing and its related aspects.

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TEXT BOOKS

REFERENCES
UNIT I INTRODUCTION
Types of Meat and its sources, composition, structure, of meat and meat products. Definition of muscle and Composition of muscle. Different types of stunning methods. Different types of slaughtering methods, Chemical and biochemical constitution of muscle - Factors reflected in specialized muscle function and constitution, The conversion of muscle to meat - Preslaughter handling, Death of the anima, ageing.

UNIT II SLAUGHTERING AND CUTTING
POULTRY: Slaughterhouse Building and Facility Requirements, Slaughtering Equipment and Operations, Poultry Carcass Evaluation and Cutting, Official Control of Slaughterhouses and Processing Plants, Poultry Packaging, Food Production from the Halal Perspective.

UNIT III DIVERSIFIED POULTRY
Ducks and Geese – Introduction, Advantages, classification, Ducks rearing system; Quails – Origin and domestication, Advantages of Quail farming; Guinea fowls – Varieties and importance of Guinea fowl farming in India; Turkeys – Turkey farming in India, Varieties.

UNIT IV SPOILAGE AND TEST METHODS OF MEAT
Colour, microbiology and spoilage factors of meat and meat products, Factors affecting post-mortem changes, properties and shelf-life of meat. The spoilage of meat by infecting organisms – TEST METHODS: Physical, Chemical and microbiological testing of meat, Sensory evaluation

UNIT V EGGS
Structure, composition, nutritive value, calculation of nutritive value and functional properties of eggs, Reasons for dirty eggs — Remedies, Nutritional and Health Attributes of Eggs, Functional Properties of Egg Components in Food Systems; Estimation of External and Internal Quality of Chicken Egg — Factors affecting the quality of Eggs.

TOTAL:45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand and identify the specific processing technologies used for meat and marine products.
2. Familiarize with quality evaluation techniques of meat and marine products.
3. Interpret the changes in the composition of foods with respect to the type of processing technology used.
4. Aware of Feed, Breed Management on production and quality Get through Pre and Post slaughter handling techniques
5. Capable of detailed understanding the detailed process flow of value added products from poultry species.
TEXT BOOKS

REFERENCES

FD3017 BYPRODUCTS IN MEAT PROCESSING

UNIT I MEAT PRODUCTS 9

UNIT II FISH BY PRODUCTS 9
Fish byproducts - production of fish meal, fish protein concentrate, fish protein hydrolyzate fish liver oil and fish silage; Production of chitin, chitosan; Production of non-food items from fish processing wastes.
Fishery by-products - Surimi- Introduction, fish muscle proteins, the surimi process, traditional and modern surimi production lines, quality of surimi products, comparison of surimi and fish mince products. Fish protein concentrates (FPC), fish protein extracts (FPE), fish protein hydrolysis (FPH)

UNIT III EGG PRODUCTS 9

UNIT IV INGREDIENTS: PAST & FUTURE ROLE IN PROCESSED MEAT MANUFACTURE 9
PAST ROLE: Scientific modelling of blended meat products; Blood by-products as ingredients in processed meat, Utilisation of hydrocolloids in processed meat systems, Use of cold-set binders in meat systems.
FUTURE ROLE: Using natural and novel antimicrobials to improve the safety and shelf-life stability of processed meat products, The use of nutraceuticals in processed meat products and their effects on product quality, safety and acceptability Use of probiotics and prebiotics in meat products.

UNIT V MEAT ALTERNATIVES 9
History of meat alternatives, Plant based meat, Market for plant-based alternatives, Meat alternatives health benefits.

TOTAL:45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand about the different by-products in different meat industries.
2. Explain about the waste product utilization in meat industry.
3. Assess the process technology for different meat by-products.
4. Develop plant based meat and meat alternatives.

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TEXT BOOKS

REFERENCES

FD3018  PRESERVATION TECHNOLOGY OF EGGS, MEAT, POULTRY AND SEAFOOD  L T P C 3 0 0 3

UNIT I  MEAT PRESERVATION
The storage and preservation of meat: Preservation of meat- chilling, freezing, curing, smoking, canning, dehydration, irradiation, freeze drying, antibiotics, microwave, chemicals. Moisture control, Direct microbial inhibition.

UNIT II  FISH PRESERVATION
Canning - Principles of canning, classification based on pH groupings, effect of heat processing on fish, storage of canned fish, pre-process operations, post process operations, cannery operations for specific canned products,(Tuna,Mackerel,Sardine).
Curing- Salting , Marinating and Smoking (smoke production , smoke components, quality, safety and nutritive value of smoked fish, processing and equipment, pre-smoking processes, smoking process control) operations.

UNIT III  POULTRY PRESERVATION I - REFRIGERATION AND FREEZING
UNIT IV  
POULTRY PRESERVATION II – HEATING, DRYING, CHEMICALS AND IRRADIATION  
Heating, Drying, and Chemicals, Irradiation.

UNIT V  
EGG PRESERVATION  
Preservation of eggs - Refrigeration and freezing, thermal processing, dehydration, coating.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to

1. Understand about the different by-products in different meat industries.
2. Explain about the waste product utilization in meat industry.
3. Assess the process technologies for different meat by-products.
4. Develop plant-based meat and meat alternatives.

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TEXT BOOKS

REFERENCES

FD3019  
MARINE FOODS PROCESSING  
L T P C  
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UNIT I  
INTRODUCTION
A history of seafood industry; Types of fish – major cultured species, underutilized fishery species; Composition, Major and minor nutrients present in sea food, nutrient intake recommendations, nutrition labelling for sea food, structure and spoilage factors of fish. Techniques for harvesting fish; Post harvest quality changes, post-harvest losses, methods for assessing and preventing losses.

UNIT II  
FISH PROCESSING
Post-mortem changes in fish. Handling and transportation of fish. Bacteriology of fish, Shellfish Handling and primary processing; Chilling of fish, Freezing and Individual quick freezing, Heat processing of Fish; Radiation processing of fish and fish products. Drying - Traditional chimney kiln, modern mechanical fish smoking kiln of fish. Overview on – Crabs, Lobsters, Prawns, Shrimps.
UNIT III  FISH FERMENTATION  9
Introduction to fermentation in Food Technology; Lactic Acid Fermentation; Traditional salt/fish fermentation; Classification of fermented fish; Future trends in fish fermentation technology.

UNIT IV  FISH WASTE MANAGEMENT  9

UNIT V  SEAWEEDS AND ITS APPLICATION  9
Introduction to seaweeds, Chemical composition; Saccharification of seaweeds; Lactic Acid fermentation of sea weeds; Applications of fermented products in food; Future prospects of seaweed fermentation.

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Able to be aware of Feed, Breed Management on production and quality Get through Pre and Post slaughter handling techniques
2. Capable of detailed understanding the detailed process flow of value added products from marine species
3. Explain about the waste product utilization in fish industries.
4. Assess the process technologies for different fish by-products.

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TEXTBOOKS:

FD3020  TECHNOLOGY OF PACKING MEAT AND MARINE PRODUCTS  L T P C
UNIT I  INTRODUCTION  9
Introduction, Packaging materials and its functions – Metal containers, Ethylenic and Non- ethylenic Thermoplastic, Package design and packaging equipment’s, Packaging safety,

UNIT II  PACKAGING OF COOKED MEATS AND MUSCLE BASED PROCESSED FOODS  9
Cooked meats, Packaging requirements for muscle-based cooked food products, Consumer trends in food packaging, choosing packaging materials for cooked meat products, Packaging materials and forms used on cooked meat and muscle-based, convenience-style food products – Wrapping, Film packing, Tray packing, Vacuum packaging, MAP.
UNIT III PACKAGING OF FISH AND FISHERY PRODUCTS
MAP principles and importance for packaging fresh fish, Non-microbial effects of MAP, Effects of MAP on fish spoilage, microbial safety of fish products, Application of MAP on fish and fishery products.

UNIT IV PACKAGING OF POULTRY PRODUCTS
Packaging of Egg and Egg Products, Over-wraps, Tray with over-wraps, Shrink film with over-wraps. Vacuum packaging, MAP.

UNIT V DEVELOPMENTS AND RECENT ADVANCES IN THE USE OF PACKAGING MATERIALS FOR MEAT, FISH AND POULTRY
Over-wrapping / stretch-wrapping, Vacuum packaging, MAP, Boil and steam cooking packaging, Retort sterilized packaging, Smart packaging, Packaging with enclosed free-oxygen scavenging agent – Future trends.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Demonstrate the packaging functions and evaluate its performance in food preservation of meat products.
2. Utilize the various food grade packaging materials in meat industries.
3. Comprehend the functions of advanced packaging methods for meat, fish and poultry by-products.
4. Apply the packaging and labelling regulations while designing the packaging system for meat, marine and poultry products.

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TEXTBOOKS:

FD3021 QUALITY, LAWS AND REGULATIONS IN MEAT INDUSTRIES

UNIT I MEAT
Physical Sensors for Quality Control during Processing, Sensory Evaluation of Meat Products, Detection of Chemical Hazards, Microbial Hazards in Foods: Food-Borne Infections and Intoxications, Assessment of Genetically Modified Organisms (GMO) in Meat Products by PCR,

UNIT II FISH 9
National and International Regulations, Standards, Quality Control and Marketing of Fish and Fish Products; Grading Standards of Fish; Quality assessment by Chemical, Physical and sensory methods. Risk characterization.

UNIT III POULTRY 9
Chemical Residues: Pesticides and Drugs (β-Agonists and Antibiotics), Factors Affecting Microbial Growth in Fresh Poultry, Basic Principles of the HACCP System in the Poultry Industry, HACCP in Poultry Slaughterhouses, Online Inspection Poultry-Related Foodborne Disease, Overview of Poultry Processing and Workers’ Safety, Poultry-Processing Industry and eTool. GRADING OF POULTRY MEAT - Grade — I, Grade — II

UNIT IV EGGS 9
The Nutritive value of Eggs after cooking; Quality identification of shell eggs; Factors affecting egg quality and measures of egg quality. Selection of types of Detergents and Sanitizers for controlling Egg Quality and Poultry Products.

UNIT V LAWS AND REGULATIONS 9
Need and various aspects of food testing and notified NABL, referral and reference labs; List of notified reference laboratories, referral laboratories and state/ public food laboratories in India; Food safety regulations and certifications; International organization for standardization (ISO); Codex alimentarius commission; Food safety and standards authority of India (FSSAI); Good manufacturing practices and standard operating procedures. TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Aware of the handling of sample from processing till packaging.
2. Aware of all the laws and regulations in supply chain.
3. Understand the food safety regulations and standards for different meat products.
4. Apply the suitable food safety regulations in meat industry sector for getting quality food product.

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TEXTBOOKS:
3. The food safety information handbook by Cynthia A. Robert, 2009

REFERENCES

FD3022 FAT AND OIL TECHNOLOGY L T P C 3 0 0 3

COURSE OBJECTIVE
- To understand the physicochemical properties of fats and oils
- To study the different methods of extractions and refining processes of various fats and oil in food processing industries.

UNIT I PHYSICAL AND CHEMICAL PROPERTIES

UNIT II EXTRACTION METHODS
Oil extraction methods-mechanical expression-ghani, power Ghani, rotary, hydraulic press, screw press, filter press- principle of operation and maintenance-solvent extraction process-steps involved, batch and continuous-continuous solvent extraction process, oil quality and standard quality regulations, shelf life and oxidative stability of oil.

UNIT III REFINING OF OILS
Scope and importance of oil refining; characterization- degumming, deacidification, bleaching of oil, decolourising agents, deodorization process and winterization process. Hydrogenation of oil-selectivity-catalyst-vanaspati, ghee and margarine. Characterization and types of fat replacers and their specific uses. Processing of other sources of edible oils and fats like rice bran, maize germ etc.

UNIT IV PHYSIOCHEMICAL PROPERTIES OF FATS AND OILS

UNIT V INDUSTRIAL APPLICATIONS AND QUALITY STANDARDS
Industrial applications of fats and oils-quality regulations-manufacture of soap, candle =, paints and varnishes-ISI and Agmark standards-site selection for oil extraction plant -safety aspects -HACCP standards in oil industries.

TOTAL:45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the processing technologies used for fats and oils
2. Identify the edible use of fats and oils in food industries.
3. To apply knowledge to manufacture of designer fats.
4. Analysis the fatty acid components by using various instrumentation.

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FD3023 PROCESSING OF CEREALS, OIL SEEDS AND PULSES

COURSE OBJECTIVE

- To provide the basic understanding of cereals, oilseeds and pulses after harvesting.
- To impart knowledge about the new technologies in oil seed processing.
- To make students able to implement their knowledge about detailed manufacturing technologies of cereals, oilseeds and pulses consumed in daily life in food industries.

UNIT I OIL SEED AND NUTS

UNIT II OIL SEED PROCESSING
Oil seeds processing, Sesame, Coconut, Groundnut, Mustard, Soyabean, Sunflower, Safflower. Oil seeds extraction traditional methods, New Technologies in oil seed processing, Calculation of extraction efficiency, new technologies in oilseed processing, Modification of oil seed process-Hydrogenation, chemical process- interesterification, dry fractionation, utilizations of oil seed meals of different food use. Desolventization and refining of oils; degumming, neutralization bleaching, filtration, deodorization.

UNIT III PROCESSING OF WHEAT AND RICE
Wheat-types, milling, flour grade, flour treatments-bleaching, maturing, types of flour for baking technology of dough development, Marconi products. Oil extraction- mechanical expression of oil-Ghani, power, Ghani, rotary, hydraulic press, screw press expellers, filter press.; solvent extraction process. Other source of edible oil like rice bran, corn germ oil.

UNIT IV PROCESSING OF CEREALS

UNIT V PROCESSING OF MAIZE
Structure-composition of maize-milling methods-Pre-cleaning-cleaning equipment -degermination and dehusking -Dry milling of maize-wet milling -flow chart-Products of milling-Flour-Semolina-Brewer’ grits etc and their applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)

At the end of the course the students would have the knowledge to

1. Explain the structure of the cereal grain, and the components of commercial flour
2. Demonstrate the cereal grain production and quality categorisation systems
3. Interpret the chemical and biological structure of pulses.
4. Comprehend different processing of legumes and its by-product.
5. Identify chemical composition of oilseed and demonstrate the oil extraction process.

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**TEXTBOOKS/REFERENCE**

FD3024 ENRICHMENT AND FORTIFICATION OF CEREALS AND OILS L T P C 3 0 0 3

**COURSE OBJECTIVE**
- Impart the knowledge on the importance of enrichment and fortification of cereals and oils.
- To understand the role of micronutrients on human health.

**UNIT I** INTRODUCTION
Food fortification; Rationale and methods, advantages, disadvantages of food fortification, large scale food fortification, Biofortification, point of use or home fortification.

**UNIT II** RICE
Enrichment-need -methods; processed foods from rice- breakfast cereals, flakes, puffing, canning, instant rice and other processed rice products.

**UNIT III** MAIZE PROCESSING
Machinery and equipment - Acid Hydrolysis, Enzyme Hydrolysis- Processing for value added products -dextrose, maltodextrin and other products. Value addition and food fortification of cereals- Exploring food fortification potential of neglected legume and oil seed crops for improving food nutrition security- among smallholder farming communities. Protein fortification of corn tortillas with oilseeds flours.

**UNIT IV** BIOFORTIFICATION IN PULSES
Introduction; Role of micronutrients on human health; Nutritional composition of pulse; Health Benefits of pulses; Interventions for Biofortification of pulses- Breading Nutritional Enrichment in pulse crops through Biofortification; Advantages; Future challenges in Biofortification.

**UNIT V**
Bread enrichment with oilseeds; Novel breads fortified through oilseed and nut cakes; Protein fortification of corn tortillas with oilseed flours; Effect of oilseed flour addition on the chemical
characteristics of wheat chapati; Fortification of cereals and cereal products with proteins and amino acid.

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Learn about food fortification of cereals and its applications.
2. Understand the need and methods of food enrichment
3. To improve the nutritional quality of the food and provide a community health benefit with minimal risk to health.

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TEXTBOOKS/REFERENCES

FD3025 MILLING AND FRACTIONATION TECHNOLOGIES

OBJECTIVE
The course aims to
• To create awareness about the processing of major cereals and pulses.
• To gain knowledge on milling process and fractionation technologies.

UNIT I PROCESSING METHODS
Concept of primary, secondary and tertiary processing; methods and types of milling – dry and wet milling; rice, wheat, maize and millet. Cereal Processing & milling -dry milling (wheat and rye), pearling (rice, oat & barely), Wet milling (corn and wheat) & malting (Barely, corn and wheat).

UNIT II RICE PROCESSING

UNIT III CORN
Corn milling – dry and wet milling, starch and gluten separation, milling fractions and modified starches. Criteria in assessment of milling process.

UNIT IV WHEAT PROCESSING
Wheat milling process-flour milling -soft and durum wheat processing. Milling of legumes- home scale, cottage scale and modern milling methods, milling quality, efficiency and factors affecting milling, problems in dhal milling industry.
UNIT V  PULSE MILLING

Need for pulse milling - unit operations of pulse milling- domestic and commercial scale pulse milling methods - dry and wet milling, Improved milling method. Pulse milling machineries- dehusking in pulse pearler-splitting of pulse in pulse splitter-Mini dhal mill - working principle- advantage and disadvantage- pulse milling efficiency- Grinding of split pulses- pulse flour products - their applications and equipments used. Cereal ban fractionation: Processing techniques for the recovery of functions components and their applications to the food industry.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Know about paddy processing and rice milling equipment which will help them entrepreneurial skills.
2. Study the processing and milling of corn & wheat which will promote gainful employment.
3. Develop skills needed in the milling of pulses.
4. Apply the knowledge of primary, secondary and tertiary processing methods of cereals, pulses and millets.

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TEXT BOOKS

REFERENCE BOOKS

FD3026  TECHNOLOGY OF MALTING AND BREWING  L T P C

3 0 0 3

COURSE OBJECTIVE
The course aims to
- To provide information about importance of malting and brewing in food industry.
- To impart knowledge about the changes occurring during processing of non-alcoholic beverages.

UNIT I  INTRODUCTION
Introduction to malting. Scope and significance of food processing; malting production: Introduction to brewing, history of brewing; Scope and importance of food processing; raw materials barely; hops; water; yeast. Adjuncts for beer production; maize, rice, millet, wheat sugar.
UNIT II  BARELY
Barely production and trade, composition and structure of barely. Preparation and storage of barely for malting, suitability of different cereals for malting, characteristics of barely for malting and brewing, steeping techniques, germination of barely, structural characteristics, enzymatic and chemical changes during malting, role of gibberellic acid in malting, Techniques of malting composition of malt, malting of wheat and other cereals.

UNIT III  QUALITY CONTROL
Quality evaluation of malt; special malts, significance of water quality in brewing process mashing; changes during mashing, methods of mashing, treatment of cereals used as adjuncts, properties and complications of using adjuncts of different sources.

UNIT IV  APPLICATIONS OF MALT IN FOOD
Baking, infant food etc. Brewing operations, constituents of hops, brewing adjuncts. Beer quality-flavor, taste, alcohol content, chemical constituent etc.

UNIT V  Applications of Brewery-By Products in the food industry. Advantages and Disadvantages of Malting and brewing technology. Applications of enzymes in the malting process.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the technology of production of alcoholic beverages.
2. Assess the knowledge about quality control techniques of beverages.
3. Apply the malting process in food processing industry.
4. Implement the food laws and regulations of beverages

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TEXTBOOKS:

FD3027  BY PRODUCTS MANAGEMENT

COURSE OBJECTIVE
- To study about the by products obtained during processing along with their uses.
- To acquire the skills of manufacturing for making food products.
- To gain knowledge about future developments in food products.

UNIT I  INTRODUCTION
Supply chain of food grains, Hydrothermal treatment of grains; Products and By-products of
cereals and millets: infant foods from cereals and millets, cereal based fermented products, breakfast cereal foods - flaked, puffed, expanded, extruded and shredded products etc.

UNIT II SPECIALITY OIL PRODUCTS
Margarine, mayonnaise, salad dressing, fat substitutes etc. chemical adjuncts: lecithin’s and GMS; Nutritional food mixes from oilseeds; processing of oilseeds for food use, protein rich foods, protein enriched cereal food.

UNIT III PULSE AND OIL SEED BY-PRODUCTS & APPLICATIONS

UNIT IV CEREAL, PULSES AND OILSEED PRODUCTS
Cereal, pulses and oilseeds Technology
Rice milling, pulse milling, wheat milling-oil extraction-Methods of manufacture of Bread - different processes of manufacture-type of breads-buns, biscuits, cakes and cookies -Pasta Products-Tortilla-Method of manufacture. Innovative products from pulses and oilseeds.

UNIT V VALUE ADDITION
Utilization of by-products-chemical composition and nutritional value, consumption, value addition-suitability of flour required for different products; Traditional process technique-parching, puffing, popping, roasting, frying, flaking, fermentation, extraction process. Processed corn products (popped, corn, cornflakes). Parched and snack products. Future developments in products and processes.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand utilization of by products from cereals
2. Get exposure to the preparation of products from cereals, pulses and oilseeds.
3. Application of practical knowledge of pulse milling and oil extraction techniques.
4. Explain about future developments in food products.

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TEXTBOOKS/REFERENCES
5. Technology of oilseeds processing, Oils & Fats and Refining, by EIRI Board (Author), 2011.
UNIT I
Objectives, importance and functions of quality control, Importance of safety in marketing of grain and grain products - domestic and export markets. International organizations: ISO, CAC, WTO, USFDA, Codex, EIC. National organizations: FSSAI, BIS, CCFS, Agmark and APEDA, Good Laboratory Practices.

UNIT II
Regulations of food safety and quality - Food laws - Food Safety and Standards Act (FSSAI) and standards of foods, Packaged Commodities Rules, QA Audit, HACCP, GMP, standard sanitary procedures- GAP, GFSI; function and roles of USFDA, USDA and EPA, ASTA

UNIT III
Quality Control Measures - International standards for export and quarantine requirements for export of food products (raw and processed). Adulteration and its types, sensory and instrumental analysis, rules and regulations for waste disposals. Sampling and specification of raw materials and finished products. Statistical quality

UNIT IV
Sampling Devices, Human Visual Analysis, Bulk Density (Test Weight), Moisture Content, Sieves and Dockage Tester, Protein Content, Wheat Hardness, ELISA Test Kits for Mycotoxins.

UNIT V
Falling Number, NIR Spectroscopy, Digital Imaging, Hyperspectral Imaging, ELISA Test Kits for Insect Activity, PCR-Based Detection Methods, Electronic Noses, X-ray Imaging for Internal Insects.

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. At the end of the course the students will be able to understand the importance of quality control of grain
2. Understand the various national and international laws & regulations involving in grain quality control
3. Understand the traditional and new technologies in involving in quality control
4. Implement the food laws and regulations of beverages

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TEXTBOOKS:
FD3029  HIGH PERFORMANCE COMPUTING  L T P C  3 0 0 3

OBJECTIVES
• This course will facilitate students to understand parallel processing, parallel programming and languages.

UNIT I  PARALLEL PROCESSING FUNDAMENTALS  9
Parallel Processing Concepts - Levels of parallelism - task, thread, memory, function; Models (SIMD, MIMD, Dataflow Models etc), Architectures- multi-core, multi-threaded.

UNIT II  PARALLEL PROGRAMMING MODELS  9

UNIT III  PARALLEL PROGRAMMING LANGUAGES  9
Parallel Programming Languages – Overview, OpenMP, History of GPUs leading to their use and design for HPC, Introduction to the GPU programming model and CUDA, host and device memories, Basic CUDA program structure, kernel calls, threads, blocks, grid, thread addressing, predefined variables

UNIT IV  CUDA  9
CUDA - example code: vector and matrix addition, matrix multiplication, Using Windows and Linux environments to compile and execute simple CUDA programs, Linux make files, Timing execution time, CUDA events, Host synchronization

UNIT V  BIOINFORMATICS AND PARALLEL COMPUTING  9
Bioinformatics and Parallel Computing- Bioinformatics Applications, Recent developments in Computational Biology and Nanotechnology and its impact on HPC

TOTAL : 45 PERIODS

COURSE OUTCOME
At the end of this course students would be expected to learn parallel computing

REFERENCES
1. Highly Parallel Computing", by George S. Almasi and Alan Gottlieb
3. CUDA by Example- An Introduction to General-Purpose GPU Programming by Jason Sanders and Edwards Kandrot Addison-Wesley, 2011.
7. Wagner, S., Steinmetz, M., Bode, A., Müller, M.M. (Eds.), High Performance Computing in Science and Engineering, Garching/Munich, Springer Verlog, 2010

FD3030  FOOD MATERIALS SCIENCE  L T P C  3 0 0 3

OBJECTIVES
The course aims to
• Impart an understanding on the microstructural and molecular basis of food materials.
• Emphasize the formation and structure of food biopolymers.
• Deliver the technologies for characterization of engineered/structured food materials
UNIT I INTRODUCTION 9
Fundamentals of food materials, Molecular basis of food materials, Observation of materials at various size ranges and size-property relationship, The Composite Structure of Biological Tissue, Amorphous and crystalline structures of materials, Gel structures of food materials, Interfacial properties of the food materials.

UNIT II MICRO TO MACRO LEVEL STRUCTURES OF FOOD MATERIALS 9

UNIT III FOOD GELS 9
Introduction to food biopolymers, Rheology of food gels: yielding and gelling soft matter, Formation and structure of biopolymer network gels, Formation and structure of micro- and nano-gel particles, Structure–rheology relationships of food gels and food gel structures.

UNIT IV FOOD MATERIAL CHARACTERIZATION 9

UNIT V FOOD MATERIAL ENGINEERING 9

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Explain the basic terms in food material engineering.
2. Understand the microstructural and molecular basis of food materials.
3. Acquire knowledge to the formation and structure of food biopolymers.
4. Interpret the technologies for characterization of engineered/structured food materials

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TEXTBOOKS/REFERENCES
OBJECTIVES
The course aims to
- Introduce the techniques of developing structured food products.
- Comprehend the structure development in various food matrices.
- Evaluate the technical and functional performance of structured food materials.

UNIT I INTRODUCTION
Nature of food structure, Food structure development, Role of hydrocolloids and proteins in food structure development, making of structured foods, Destruction, destabilization and deformation of food matrix, Application of materials science in food design and development of engineered food materials, the systematic approach to food engineering systems (SAFES), Complex Disperse System (CDS) formalism, Top-down and Bottom-up strategies of constructing food matrix. Modelling and Computer Simulation Approaches to Understand and Predict Food Structure Development.

UNIT II TECHNIQUES FOR FIBROUS STRUCTURE FORMATION
Cultured meat, Mycoprotein, Wet spinning, Electrospinning, Extrusion, Mixing of proteins and hydrocolloids, Freeze structuring, Shear cell technology.
Food Printing: 3D food printing; Approaches, Technologies in food printing, Printability of food components, Factors affecting the printability, 4D Printing; Concept and Functionality, smart food materials, shape memory effect in 4D food printing, Deformation and breakup, Coalescence and alignment, Applications of 3D and 4D food printing.

UNIT III FOOD STRUCTURE DEVELOPMENT IN EMULSION SYSTEMS
Emulsions: Principles and Preparation, Basic constituents of Food emulsion, Emulsion architecture, Microstructure design and performance. Food Structure Development in Oil and Fat Systems; nanoscale crystals and the structures of lipids and fat, fat crystal network. Role of bubbles in food structure development; Formation of foam/bubble microstructures, Rheological behaviour, Characteristics of bubble-containing structures.

UNIT IV STRUCTURING POLYPHASIC FOOD SYSTEMS

UNIV PERFORMANCE OF STRUCTURED FOOD
Food Structure Development for Rheological/Tribological Performance; structure-property-oral process relationships. Developing Food Structure for Mechanical Performance; structure and bulk behavior of soft solid foods, particulate composites and gels, cellular solid foams, and short fiber-reinforced foods. Design Structures for Optimal Sensory Performance, Development of Food Structures for the Encapsulation and Delivery of Bioactive Compounds.

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Aware techniques of developing structured food products.
2. Understand the concepts and principles of food structuring.
3. Assimilate the modern techniques of food structure development.
4. Evaluate the technical and functional performance of structured food materials.
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TEXTBOOKS/REFERENCES

FD3032 CONCEPTS ON EXPERIMENTAL DESIGN AND MODELLING L T P C

UNIT- I INTRODUCTION TO EXPERIMENTAL DESIGN

UNIT -II: DESIGN OF EXPERIMENTS -SINGLE AND MULTIFACTOR EXPERIMENTS
Types of Design of experiments- Completely randomized design, Randomized block design, Latin square design, Two and three factor full factorial experiments, 2K factorial Experiments, Confounding and blocking designs, Plackett- Burman design.

UNIT -III: SPECIAL EXPERIMENTAL DESIGNS
Fractional factorial design, Nested designs, Split plot design, Response Surface Methodology (RSM), Experiments with random factors, rules for expected mean squares, approximate F- tests.

UNIT- IV: ANALYSIS AND INTERPRETATION METHODS
Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments- one way ANOVA, two way ANOVA and multi way ANOVA, Pairwise comparison- Tukey’s test and Fisher LSD test, Regression analysis, Statistical analysis, estimation of model parameters, model adequacy checking, Forming mathematical models from experimental data- First order, second order models.
UNIT- V: DESIGN OF EXPERIMENTS
Design using Orthogonal Arrays, Data analysis, Robust design- control and noise factors, S/N ratios, parameter and tolerance design concepts, case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to
CO1 Understand the basic concepts related to experimental design
CO2 Understanding the different types of design and its relevance to real time experiments.
CO3 Gain knowledge in analyzing the design and developing appropriate models

TEXTBOOKS/REFERENCES

FD3033 STATISTICAL TOOL IN DATA ANALYSIS L T P C 3 0 0 3

OBJECTIVE:
The course aims to
• Provide an insight into various statistical tools in data analysis.
• Provide an insight into the real-life and varied application of the subject.

UNIT I INTRODUCTION TO SCIENCE OF STATISTICS
Fundamental Elements of Statistics, Qualitative and Quantitative Data Summaries, Statistical Inference, Stating Hypotheses, Test Statistics and p-Values, Evaluating Hypotheses, Equation of multiple linear regression, Interpretation of multiple linear regression, Cautions about Regression.

UNIT II DATA MANAGEMENT AND ANALYSIS
Quantitative analysis, descriptive statistics, inferential statistics: Uses and limitations Summation sign and its properties, Proportions, percentages, ratios, Measures of central tendency-mean, median, mode arithmetic mean and its uses, mid — range, geometric mean, weighted mean, measures of dispersion /variability- range, variance, standard deviation, standard error, coefficient of variation, Kurtosis, Sleekness (practical aspects of grouped data-frequency distribution, histogram, frequency polygons, percentiles, Data Management and Analysis, Frequency distributions, Measures of central tendency, measures of dispersion, variability).

UNIT III STATISTICAL DATA ANALYSIS USING SPSS

UNIT IV DATA ANALYTICAL MODELS
Reducing Data Complexity (Principal Component Analysis (PCA) and Exploratory Factor Analysis (EFA)), Additional Linear Model Topics (Collinearity, Logistic, Hierarchical Linear Models (HLM)), Confirmatory Factor Analysis and Structural Equation Modeling (SEM).
UNIT V  DATA ANALYTICS: SOFTWARES AND TOOLS  9
SQL, Tableau, QlikView, R language, Python, RapidMiner, OpenRefine, SAS.

TOTAL:45 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to
CO1- Collect, store, process and analyze data according to high standards
CO2- conduct empirical research in food science and technology using modern analytic software tools
CO3- develop and apply new research methods
CO4- solve problems using best practices of data analysis using modern computational tools.

TEXTBOOKS/REFERENCES

FD3034 FOOD INFORMATICS L T P C 3 0 0 3

OBJECTIVE
The course aims to
- Impart knowledge on structural interaction between organic molecules and their interaction.
- Provide a knowledge about the various types of sequence database
- Impart knowledge on both Insilico and Invitro studies

UNIT I INTRODUCTION  9
Role of functional foods against metabolic syndrome like diabetics, celiac diseases. Potential benefits (like antioxidant, anticancer activity) of active compounds present in the food materials (herbs, fruits, & vegetables) – proteins and phytochemicals like – Carotenoids, Lycopene, Xanthophylls, lutein, Sulfides, Polyphenolics, Flavonoids, Naringin, Quercetin, Anthocyanidins, catechins, Flavones, Prebiotics / Probiotics, Fructo oligosaccharides, Lactobacillus, Phyto estrogens: Isoflavones, daidzein, Guebbustin, lignans, Tocopherols, etc.

UNIT II SEQUENCE DATABASE  9
Introduction to bioinformatics tools: Sequence database – Nucleotide, protein, Literature Databases, Composite Databases (NRDB), Genome Databases- (Viral genome database (ICTV db)), Bacterial Genome database (GOLD, MBGD), Organism specific database. file formats, Introduction to sequence alignment (only general ideas, not algorithm) - Local and global, pair wise and multiple, BLAST. Small compound database – PubChem, ChemSpider, ZINC, ChEMBL, Drug Bank, Flavornet (Volatile compounds form the literature based on GC-MS), SuperSweet (Database – Carbohydrates & artificial sweeteners).

UNIT III STRUCTURE PREDICTION  9

UNIT IV IN Silico Models  9
Introduction to Molecular docking, Structure Based methods to identify lead components, Energy minimization tool, Denovo ligand design, molecular docking and molecular simulation case studies.
UNIT V   IN VITRO MODELS


COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the facts and importance’s of phytochemicals.
2. Evaluate the structural prediction and refinement of organic molecules.
3. Able to discuss about the various types of sequence database
4. Apply the fundamental conceptual of both In-silico and Invitro methods.

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TEXTBOOKS/REFERENCES

FD3035  APPLIED GENOMICS AND PROTEOMICS  L T P C
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OBJECTIVES
The course aims to,
• provide advanced theoretical knowledge on the organization and function of genomes,
• functional genomic analyses, and advanced methods and approaches in proteomics.

UNIT I  STRUCTURE OF GENOMES, MAPPING AND SEQUENCING
Organization and structure of genomes in prokaryotes, eukaryotes, and organelles (chloroplast, mitochondrion); Genome mapping methods (genetic and physical); RAPD, RFLP, SNP analyses; Fluorescence In-Situ Hybridization (FISH) techniques; Advances in gene finding and functional prediction; Chain termination and chemical degradation sequencing methods.

UNIT II  LARGE SCALE GENOMICS/ FUNCTIONAL GENOMICS ANALYSES
Genome-wide association (GWA) analysis; Comparative Genomic Hybridization (CGH); Massively Parallel Signature Sequencing (MPSS); Whole genome shot-gun sequencing and its applications. Introduction of Next Generation Sequencing (NGS).

UNIT III  TRANSCRIPTOMICS ANALYSES
Gene expression analysis by cDNA and oligonucleotide arrays; Microarray experimental analysis and data analysis. Methylation analysis using microarray; ChiP-on-Chip analysis. Bioinformatic analysis of large-scale microarray data for comparative transcriptomics.
UNIT IV SEPARATION AND PROCESSING OF PROTEINS FOR PROTEOMICS
Overview of strategies used for the identification and analysis of proteins; Protein extraction from biological samples (Mammalian Tissues, Yeast, Bacteria, and Plant Tissues); 2-DE of proteins for proteome analysis; Liquid chromatography separations in proteomics (Affinity, Ion Exchange, Reversed-phase, and size exclusion); Enzymatic cleavage of proteins. Analysis of complex protein mixtures using Nano-liquid chromatography (Nano-LC) coupled to Mass-spectrometry analysis.

UNIT V MASS SPECTROMETRY AND COMPARATIVE PROTEOMICS
Common ionization methods for peptide/protein analysis; Introduction to Mass spectrometers; MALDI-TOF and LC-MS analyses; Comparative proteomics based on global in-vitro and in-vivo labeling of proteins/peptides followed by Mass-spectrometry. Analysis of post-translational modification (PTM) of proteins; Characterization of protein interactions using yeast two-hybrid system and Protein microarrays; Proteomics informatics and analysis of protein functions.

COURSE OUTCOMES:
At the end of the course students will be able to,
CO1 have advanced theoretical knowledge on the organization and function of genomes
CO2 know functional genomics analyses
CO3 understand advanced methods and approaches in proteomics.

TEXTBOOKS AND REFERENCES

FD3036 TECHNOLOGY OF FRUIT AND VEGETABLE PROCESSING
OBJECTIVES
The course aims to
- develop the knowledge of students in the area of vegetable and fruit processing and technology.
- enable students to appreciate the application of scientific principles in the processing of fruits and vegetables.

UNIT I BASIC AGRICULTURAL ASPECTS OF VEGETABLES AND FRUITS
Ability to identify all commercially important fruits and vegetables with their names in important Indian languages, important regions, season, Production and processing scenario of fruits and vegetable India and World. Scope of Fruit and Vegetable Preservation Industry in India. Present status, constraints and prospectus. Problem solving in post-harvest quality of fruits and vegetables.

UNIT II FRESH FRUITS AND VEGETABLES
Physical, Textural characteristics, structure and composition. Maturity standards; Importance,
methods of Maturity determinations maturity indices for selected fruits and vegetables. Harvesting of important fruits and vegetables. Fruit ripening- chemical changes, regulations, methods. Calculation of respiration rates, Spoilage of fruits, vegetable and their processed products.

UNIT III PRESERVATION OF FRUITS AND VEGETABLES 9
Preservation by fermentation- Definition, Advantages, disadvantages, Types of fermentation, equipments; Fruit wine. Irradiation applications for fruits and Vegetable. Minimally processed fruits and vegetables, solving problems with respect to natural resistance of fruit, General pre processing, drying and freezing of fruits and vegetables - problems associated with specific fruits and vegetables, problem solving in Post- cutting treatments to extend the shelf-life of fresh-cut products.

UNIT IV CANNING, PUREES AND JUICES 12
Canning- General pre-processing, specific or salient points in fruits and vegetables like – Blanching, exhausting, processing conditions; Indian Food Regulation and Quality assurance Fruit Juice / pulp/ Nectar/Drinks, concentrates – General and specific processing, different packing including aseptic. Indian Food Regulation and Quality assurance Vegetable Purees/pastes - General and specific processing, different packing including aseptic. Technology for juice pressing, juice extraction and clarification, methods of bottling, enzymatic clarification and debittering of juices, fruit juice powders- preparation and packaging.

UNIT V FRUIT AND VEGETABLE PRODUCTS 8
Ready to eat fruit and vegetable products, Jams/Marmalades, Squashes/cordials, Ketchup/sauces, Chutneys, Fruit Bar, Soup powders, Candied Fruits, Natural colors, Fruit and Vegetable Fibres- General and specific processing, different packing including aseptic, Dried Onion, Powder. Garlic Dried Garlic, Powder, Oil. Potato Wafer; starch, Papad, Carrot Preserve, candy, Pickle, Jam. Cauliflower and cabbage Dried cauliflower and cabbage, Sauerkraut, Pickle Leafy vegetables; Dried Leafy Vegetables. (Spinach, Fenugreek, Coriander leaves, Curry leaves). Bitter gourd Pickle, Dried bitter gourd. Indian Food Regulation and Quality assurance, Case studies- Improving the nutritional quality of processed fruits and vegetables, Waste management in fruit and vegetable processing industries.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Assess the basic agricultural aspects of fruits and vegetables.
2. Demonstrate the processing of fruits and vegetables.
3. Apply the freezing and dehydration technology in preservation of excess produce.
4. Apply thermal processing methods in fruit and vegetable technology.
5. Demonstrate the manufacturing of fruit and vegetable products.

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TEXT BOOKS:
FD3037 FRUITS AND VEGETABLES AS NUTRACEUTICAL

OBJECTIVES
The course aims to

- Understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- Understand the role of Nutraceuticals and functional food in health and disease

UNIT I
Introduction to major class of bioactives in fruits and vegetables, present scenario of nutraceutical market, food and nutrient intake behavior in Indians, classification of plant derived bioactives, interaction of functional food with medicine, Vitamins and Minerals of fruits and Vegetables, Flavonoid, Isoflavone, and Carotenoid Contents in Raw fruits and Vegetables, Fibre – dietary fibre, plant tissue and type of cell walls, cell wall polysaccharide, effects of cooking or processing on cell wall composition, health benefits

UNIT II
Pharmacological properties of fruits and vegetables; nutritional indicators and health aspects of fruits and vegetable consumption in adults; diabetes, diabetic complication and flavonoids; curcumin – epigenetic therapy; Nutraceuticals as therapeutic agent for inflammation – flavonoids, anthocyanin; diet and nutrition in prostate health, Antioxidants in fruits & vegetables – factors that affect antioxidant response to ingestion of fruit - health properties.

UNIT III
Role of fruit and vegetable nutrients in Cancer and immune system enhancer, utilization in functional foods, phytosterol, phytoestrogens, glucosinolates, organosulphur compounds, flavonoids, carotenoids, etc. Sports foods – ingredients, components in sports foods, sports drinks, design consideration, ergogenic aids in sports nutrition. Formulations for meeting normal and special needs of infants, current status of infant foods, additives for infant foods. Foods for aged persons, design consideration, ingredients for geriatric foods

UNIT IV
Concept of new health food product development from fruits and vegetables. Safety; marketing strategy and consumer response; economic analysis and costing of novel foods from fruits and vegetables, Prebiotic substances from fruits and vegetables and their utilization in functional foods, symbiotic foods, technological aspects and recent development in probiotics, prebiotics and symbiotic

UNIT V
Nutraceutical delivery vehicles, Role of bioactives from fruit and vegetables for human health – plant parts and chemistry, mechanism of action - case studies, recovery of valuable bioactives from residues of fruit and vegetable processing industry, stability and bioaccessibility of fruit and vegetables bioactives in food – food component interaction and matrix effect.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to

1. Understand the concepts of physiological characteristics of fruits and vegetables.
2. Aware of the basic concepts of nutraceuticals and its role in health and disease
3. Examine the chemical nature of nutraceuticals and methods of extraction
4. Evaluate the role of Nutraceuticals and functional food in health and disease
FD3038  ADVANCES IN FRUIT AND VEGETABLE PROCESSING TECHNOLOGIES  L T P C  3 0 0 3

OBJECTIVES
The course aims to
- Familiarize students with advanced fruit and vegetable processing techniques and its applications
- Understand the effect of Novel non thermal methods on quality and safety of fruit and vegetable products.

UNIT I  9
Ultraviolet light for processing of fruit and vegetable products, high pressure processing of fruit and vegetable, ultrasound application of fruit and vegetable products, minimal processing

UNIT II  9
Membrane application in fruit and vegetable processing technologies, high intensity pulsed electric field applications, applications of ozone in fruit and vegetable processing, irradiation application in fresh fruit and vegetable produce processing

UNIT III  9
Enzyme maceration, fruit and vegetable juices as vehicle for probiotic microorganism and prebiotics oligosaccharides, vacuum frying of fruit and vegetable application in processing, role of canning in preservation of fruits and vegetables,

UNIT IV  9
 Freeze concentration applications in fruit and vegetable processing, refrigeration and cold chain effects on fruit and vegetable product shelf life, edible coatings.

UNIT V  9
Thermal treatment effects in fruit and vegetable juices, effect of fruit and vegetable processing on product aroma, sensory evaluation in fruit and vegetable product development, ohmic heating, microwave dielectric heating recent trends in drying

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand different non thermal processing of food and its application in fruit and vegetable processing
2. Familiarize students with Novel non thermal methods for sterilization of fruit and vegetable
3. Discuss about the quality evaluation of fruit and vegetable products.
4. Understand the effect of Novel non thermal methods on quality and safety of fruit and vegetable products
TEXTBOOKS

FD3039 BEVERAGE TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE
- To impart knowledge on scope and importance of beverage industries.
- To impart knowledge on the processing aspects of beverage production.
- To understand the principal facts behind non-alcoholic beverage production

UNIT I INTRODUCTION 9
Classification of beverages and their importance. Scope of food beverages & its processing units in India. Ingredients details in carbonated beverages, History of Soft Drinks, Findings and Development of carbonation apparatus, Transformation of health drinks to common beverages, Product timeline and marketing. Non-carbonated beverages.

UNIT II ALCOHOLIC & NON-ALCOHOLIC BEVERAGES 9
Brewing techniques, nutritional value of alcoholic beverages, Processing aspects (Distillation techniques) of beer, wine, and other non – alcoholic beverages like vodka, rum, gin, whisky, brandy, & toddy. Distilled spirits.
Tea - Processing of different types of tea and its importance, coffee processing – introduction, biological activity of coffee, flavored milk, cereal-based non-alcoholic beverages.

UNIT III FRUIT AND VEGETABLE BASED BEVERAGES 9

UNIT IV CARBONATED SOFT DRINKS- MANUFACTURING 9
Source of carbon dioxide, chemical and physical properties of carbon dioxide, carbonating process, Machineries and equipment used. Preparation of syrups; Dilution systems; Filling system; Packaging-containers and closures; Effective application of quality controls, brix, acidity to brix ratio, single strength of product- sanitation and hygiene in beverage industry.

UNIT V HEALTH AND REGULATORY ISSUES 9
Quality control of beverage: Quality standards for beverages, chemical, microbial and sensory evaluation, product shelf life. FSSAI, CODEX, FDA and EU regulations- Labelling and packaging; Ingredients according to PFA, EFSA and FDA – Absolute requirements of soluble solids and
titrable acidity in beverages.

**COURSE OUTCOMES (COs)**

At the end of the course the students would have the knowledge to

1. Formulate the beverages using selected ingredients
2. Apply Unit operations involved in the carbonated beverage manufacturing
3. Explain the various production techniques in non-carbonated beverages
4. Evaluate the quality parameters of fermented beverages
5. Implement the food laws and regulations of beverages

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**TEXTBOOKS/REFERENCES**


**FD3040 FRUIT AND VEGETABLE STORAGE**

**OBJECTIVES**

The course aims to

- Provide in-depth knowledge on safe storage of food materials.
- Enable design of storage structures for various categories of food products.

**UNIT I**

Introduction – storage operation, harvest and pre-harvest factors, traditional and modern storage methods, changes during storage, factors influencing storage, genetic effects on storage, humidity and temperature – measurement and control technology, store design and methods, pre-storage treatments

**UNIT II**

Pre-cooling of fruits and vegetables – methods, estimation of cooling time, ventilation & forced system, combined forced and extraction system, low cost cold room, storehouse – layout of floor duct, air distribution, packaging icing, cooling load calculations, vacuum cooling – principle,
process, mechanism, equipment, advantages, limitations, Commercial forced air cooling methods, product moisture loss and produce cooling pattern with forced air cooling; heat load; hydrocooling of fruits and vegetables – hydrocooling rate, methods; evaporative cooling (EC) – thermodynamics and psychrometric of EC process, types of EC system, limitations, maintenance and design

UNIT III
Hypobaric storage – mode of action, transport, effect on fruits and vegetables, case studies on raw horticultural commodities and processed products, vacuum infiltration and cooling, hyperbaric storage – mode of action, effect on fruits and vegetables, case studies on raw horticultural commodities and processed products

UNIT IV
Controlled atmosphere (CA) – changes during storage, biochemical considerations, gas exchange mechanism, equipment for producing and regulation CA, design, construction and operation - on raw horticultural commodities and processed products, gas measurement and control technology, effect of gas atmosphere and interactions, MAP – techniques, polymeric film properties, gas and vapour applied to MA process operation, effect on shelf life of fruits and vegetables, MAP design with O2 modeling, chilling injury, control of temperature, absorbers

UNIT V
Handling of common fruits and vegetables – recommended storage conditions for various fruits and vegetables, storage and transportation of fruits - citrus, sub tropical, pears, grapes, plums, cherries, peaches, apricot and berries. Vegetables – artichokes, asparagus, corn, cucumber, eggplant, garlic, lettuce, melon, mushroom, okra, onion, parsnip, parsley, peas, pepper, potato, spinach, canned foods . transport. – sea, CA, hypobaric, MA – case studies.

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand trends and development storage technologies aiming at assuring the safety and quality of fruits and vegetables.
2. Explain the design, construction, operation, control and maintenance of commercial refrigeration systems and cold storages for fruits and vegetables
3. Assess basic in storage of fruits and vegetables
4. Examine the design of storage Structures for various categories of food product

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TEXTBOOKS
OBJECTIVES
The course aims to
- Understand the different methods involved in development of fruit and vegetable packaging systems.
- Understand the different packaging system available for fruit and vegetable packaging

UNIT I
Bio-based packaging of fruits and vegetables, MAP of fresh produce, shrink packaging of fruits and vegetables, NMBP, antimicrobial packaging – basic concepts and applications in fresh and fresh-cut fruits and vegetables, cushioning materials for fruits and vegetables

UNIT II
Active packaging of fresh and fresh-cut fruits and vegetables, Intelligent packaging applications of fruits and vegetables, Edible coating and their effect on their effect on post-harvest quality of fruits and vegetables, nano-enabled packing of food products

UNIT III
Engineering properties of packaging film for raw and processed fruits and vegetable products, predictive modeling for packaged fruits and vegetables, mathematical modeling for micro-perforated films in fruits and vegetables packaging

UNIT IV
Smart packaging technologies for fruit and vegetable beverage products – gas release, flavour release, nutrient release, enzyme release, thermochromic labelling, smart branding, odour removal packaging, anti-counterfeit beverage packaging, tamper-proof packaging.

UNIT V
Improving convenience in product use and for on-the-go food and drink consumption, self heating and self cooling systems, smart packaging of fruit and vegetable beverages with aerosol

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the concepts, types of food packaging systems for fruits and vegetables
2. Analyse complex systems of food packaging and logistics in packaging of fruits and vegetables.
3. Understand the different packaging system available for fruit and vegetable packaging
4. Explain the advances involved in processing of fruits and vegetables

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TEXTBOOKS
FD3042 FRUIT AND VEGETABLE INDUSTRY SAFETY AND LAWS L T P C
3 0 0 3

OBJECTIVES:
- To study various food laws, importance and functions of food safety management systems
- To impart knowledge on food laws and safety in food processing.

UNIT I NECESSITY OF LAW IN FRUIT AND VEGETABLE PROCESSING INDUSTRY 9
Establishment of US Pure Food Law in early 1900s and of Food & Drug Administration to enforce safety of food products; Urbanisation of population and necessity of processed and preserved foods and the necessity of ensuring quality of food to prevent adulteration. PFA; Various aspects of defining adulteration, taking samples of food for analysis by public analyst, prosecution for adulteration and punishment; Standards of various food products; FPO; Use of permitted additives like colours, preservatives, emulsifiers, stabilisers, antioxidants etc. Food Safety & Standards Act 2006 and the provisions therein; Integrated Food Law - Multi departmental - multilevel to single window control system, consumer protection Act.

UNIT II FOOD SAFETY IN PROCESSING 9
Fruit and vegetable processing industry - Building and equipment design; microbiological quality of fruit and vegetable products, air; Safety in food procurement, storage, handling and manufacture; Food safety in retail fruit and vegetable product businesses; international food service operators, institutional food service operators; application of the principals of modern hygiene; Food handlers, habits, clothes, illness;

UNIT III KEY SAFETY PRINCIPLES 9
Fruit and vegetable processing industry - Training & Education for safe methods of handling fruits and vegetables; cleaning and sanitization of processing plants; principles of cleaning and sterilization; sterilization & disinfection- different methods used-detergents, heat, chemicals; selecting and installing equipment; Cleaning of equipment and premises. Safety limits of sanitizers; pest control; management and disposal of waste.

UNIT IV FOOD SAFETY MANAGEMENT SYSTEM 9
Fruit and vegetable processing industry - Physical, chemical and Microbial hazards and their control in food industry; Quality systems standards including ISO: - ISO 9000; total quality management (TQM); hazard analysis of critical control points (HACCP); good manufacturing practices (GMP);

UNIT V MANAGEMENT 9

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Identify the Agency responsible for legislation & implementation when facing a problem concerning fruits and vegetables
2. Elaborate on the relevant legislation/standard for a fruits and vegetables based product
3. Assess the meaning of what is written in the relevant legislation when facing a problem concerning fruits and vegetables
4. Propose to pertinent Authorities amendments to existing legislation/standard whenever it seems justifiable

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TEXT BOOKS:

REFERENCES
COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand basic concept of Packaging Design and Sustainable Package Design
2. Able to develop the knowledge of students in the area of food packaging designs and the
technologies used in packaging design.
3. Explain latest food packaging technologies for adoption of sustainability in food industry.
4. Elaborate Hazards and toxicity associated with packaging materials, labelling of foods.

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TEXTBOOKS:
8) Klimchuk & Krasovec, “Packaging Design: Successful Product Branding from Concept to Shelf”

FD3044 PACKAGE PRINTING INKS AND COATINGS

UNIT I
Introduction Packaging printing, more than just putting ink on substrate - Origination: Conventional, originals, Digital originals. Printing Inks. PACKAGING EMBELLISHMENT AND PRINTING a) Graphic design – Preparation and reproduction of art work. b) Printing Techniques – Letterpress. Flexography, Lithography, Gravure, Silkscreen. c) Printing inks and Print evaluation. d) Ink-Jet Printing in Bar Coding

UNIT II

UNIT III
Advances in Printing on Packaging with special reference to the Digital Printing Printing and embossing, Decoration and printing of corrugated board containers, The choice of printing process at different levels of packaging: primary, secondary and tertiary packaging materials.
UNIT IV
Introduction, Light and colour, the description of colour, Colour vision, Additive and subtractive
colour mixing, other factors affecting colour, Colour printing, Graphic design, reprographics and
pre-press, E-marketing—traditional marketing vs. e-marketing—internet marketing—e advertising new
trends in internet marketing—e branding - e-payment systems and security features in internet

UNIT V
Proofing options and approval processes, Technological aspects of printing processes, other
processing techniques, Quality control in packaging, s, holograms on labels, printing inks and
adhesives, Packaging and Branding: Brand Loyalty and Brand Equity—Labeling—Product Life Cycle—
New Product Development

TOTAL – 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the
1. Aware to develop food packaging designs and the technologies used in packaging
printing.
2. Understand the Basic Concept of Printing on Packaging.
3. Assess latest food Printing technologies for adoption in food industry.
4. Evaluate the chemical hazards and toxicity with packaging materials and regulations.

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TEXTBOOKS:
(1) Giles, “Design and Technology of Packaging Decoration for the Consumer Market”, Blackwell,
(3) Klimchuk & Krasovec, “Packaging Design: Successful Product Branding from Concept to
Shelf”.

FD3045 GLASS WOOD AND METAL PROCESSING AND PACKAGING

UNIT I GLASS TECHNOLOGY
Production, 6. Quality Control and Instrumentation. 7. Special Glasses. 8. Refractories: Additives
and their Effects. Basic processes of glass making, Batch process, Continuous process, Raw
materials selection, Batch house & mixing, Batch transportation, Tank furnace, Batch feeding,
Melting & refining,

UNIT II GLASS CONTAINER MANUFACTURING & TESTING
Concept and Advanced Processing of Glass Packaging Bottle glass, Sheet glass, Glass
Containers, Other glasses, Annealing, Thermal treatment, Chemical treatment, Production control
& planning- Bottle Forming Process & Designs. Quality control & testing of finished glass bottles - USP Types of Glass ad Properties and its applications and testing.

UNIT III  METAL CONTAINERS  9

UNIT IV CONCEPT AND ADVANCEEMENT IN METAL PACKAGING  9

UNIT V WOODEN CONTAINERS  9

TOTAL – 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Develop food packaging designs in Glass and the technologies used in packaging industries.
2. Aware about the latest technologies in glass, design packaging of foods in relation to laws and regulations
3. Understand basic concepts of metals in packaging and their characteristics.
4. Improved knowledge in wood and glass materials adoption in food industry.

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TEXTBOOKS:
1. Glasses and the Vitreous State – J. Zarzycki
3. Handbook of Glass Manufacture - F.V. Tooley
UNIT I  INTRODUCTION TO PLASTICS, POLYMERS AND DIFFERENT PROCESS AND PACKAGING 9

UNIT II  INJECTION MOULDING 9

UNIT III  EXTRUSION MOULDING 9
Extrusion – Constructional features of extruded equipments, blown film, cast films, multiplayer films, Biaxially oriented films, Extrusion of sheets, tapes, box strapping and monofilaments. Extrusion coating/ lamination Aspects to be covered are auxiliary equipment, plant layouts, process parameters and their effect on the quality of the extruded products and trouble shooting.

UNIT IV  CONCEPT AND ADVANCED PROCESSING OF PLASTICS AND POLYMER PACKAGING 9

UNIT V  OTHER METHODS OF RIGID CONTAINER FORMATION 9

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the importance of food polymers
2. Explain the concept of selection of packaging materials.
3. Understand the effect of various methods of processing on the structure and texture of food materials with relate to plastics
4. Understand the interaction of food constituents with respect to thermal, electrical properties to develop new technologies for processing and preservation of food materials.

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TOTAL – 45 PERIODS
TEXTBOOKS:

FD3047 PAPER, CFB AND PAPER BOARD BASED PACKAGING

UNIT I 9

UNIT II 9
Folding board cartons. Standard industry terminology. General nomenclature, usual consideration, styles, dimensions, materials, coating structure, printing, crease quality, packing and storage, multipacks, Corrugated Fibre Board, Box Style & Their Economics.

UNIT III 9
Composite Containers: General consideration, construction, types, materials, manufacture, economy, applications, composites for liquids, Multiwall paper Sacks.

UNIT IV 9

UNIT V 9

TOTAL – 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Interpret development and designs of different packaging products.
2. Able to develop models for various food products in paper-based materials.
3. Understand the importance of packaging applications for all food groups
4. Familiarize to use packaging instruments and analytical techniques.

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TEXTBOOKS:

FD3048 PACKAGING LAWS AND REGULATIONS

UNIT I
STANDARD AND QUALITY CONTROL
1) Basic concepts.
2) Standard for packaging material - rigid, non-rigid and ancillary material.
3) Standard for export packages – labelling and marketing regulations.
4) Packaging quality control criteria.
5) Sampling, variables and attributes, AQL.
6) Implication of ISO-9000.
7) Eco Packaging and regulation.
8) Recycling and Disposal of Packaging Waste.

UNIT II
LAWS & REGULATIONS
a) Food Safety & Standards Act, 2006
b) The Legal Metrology Act, 2009 (Packaged Commodities Rules, 2011)
c) UN certification code for packaging of Dangerous goods.
d) Packaging laws and regulations – legal requirements

UNIT III
Packaging Laws and Regulations Standards, Bureau of Indian standard, standardization, Quality standards Legal Meteorology Act, FDA/AGMARK rules and regulations, Eco- regulations, eco labeling, Pollution control related to packaging, IMDG, ICAO, Life Cycle Analysis, Export Regulations, recent FSSAI act, RFID, Barcode Markings & Labeling on Transport packaging.

UNIT IV
Packaging Laws & Regulations Standards, Bureau of Indian standard, standardization, Quality standards. Legal Meteorology Act, Weights and measures Acts, FDA/AGMARK rules and regulations, Eco- regulations, eco labeling, Counterfeiting, IMDG, ICAO, Life Cycle Analysis, Export Regulations,

UNIT V
Governing laws and regulations involved in packaging of products FSSAI Rules and Regulations, Packaging Standards, Laws and Regulation, Role of BIS, FSSAI, MoFI and NABL, IATA, ILAC, IMDG, ASTM, TAPPI, IMDG with reference to the Packaging Industry.

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the various laws and associated Authorised bodies and functions and responsibilities.
2. Analyze the testing and labeling regulatory requirements with respect to food packaging
3. Maximize knowledge to FSSAI, associated with and laws, regulations and the monitoring agencies involved food safety, labelling of foods, and international bodies.
4. Elaborate registration and obtaining license from FSSAI, Packaging laws and regulations.

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UNIT I
Introduction to Food Preservation/ Packaging Technology, Method of Storage. - Speciality packages a) Aerosols, easy opening devices, carry home packs, Strip packaging, shrink packaging, blister packaging, skin packaging and stretch wrapping. Systems packaging – Lined cartons, Form Fill Seal (FFS), Stand – up pouches, etc. Controlled Atmosphere packaging (CAP) and Modified Atmosphere packaging (MAP). Aseptic packaging.

UNIT II

UNIT III
Packaging processes and machinery – types, characteristics and specialities; selection and specification. Equipments for canning, paper / board carton, flexible packaging, etc. Packaging Machinery: Types, merits, demerits of the process Filling of dry and liquid products Gravimetric filling, volumetric filling, filling of still liquids, Filling of carbonated liquids and other packaging techniques.

UNIT IV
In line check weighing Equipment for filling tubes, packaging of counts, automatic capping machinery, form-fill seal machinery for liquids, non-liquids, rigid preformed container machinery, bag handling-filling-sealing machinery, Cartoning, Labelling, Thermoforming. In plant plastic bottle making; Laminating, Hot melt – use, method, equipment; Vacuum and gas packaging, method, application, equipment. Latest developments in packaging machinery.

UNIT V

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand and identify the specific processing technologies used for foods and the various products derived from the materials.
2. Well equipped with skills on handling food equipment’s.
3. Prove knowledge to instruments working, calibration.
4. Understand and apply advanced preservation and packaging techniques for all food
products.

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**TEXTBOOKS:**

3) Pharmaceutical Packaging Handbook By Edward Bauer
4) Textbook of Pharmaceutical Packaging Technology by Kaushik

FD3050 INTRODUCTION TO BAKING AND BAKERY PRODUCTS  L T P C  3 0 0 3

**UNIT I** INTRODUCTION 9
Historical development and status of bakery industry in India; Introduction and definition of bakery products as per FSSAI – bread, biscuit, cake, pastries, rusk, crackers, bun and their specifications. Present status and future prospectus

**UNIT II** BAKERY INGREDIENTS 9
Classification of bakery products. Bakery ingredients and their functions-Essential ingredients. Flour, yeast and sour dough, water, salt- Other ingredients Sugar, color, flavor, fat, milk, milk powder and bread improvers. Leaveners and yeast foods. Shortenings, emulsifiers and antioxidants.

**UNIT III** TRADITIONAL AND SPECIALITY PRODUCTS 9
Cakes, biscuits, pastries, pretzels production and quality control, Enriched Bakery Products - Bakery goods with soya flour, groundnut flour, whole wheat meal etc., bakery products of unconventional flours, dietetic bakery products. Specialities from All Over the World ; Bakery Products of China ; Italian Bakery Products ; Mexican Bakery Products ; Bakery Products of Turkey.

**UNIT IV** BAKERY INGREDIENTS AND ADDITIVES 9

**UNIT V** BAKERY PLANT LAYOUT 9
Plant layout and maintenance for bakery and confectionery processing: Introduction to food plant design - plant location - location factors, site selection - layout - objectives, classical and practical layout – preparation of process chart and machinery layout – product layout and process layout - repair and maintenance of equipment – preventive and breakdown maintenance – replacement of equipment

**TOTAL: 45 PERIODS**
**COURSE OUTCOMES (COs)**

At the end of the course the students would have the knowledge to

1. Apply basic principles of baking technology for product manufacturing.
2. Demonstrate the different bread baking process.
3. Explain the principles and operate the equipment's in baking industry.
4. Assess the quality of ingredients and its impact on bread and cake
5. Prepare confectionery products and evaluate its quality characteristics.

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**TEXT BOOKS:**

2. Cauvain, Stanley P, and Young, Linda S., —Technology of Bread Making, 2007, springer

**REFERENCES:**


**FD3051 FLOUR CHEMISTRY AND RHEOLOGY**

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**UNIT II WHEAT FLOUR**

Wheat grain structure and composition, classification and grading, dry milling of wheat, flour characteristics, optimization, chemistry & biochemistry – wheat proteins, adverse reactions to wheat proteins, polysaccharides, interaction within components and interaction with other components

**UNIT III PHYSIOCHEMICAL TESTS & FUNCTIONAL TESTS**

Principles and methods of estimation of moisture, protein, ash, minerals, fats, diastatic activity, starch damage content, maltose value, flour colour grade value and flour particle size distribution. Principles and methods of estimation of gluten quantity, SDS -Sedimentation volume, falling number, dough raising capacity and alkaline water retention test. Significance of above tests in relation to bread, biscuits and cakes.

**UNIT IV BASIC APPROACHES TO DOUGH RHEOLOGY**

Dough structure and basics of rheology. Creep and recovery, viscometry, stress relaxation, oscillatory measurements. Empirical and fundamental testing. Rheological behavior of dough and gluten. Rheological properties of dough from high extraction, whole wheat and composite flours.
Importance of dough and gluten viscoelasticity in gas retention and bread making. Bakery ingredients and dough rheology: Effects of water, yeast, oxidation and compounds with disulfide and thiol groups, sugar and emulsifiers on rheological properties of dough.

UNIT V  RHEOLOGICAL TESTS
Flour constituents, processing parameters and dough rheology: Influence of proteins, gluten, starch and enzymes on rheological properties of dough. Effects of mechanical work, mixing time and temperature on dough rheology. Application of dough recording mixers for assessing physical properties of the dough such as mixing behavior, water absorption, dough strength and stability. Determination of Extensograph characteristics of the dough. Application of viscoamylograph in dough testing

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the use of wheat flour in bakery products
2. Perform the different tests for bakery products
3. Explain the concept of dough structure and basics of rheology
4. Assess the importance of rheological test for bakery products

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REFERENCES:
UNIT IV  FONDANTS AND CREAMS  9
Introduction, formulation and ingredients, manufacturing – fondant, powdered fondant, creams. Product characteristics, potential problems and trouble shooting.

UNIT V  CARAMEL, FUDGE AND TOFFEE  9

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the basics about different confectionery products.
2. Determine the production of hard candy, fondants and creams.
3. Assess the preparation of sugar confectionary products
4. Interpret the formulations of caramel, fudge and toffee

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REFERENCES:
2. Hartel W., - Confectionery science and technology, Springer, 2018
INDUSTRIAL PRODUCTION OF COOKIES AND BISCUITS

UNIT I
CLASSIFICATION AND PROCESSING TECHNOLOGY OF BISCUITS

UNIT II
BISCUIT MAKING MACHINES

UNIT III
CLASSIFICATION AND PROCESSING TECHNOLOGY OF COOKIES
Characteristic features of ingredients of cookies, Quality assessment of raw ingredients used in cookies. Types of cookies, general process of cookies production - mixing, dough sheeting, baking, cooling and packaging.

UNIT IV
COOKIE MAKING MACHINES

UNIT V
CRACKERS AND MISCELLANEOUS BISCUIT LIKE PRODUCTS
Classification of crackers - cream, soda and snack crackers. Manufacturing technology of crackers. Wafers and pretzels biscuits.

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Analyze the role of ingredients in baking
2. Evaluate the processing technology of biscuits.
3. Examine the working of biscuit and cookie making machines
4. Apply the processing technology of cookies

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REFERENCES:

INDUSTRIAL PRODUCTION OF BUN, BREAD, CAKES AND PASTRIES

UNIT I
BREAD MAKING PROCESS
Status of bakery industry. Bread formulation, basic bread making procedure - mixing.

Straight dough method, normal straight dough, 70% sponge and dough, 100% sponge and dough, soaker and dough method, ferment method, frozen dough process, micro-wave process. Advantages and limitations of various bread processes.

UNIT II   INGREDIENTS & BREAD MAKING MACHINES  9

UNIT III    BAKING OF CAKES  9

UNIT IV    MIXING METHODS AND PROCESSING TECHNOLOGY OF CAKES  9

UNIT V   CAKE MAKING MACHINES  9

UNIT V   PASTRY  9
Basic formulation - different types - flaky, puff and danish pastry- bakery products that combines flour and fat. Pie - types and methods. Preparation methods of danish pasties and the role of ingredients used. Cold and hot pastries

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Assess the role of ingredients in cake baking process.
2. Examine the different mixing methods and machineries.
3. Evaluate the role of ingredients in pastry production.
4. Demonstrate the pastry production.

REFERENCES:
UNIT I  INTRODUCTION

UNIT II  BREAD PACKAGING
Storage of bread, packaging specifications, characteristics of packaging material, types of packaging – fundamental classification, different packaging materials.

UNIT III  BISCUIT PACKAGING
Types of Biscuit Packaging, Packaging Functions, Packaging Materials, Modified Atmosphere Packaging, Vertical Form Fill Seal Packaging, On Edge Flowpack, Biscuits in Trays, Pile Packs, Cartons, Biscuit Tins

UNIT IV  PACKAGING OF CONFECTIONERY PRODUCTS
The container, metal cans, paper and associated materials, types of paper, metal foil, transparent films, metallized films, shrink and stretch films, laminates, the type of wrap, wrapping materials in display and advertising, mechanical sealing methods, dessicant pouches.

UNIT V  PACKAGING ADVANCES
Advance in packaging, different packaging materials, methods and machineries involved (primary, secondary and tertiary) in packaging. Selection of packaging materials and standards for baked products. Recent packaging techniques to extend the shelf life of the product. Technologies - MAP, hermetic packaging, convenient intelligent and smart packaging.

TOTAL:45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the basics of packaging.
2. Understand the packaging methods and materials for biscuit and bread.
3. Elaborate the packaging methods and materials for confectionery products.
4. Evaluate the different advances in packaging.

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TEXTBOOK:

REFERENCES:
UNIT I  SPECIFICATIONS FOR BAKERY INGREDIENTS AND PRODUCTS  9
BIS standards for whole wheat flour (atta), protein rich flour, maida, fortified maids, protein rich maids, suji (semolina), BIS standards for wheat flour used in bread/biscuit industry, limits for heavy metal contaminants in food grains, limits of pesticides/insecticides residues in food grains/milled food grains

UNIT II  FOOD SAFETY REGULATIONS & CERTIFICATION  9
Need for testing of food, notified NABL labs, referral labs and reference labs in India. GMP, GHP, GLP practices, HACCP implementation program. Regulations and standards for maintaining food safety and quality –BIS, FSSAI and International standards – FSSAI packaging and labeling requirements. FSSAI registration and licensing procedure.

UNIT III  BAKERY HYGIENE  9
Cleaning and Sanitation in bakery, General cleaning and sanitizing program Cleaning methods: Clean-out-of-Place Manual cleaning, Properties of food soils Cleaning agents, Sanitizers: Physical and chemical Factors affecting effectiveness of sanitizer

UNIT IV  SAFETY AND SANITATION  9

UNIT V  SENSORY ATTRIBUTES OF BAKERY PRODUCTS  9

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the different specifications for bakery products.
2. Apply the food safety regulations
3. Explain safety and sanitation followed in baking industries.
4. Appraise the different sensory attributes

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REFERENCES:
UNIT I  
**DRYING AND STORAGE OF MAJOR SPICES**  
9  
Different methods of drying and storage, microbial contamination of stored product, influence of temperature and time combination on active principles of spice crops, viz., Pepper, Cardamom, onion, ginger and turmeric. Extraction of oleoresin and essential oils.

UNIT II  
**DRYING AND STORAGE OF MINOR SPICES**  
9  
Different methods of drying and storage, microbial contamination of stored product, influence of temperature and time combination on active principles of spice crops, viz., Cumin, Coriander, Cinnamon, fenugreek, pepper, Garlic, Clove and Vanilla. Extraction of oleoresin and essential oils.

UNIT III  
**DRYING AND STORAGE OF PLANTATION CROPS**  
9  
Different methods of drying and storage, microbial contamination of stored product, influence of temperature and time combination on active principles of plantation crops, viz., coconut, arecanut, cashewnut, oil palm, palmyrah, cocoa, tea and coffee.

UNIT IV  
**FORMS, FUNCTIONS, AND APPLICATION OF SPICES**  
9  

UNIT V  
**EQUIPMENT IN SPICE PROCESSING**  
9  
Spice cleaning - Magnets, sifters, air tables, destoners, sir separators, indent separators, spiral separators. Spice reconditioning. Spice grinding - Different mills sifting operations, ambient condition grinding, cryogenic grinding. Post processing treatments - Ethylene oxide, propylene oxide, irradiation, steam sterilization.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES (COs)**  
At the end of the course the students would have the knowledge to  
1. Learn about drying and storage of spices  
2. Evaluate the extraction of flavour components from minor and major spices  
3. Acquire knowledge to forms, functions and application of spices  
4. Learn about equipment in spice processing.

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**TEXTBOOKS:**  

**REFERENCES:**  
1. ASTA, Official analytical methods of the American Spice Trade Association, IV Edition,
FD3058  BLENDING AND VALUE ADDITION  L  T  P  C
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UNIT I  9
Value added products: Spice powders, Curry powders, Sterilized spices, Enriched Spices, Encapsulation, aqueous flavourants.

UNIT II  9
Spice Oils & Oleoresins: Flavor extraction from spices by different methods. Estimation of principle constituents in spices & spice products, residual solvent in spice oleoresins.

UNIT III  9
Simple seasoning blends - Soluble seasonings, celery salt, garlic salt and onion salt, chili powder, curry powder, pickling spice, poultry seasoning, pumpkin pie spice, apple pie spice, oriental five spice blend.

UNIT IV  9
Spice applications - Marinades, rubs, glazes. Spice blends, seasonings and condiments.

UNIT V  9
Value addition Indian spices - Whole spices, spice blends, crushed spices, curry mixes, curry pastes, pickled spices, freeze dried spices, dehydrated spices, natural food colors, spice oils and oleoresins.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Learn about different value added spices
2. Acquire knowledge to spice oil and oleoresin production
3. Learn about different spice application.
4. Explain about value additions in spices.

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TEXTBOOK:
UNIT I  GREEN COFFEE PROCESSING

UNIT II  DECAFFEINATION OF COFFEE
Introduction, solvent decaffeination, water decaffeination, supercritical carbon dioxide decaffeination, decaffeination of roasted coffee and extract, caffeine refining.

UNIT III  ROASTING AND GRINDING
Introduction, process factors in roasting – mechanisms, chemical changes, heat factors, physical changes, measurement of roast degree. Roasting equipment – horizontal drum roasters, vertical fixed drum, rotating bowl, fluidized beds and ancillaries. Grinding equipment.

UNIT IV  EXTRACTION
Introduction, mechanism and methods – soluble solids extraction, volatile compound extraction, compositional factors. Process equipment – percolation batteries, screw extractor.

UNIT V  DRYING

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Learn about processing steps involved in green coffee processing and decaffeination.
2. Acquire knowledge to post-harvest processing of coffee
3. Assess the unit operations and processing steps involved in the manufacture of coffee
4. Learn about processing involved in instant coffee

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TEXT BOOK

REFERENCES
PROCESSING OF TEA

UNIT I INTRODUCTION


UNIT II GREEN TEA

Introduction to green tea production, manufacturing process – Post harvest spreading of leaves – Fixing, Rolling, Shaping and Drying. Chemical and Biochemical changes during green tea processing. Character of green tea – taste – chemical components responsible for tea taste, roast aroma.

UNIT III SEMI-FERMENTED TEA

Manufacturing process for semi fermented tea – Plucking, Pruning, Jat, Flush, Withering, Rolling, Shifter, Fermentation, Drying, Sorting and Grading. Character of semi fermented tea, aroma of oolong tea, mechanism, aroma pattern under different degrees of fermentation, infusion color and taste of oolong tea.

UNIT IV BLACK TEA

Introduction, orthodox tea, CTC tea. principal stages of processing – withering, cutting, rolling, oxidation or fermentation – different methods, drying or firing, sorting and fibre removal. Different grades of tea. Chemistry and biochemistry of black tea production - non volatiles. Green leaf polyphenols, polyphenol oxidase, black tea polyphenols. Tea aroma - Introduction, biogenetic pathways of the aroma compounds in the tea, changes in the composition of the aroma complex, use of the aroma complex.

UNIT V INSTANT TEA

Introduction, production of instant tea – Extraction, Decanting, aroma stripping, De-creaming, Concentration, Blending, Drying. Grading of tea, Processing and quality control.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)

At the end of the course the students would have the knowledge to

1. Learn about processing steps involved in different types of tea
2. Acquire knowledge to post-harvest processing of tea
3. Assess the unit operations and processing steps involved in the manufacture of coffee
4. Learn about processing involved in instant tea.

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TEXTBOOK:

REFERENCES:
UNIT I COCOA
Introduction, Flowering and pod development, Harvesting and pod opening, Bean composition and flavor precursor formation, Flavour development during post-harvest treatments of cocoa – Fermentation process and drying.

UNIT II INDUSTRIAL COCOA PROCESSING
Introduction, cocoa processing and technology – bean selection and quality criteria, cleaning, breaking and winnowing, sterilization, alkalization, roasting, nib grinding and liquor treatment, liquor pressing, cake grinding, cocoa powder production.

UNIT III CHOCOLATE MANUFACTURING PROCESSES
Mixing, refining, conching – dry conching, pastry phase, liquid conching, tempering, lipid crystallization and continuous phase character during chocolate, particle distribution in chocolate.

UNIT IV CHOCOLATE QUALITY AND DEFECTS

UNIT V CHEMISTRY OF FLAVOR DEVELOPMENT DURING PROCESSING
Introduction, influence bean selection on chocolate flavour quality, effect of roasting, flavour development during chocolate manufacture, key flavour compounds in milk chocolate, key flavour compounds in dark chocolate. Sensory perception of quality in chocolates.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the cocoa plantation
2. Acquire knowledge to cocoa processing and chocolate manufacturing technology
3. Learn about chemistry of flavour development during processing.
4. Evaluate chocolate quality and defects

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TEXTBOOK:
1. Emmanuel., - Chocolate science and technology, Wiley, 2010

REFERENCES:
1. Shanmugavelu KG, Kumar N, Production Technology of Spices and Plantation Crops, 1st Edition, Peter KV Publisher : Agrobios (India), 2018
UNIT I
INTRODUCTION

UNIT II
PACKAGING OF SPICES

UNIT III
CHEMICAL CHANGES IN SPICES AND SPICE PRODUCTS
Nature and deteriorative characteristics of spices and spice products - Loss of aroma and flavour, Bleaching of colour, Loss of free flowing nature, microbial spoilage and insect infestation. Packaging material requirement of spices and spice products. Packaging for seeds and fruits, Packaging for leaves and stems, Packaging for flowers and buds, Packaging for roots and rhizomes, Packaging for bark, wood and resins. Storage.

UNIT IV
PACKAGING METHODS AND MATERIALS FOR SPICES

UNIT V
PACKING OF ROAST, INSTANT COFFEE AND TEA

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand the basics of food packaging
2. Acquire knowledge to spice packaging on different aspects
3. Learn about the packaging of coffee and tea.
4. Understand packaging methods and materials for spices

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TEXTBOOK:
REFERENCES:
2. Shanmugavelu KG, Kumar N, Production Technology of Spices and Plantation Crops, 1st Edition, Peter KV Publisher: Agrobios (India), 2018

FD3063 SPICE PROCESSING AND PRODUCTS LAWS, QUALITY STANDARDS AND REGULATIONS

UNIT I SPICE LABELING, STANDARDS, REGULATION AND QUALITY SPECIFICATIONS
Spice definition and labeling, spice regulations, spice authenticity and quality concerns, spice quality specifications, maintaining spice quality.

UNIT II PACKAGING, GRADING AND QUALITY ANALYSIS OF SPICES
Cleaning and grading of spices - packaging and storage of spices – grading specifications – AGMARK, ASTA, ESA specifications - processes involved in the manufacture of oleoresins and essential oils – quality analysis of spices and their derivatives

UNIT III ANALYSIS OF PLANTATION PRODUCTS
Tea & Coffee- Preparation of sample, Moisture content, Total ash, Water soluble ash, Determination of Caffeine content by different methods, Microscopic examination, Determination of solubility in boiling water, Determination of Iron filings and size of the particles, Test for presence of added colouring matter

UNIT IV ANALYSIS OF SPICES
Spices- Sample preparation, Determination of moisture, Acid insoluble ash, Determination of Cold Water Extract, Determination of Alcohol Soluble Extract, Calcium Oxide, Non Volatile Ether Extract, Volatile Oil, Crude Fibre

UNIT V SPICE SPECIFIC TESTS
Allyl isothiocyanate in Mustard, p-hydroxybenzyl isothiocyanate in white mustard, Microscopic Examination of Spices, Black Pepper- Determination of Bulk density, Light berries, Piperine content, Turmeric- Determination of curcumin content, Starch content, Detection of chromate content, Detection of Argemone seeds in Mustard, Detection of Mineral Oil in Black Pepper, Detection of Papaya seeds in Black, Pepper, Detection of Turmeric in Chillies and Coriander, Detection of Oil Soluble Colour, Determination of Light and Heavy Filth in Spices and Condiments, Determination of capsaicin content in chilli powder.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand about the standards and specifications
2. Acquire knowledge to packaging, grading and quality analysis of spices
3. Learn about analysis of spices.
4. Assess the quality analysis of spices with respect to active constituents.
FD3064  INTRODUCTION TO FOOD SAFETY ANALYSIS AND QUALITY RISK MANAGEMENT

UNIT I  9
1 General overview of Food Safety, 2 Food Industry: A glance 3: Understanding contemporary U.S. food safety policy 4: Food laws and policies of India 5: Study on Food-borne Hazards, Illness & Epidemics, Food GMP and its regulations.

UNIT II  9
Food Safety Management System (HACCP LEVEL 4, ISO 22000/FSSC 22000), International standards and regulations for food safety, Understanding the basic concepts of microbiology in food safety, Emerging trends in food safety (like HARPC, etc), Food Quality Regulations and guidelines in India

UNIT III  9
Quality, Quality Assurance and Quality Control in pharmaceutical industry, Qualification and Validation, Quality Assurance and Quality Control- Possible Problems and Fixes, Introduction to Quality Risk Management & Total Quality Management, Computer System Validation (CSV), WHO Risk Based Approach Analysis, Case Studies

UNIT IV  9
Over view of food supply chain, Risks and Controls in Food Chain, Potential Hazards, Good Hygiene practices in food chain, Examples of Food safety Incidents, One Point Lessons in online Production, Risk and Control, Backward and forward flow of process line, Instrumental analysis of Food

UNIT V  9
Sensory Evaluation of Food, Good Laboratory Practices - Food Laws, Applied Statistical Method in Quality Assurance, Practical on Food Analysis – Hand on training on Physical Analysis, Chemical Analysis and Instrumentation Analysis of food, Laboratory demonstration, practicals and instrument handling

TOTAL: 45 PERIODS
COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand about the basic Food Safety laws
2. Assess the safety with National and International standards
3. Facilitate in understanding the overall food safety and hazard controls.
4. Examine the quality with Sensory Evaluation of Food, Good Laboratory Practices

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TEXTBOOKS:
1. Food Safety Management: A Practical Guide for the Food Industry
2. Food Safety Hand Book - Ronald H. Schmidt, Gary E. Rodrick
3. Food Safety Sanitation and Personal Hygiene

FD3065 HACCP IN FOOD PROCESSING AND PRESERVATION L T P C
3 0 0 3

UNIT I
Food Safety: HACCP Principles, Haccp Plan, 2 Role of Pre requisite programmes (PRP) Operational Pre-REQUISITE Programmes (OPRP) and GMP in Food Industry, Implementation of HACCP in a food industry/retail food establishment/catering industry. Documentation required for implementation of HACCP.

UNIT II
HACCP levels, CP's, CCP Controls, Audit: First, second- & third-party audits, CAPA report Comprehensive global perspective of HACCP (USA, Canada, UK, EU, Africa, Japan) HACCP as a part of ISO 22000/FSSC 22000 8, HACP plan Preparation for different food products, Case Studies

UNIT III
Introduction to Food Processing, Food processing and its types, Microbial, Chemical, Physical Hazards, HACCP generic Model, Importance of Equipment/ Process Selection, Advantages in Implementing HACCP, Risks at different stages of Food Chain. Food Preservation and techniques, Food Good Manufacturing Practices, Good Laboratory Practices HACCP Implementation in Storage and Transport, Retail and Distribution

UNIT IV
Food Plant Design, layout and Food Logistics, Food Packaging Technology and Labelling Food Microbiology, food borne illness and hazards, Food Sensory Evaluation, Entrepreneurship Development in Food Processing, Case studies, Quality Risk Assessment, Quality Risk Management: Ins and Outs, Deviation Management, CAPA, and Change control, Case Study.
UNIT V
HACCP based approach towards Food Safety, Principles of HACCP, Steps in HACCP, VACCP, Principles of Food Preservation, Processing and Packaging, Food Processing Operations, Principles, Good Manufacturing Practices, principles including novel and emerging methods, Hazards Associated with Sea foods, production of safe sea foods – Pre requisite programmes and HACCP, Risk assessment at different stages of sea food process, Application of HACCP, VACCP and TACCP system in Sea food Process

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand about the HACCP and its principles
2. Appraise the implementation of HACCP in food industries
3. Facilitate in understanding the overall protection and handling of food materials
4. Apply the Food Plant Design, layout, Food Logistics, Food Packaging Technology and Labelling

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TEXTBOOKS:
1. Food Safety Management: A Practical Guide for the Food Industry
2. Food Safety Hand Book - Ronald H. Schmidt, Gary E. Rodrick

FD3066 FSMS AND FOOD PRODUCT AND SUPPLY CHAIN MANAGEMENT
UNIT I
Introduction to GMP & PRP in the food industry, Global Food regulatory Authorities, Concept of HACCP implementation, Hazards and Risks, ISO 22000: Food Safety Management System.

UNIT II

UNIT III
COP Cleaning, Sanitization Chemistry, Common Cleaning Problems in Food Process environment.

UNIT IV 9

UNIT V 9
Food Industry- An Overview, Role of GMP & GAP in Food Supply Chain, Principles of Food Supply Chain Management, Principles of Management, Food Quality & Safety Aspects of Food Supply Chain (An international perspective) Food Supply Chain Risk Management and Mitigation Strategies, Industry based Case Studies

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand about the overall food plant management
2. Understand about the regulations and their role in managing the food safety.
3. Facilitate them in understanding the overall management of food safety at all stages of food supply chain.
4. Evaluate the Formulation and Optimization of New Product

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2. Food Safety Hand Book - Ronald H. Schmidt, Gary E. Rodrick
3. Food Safety Sanitation and Personal Hygiene

FD3067 FOOD LAWS – INDIAN AND INTERNATIONAL L T P C 3 0 0 3

UNIT I 9
Food Safety and Standards Act of India, 2006: Provision, definitions and different sections of the Act and implementation, FSS Rules and Regulations, Overview of other relevant national bodies (e.g. APEDA, BIS, EIC, MPEDA, Spice Board etc.); International Food Control Systems/Laws, Regulations and Standards/Guidelines with regard to Food Safety – (i) Overview of CODEX Alimentarius Commission (History, Members, Standard setting and Advisory mechanisms: JECFA, JEMRA JMPR): WTO agreements (SPS/TBT), Important national and international accreditation bodies
UNIT II  9
Food Regulatory Affairs: Introduction to global regulatory authorities for food Industry, Food GMP and its regulations, From Farm to Fork: Understanding the Food Regulatory Cycle [International perspective of USA, Europe, UK, Canada, GCC (UAE), South Africa, Australia & New Zealand], Food safety in the process chain,

UNIT III  9
Documentation for launch of a new food product and regulatory filing in US, Europe, UK, India, Canada and Japan, Food Industry IPR, Patents, Copyrights and Trademarks, Food Product Marketing, Import and Export regulations, Compliance guidelines, Govt. Audits (FSSAI, BIS, etc), Food Regulations & Guidelines in India, Food Licensing & Registration in India, Industry based case studies

UNIT IV  9
FSSAI – Role, Functions, Initiatives (A General Understanding) Genesis and Evolution of FSSAI, Structure and Functions of Food Authority, Overview of systems and processes in Standards, Enforcement, Laboratory ecosystem, Imports, Third Party Audit etc., Promoting safe and wholesome Food (Eat Right India, Food Fortification, snf, Clean Street Food Hub, RUCO and various other social and behavioural change initiatives),

UNIT V  9
Training and capacity building, Role of State Food Authorities. Food Safety Compliance System (FoSCoS), Foos Safety Training and Certification (FoSTaC), Food Licensing and Registration System’ or (FLRS), food business operators, Food Import Clearance System, Indian Food Laboratory Network, (INFoLNET) RUCO, Detect Adulteration with Rapid Test (DART) FSSAI e Books on Food Safety (pink, purple, Yellow, Orange etc)

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand about the Food Safety
2. Understand about the regulations and training of food safety
3. Facilitate in understanding the overall view of FSSAI laws and regulations.
4. Comprehend the Training and capacity building and Role of State Food Authorities

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TEXTBOOKS:
1. Food Safety Management: A Practical Guide for the Food Industry
2. Food Safety Hand Book – Ronald H. Schmidt, Gary E. Rodrick
3. Food Safety and Hygiene Regulations.
4. www.fssai.gov.in
FD3068  FOOD SAFETY IN HOSPITALITY INDUSTRY AND GLP IN FOOD INDUSTRIES  L T P C  3 0 0 3

UNIT I  9

UNIT II  9
Use of Computers in the laboratory, General Good Testing Conduct, International GLP of the OECD, FDA etc, Management, Personnel, Buildings & Equipment, Validation and Quality Assurance, Inspection of a testing facility, Laboratory demonstration, practicals and instrument handling, Case studies

UNIT III  9
Hospitality Industry – An overview (hotels, restaurants, cafeterias, hospitals, travel & tourism, contract caterings etc) Food safety sensitization in Hospitality Industry, Food safety in preparation and service Premises, safety and personnel health & hygiene, Supply and storage of food in Hospitality Industry

UNIT IV  9

UNIT V  9
Introduction to Food and Nutrition, Basics of Food Microbiology, Extrinsic and Intrinsic factors of microbial growth, Significance and principles of food preservation, Fermentation process and their products, Food Spoilage, Food safety guidelines for microbiology, Laboratory demonstration, practical and instrument handling, Industry based Case Studies

TOTAL: 45 PERIODS

COURSE OUTCOMES (COS)
At the end of the course the students would have the knowledge to
1. Understand about the Food Safety in laboratories
2. Apply the laws of food safety in hospitality industry
3. Facilitate in understanding the overall management of food quality control.
4. Organise the basics of food microbiology and food borne-pathogens

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FD3069 FOOD ANALYSIS, TESTING AND MICROBIAL SAFETY ANALYSIS  

**UNIT I**  
Food Microbiology & General principles of Food Hygiene, General principles of food microbiology and overview of food borne pathogens, General principles and techniques in microbiological examination of foods, Overview of sources of microorganisms in food chain (raw materials, water, air, equipment etc.) and microbiological quality of foods, Microbial food spoilage and Food borne diseases, quantitative methods of microbial measurement,

**UNIT II**  
Principles and Basics of Food Chemistry and their role in Human Nutrition, Structure and functions of macro-and micro nutrients, Role of macro and micronutrients in human nutrition, Overview of food additives with respect to their technological functions, Overview of anti-nutritional factors and their removal from foods, Overview of beneficial microorganisms and their role in food processing and human nutrition

**UNIT III**  
Overview of enzymes as food processing aids, Overview of nutraceuticals and functions foods, Overview of food contaminants and adulterants and their effects on human health, Food allergens and allergen city, Importance of diet in alleviating health risks, especially non-communicable diseases,

**UNIT IV**  
Fundamentals of field level and laboratory sampling with reference to importance of statistical tools, Overview of basic/classical methods of food analysis, Overview of modern analytical techniques including mass spectrometry and molecular techniques, Principles of Quality assurance and Quality control with reference to food analysis and testing, general concepts of food analysis and testing,

**UNIT V**  
General principles of food safety management systems including traceability and recall – sanitation, HACCP, Good production and processing practices - GMP, GAP, GHP, GLP, BAP

**TOTAL: 45 PERIODS**

**COURSE OUTCOME**
- CO1 To make the student to understand about the microbial food safety
- CO2 To make the student to understand about the hard controls at all stages of food manufacturing
- CO3 To facilitate them in understanding the overall management of food laboratory

**TEXTBOOKS:**
FD3070 FOOD QUALITY ASSURANCE AND QUALITY CONTROL L T P C 3 0 0 3

UNIT I
Fundamentals of Food Quality Assurance and Quality Control, Quality Assurance in Food Industry Validation and Verification, Quality Control and testing procedures, Documentation, Good Documentation Practices, SOPs & Protocols, Establishing Quality Control Checks Inspection & Audits.

UNIT II

UNIT III
Introduction to Food GMPs, cGMPs (US FDA & WHO), HVAC Systems, Food HVAC Rules and Design, Validation of HVAC Systems, HVAC Audit and Inspection, WIP, CIP, Sanitation and Hygiene Practices and In-Process, Good Laboratory Practices (GLP), Physical & Chemical analysis of food, Molecular and Elemental Analysis of Food.

UNIT IV
Guidelines for Sample preparation, Instrument operation and Interpretation of results, laboratory demonstration and requirements, Lay Out and Design of Lab, ISO requirement for food testing lab (ISO 17025), Microbiological analysis of food, Swab Analysis in-Process and Off – Line Process, FSSAI Regulations for food laboratory.

UNIT V
Introduction of FSSAI, Recent update in FSSAI , Location, Layout & Facilities (Pre-Requisite Program), Receiving and storage, Types of cross-contamination, Pre-Production (Vegetable washing, thawing), Production (Cooking, Cooling, and Reheating), Holding, serving/catering/dining/transportation, Personal hygiene, Pest control, Cleaning and maintenance, Waste Handling, Record Keeping, Consumer Awareness.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)
At the end of the course the students would have the knowledge to
1. Understand about Food Safety required for Industry
2. Comprehend the quality assurance and delivery of safe to end users.
3. Evaluate the overall food safety management
4. Explain various Food safety standards and regulations

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**TEXTBOOKS:**
1. Food Safety Management: A Practical Guide for the Food Industry
2. Food Safety Hand Book - Ronald H. Schmidt, Gary E. Rodrick

**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

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

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

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

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

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

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

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

MX3084 DISASTER RISK REDUCTION AND MANAGEMENT

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

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

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

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


UNIT V
DISASTER MANAGEMENT: CASE STUDIES

Discussion on selected case studies to analyse the potential impacts and actions in the 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:

REFERENCES

COURSE OUTCOME:

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

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MANDATORY COURSES II
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 handle every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

UNIT I HEALTH AND ITS IMPORTANCE 2+4
Health: Definition - Importance of maintaining health - More importance on prevention than treatment
Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional health.


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

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

UNIT II DIET 4+6
Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.


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

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

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
COURSE OUTCOMES:
After completing the course, the students will be able to:

- Learn the importance of different components of health
- Gain confidence to lead a healthy life
- Learn new techniques to prevent lifestyle health disorders
- Understand the importance of diet and workouts in maintaining health

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

UNIT-I CONCEPTS AND PERSPECTIVES
Meaning of History
Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history
Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism.

Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

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

UNIT-III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA
Technology in pre-historic period
Beginning of agriculture and its impact on technology
Science and Technology during Vedic and Later Vedic times
Science and technology from 1st century AD to C-1200.
UNIT-IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA
Legacy of technology in Medieval India, Interactions with Arabs
Development in medical knowledge, interaction between Unani and Ayurveda and alchemy
Astronomy and Mathematics: interaction with Arabic Sciences
Science and Technology on the eve of British conquest

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

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

TOTAL : 45 PERIODS

MX3087 POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY

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

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

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

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

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

(Refs: Adam smith, J S Mill)

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

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

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

Welfare state. Relation with human desires. Empowered human beings, satisfaction. (3 lectures)

Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one’s lives. Relationship with nature. (6 lectures)

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

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

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

Conclusion (2 lectures)

Total lectures: 39

Preferred Textbooks: See Reference Books

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

GRADING:

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TOTAL : 45 PERIODS

OUTCOME:

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

MX3088 STATE, NATION BUILDING AND POLITICS IN INDIA

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

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

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


1857 and the national awakening.

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

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

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

SUGGESTED READING:

TOTAL : 45 PERIODS

MX3089 INDUSTRIAL SAFETY

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

UNIT I SAFETY TERMINOLOGIES
Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold 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

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

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

REFERENCES
5. Society of Safety Engineers, USA

ONLINE RESOURCES
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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

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

UNIT III LEARNING

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

UNIT IV SUPERVISED LEARNING


UNIT V UNSUPERVISED LEARNING

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

PRACTICAL EXERCISES: 30 PERIODS

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

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

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

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

TOTAL PERIODS: 60

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

REFERENCES

OCS352
IOT CONCEPTS AND APPLICATIONS

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

UNIT I
INTRODUCTION TO INTERNET OF THINGS

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

UNIT III
PROTOCOLS AND TECHNOLOGIES BEHIND IOT
UNIT IV OPEN PLATFORMS AND PROGRAMMING 7

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

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

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

TOTAL PERIODS: 60

TEXTBOOKS

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

OCS353 DATA SCIENCE FUNDAMENTALS L T P C
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COURSE OBJECTIVES:
● Familiarize students with the data science process.
● Understand the data manipulation functions in Numpy and Pandas.
● Explore different types of machine learning approaches.
● Understand and practice visualization techniques using tools.
● Learn to handle large volumes of data with case studies.

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

UNIT II  DATA MANIPULATION

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

UNIT IV  DATA VISUALIZATION

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

PRACTICAL EXERCISES:

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

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

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

TOTAL PERIODS: 60

TEXT BOOKS

REFERENCES

CCS333 AUGMENTED REALITY/VIRTUAL REALITY

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

UNIT I INTRODUCTION

UNIT II VR MODELING

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

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

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

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

OUTCOMES:
On completion of the course, the students will be able to:
CO1: Understand the basic concepts of AR and VR
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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
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

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CO-PO & PSO MAPPING

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

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

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

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

UNIT III  CORE CONCEPTS IN LEAN
Concepts in lean thinking - Principles of lean construction - Variability and its impact - Traditional construction and lean construction - Traditional project delivery - Lean construction and workflow reliability - Work structuring - Production control.

UNIT IV  LEAN TOOLS AND TECHNIQUES

UNIT V  LEAN IMPLEMENTATION IN CONSTRUCTION INDUSTRY
Lean construction implementation - Enabling lean through information technology - Lean in design - Design Structure - BIM (Building Information Modelling) - 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

219
• 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

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

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

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

UNIT – II SOLAR ENERGY
UNIT – III WIND ENERGY

UNIT – IV BIO-ENERGY

UNIT – V OCEAN AND GEOTHERMAL ENERGY

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

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Low (1) ;  Medium (2) ;  High (3)
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  9
Exploring Human-centered Design - Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy-building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] - Case studies

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

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

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS
1. Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
REFERENCES
1. https://www.ideou.com/pages/design-thinking#process
4. https://blog.forgeward.in/evaluating-product-innovations-e8178e58b86e
5. https://blog.forgeward.in/user-guide-for-product-innovation-rubic-857181b253dd
6. https://blog.forgeward.in/start-up-failure-is-like-true-lie-7812cdfe9b85

MF3003 REVERSE ENGINEERING LT P C
3 0 0 3

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

UNIT I INTRODUCTION & GEOMETRIC FORM 9 Hours

UNIT II MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION 9 Hours

UNIT III DATA PROCESSING 9 Hours

UNIT IV 3D SCANNING AND MODELLING 9 Hours

UNIT V INDUSTRIAL APPLICATIONS 9 Hours

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
- Apply the fundamental concepts and principles of reverse engineering in product design
and development.

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

TEXT BOOKS:

REFERENCES:

OPR351 SUSTAINABLE MANUFACTURING

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
UNIT – IV  MANUFACTURING STRATEGY FOR SUSTAINABILITY
9
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
9
Principles of sustainable operations - Life cycle assessment manufacturing and service activities -
influence of product design on operations - Process analysis – Capacity management - Quality
management - Inventory management - Just-In-Time systems - Resource efficient design -
Consumerism and sustainable well-being.

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.

TOTAL: 45 PERIODS

Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS:
1. Ibrahim Garbie, “Sustainability in Manufacturing Enterprises Concepts, Analyses and
Assessments for Industry 4.0”, Springer International Publishing., United States, 2016,

REFERENCES:
Competitive and Sustainable High-Adding-Value Manufacturing”, Springer,2009, United
COURSE OBJECTIVES:

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

UNIT I  DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES  9


UNIT II  ENERGY SOURCES  9


UNIT III  MOTORS AND DRIVES  9

Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT IV  POWER CONVERTERS AND CONTROLLERS  9


UNIT V  HYBRID AND ELECTRIC VEHICLES  9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the student will be able to

1. Understand the operation and architecture of electric and hybrid vehicles
2. Identify various energy source options like battery and fuel cell
3. Select suitable electric motor for applications in hybrid and electric vehicles.
4. Explain the role of power electronics in hybrid and electric vehicles
5. Analyze the energy and design requirement for hybrid and electric vehicles.

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 - Newtons 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:
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

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

TOTAL: 45 PERIODS
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OIE354 QUALITY ENGINEERING  L  T  P  C  3  0  0  3

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

UNIT I INTRODUCTION

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

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

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

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

TOTAL: 45 PERIODS

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

- To enable the students to acquire knowledge of Fire and Safety Studies
- To learn about the effect of fire on materials used for construction, the method of test for non-combustibility & fire resistance
- To learn about fire area, fire stopped areas and different types of fire-resistant doors
- To learn about the method of fire protection of structural members and their repair due to fire damage.
- 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 PERIODS: 45**
COURSE OUTCOMES
On completion of the course the student will be able to
CO1: Understand the effect of fire on materials used for construction
CO2: Understand the method of test for non-combustibility and fire resistance; and will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.
CO3: To understand the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.
CO4: To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.
CO5: Describe the safety techniques and improve the analytical and intelligence to take the right decision at right time.

TEXT BOOKS

REFERENCES:

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

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OML351 INTRODUCTION TO NON-DESTRUCTIVE TESTING

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

- Understanding the basic importance of NDT in quality assurance.
- Imbibing the basic principles of various NDT techniques, its applications, limitations, codes and standards.
- Equipping themselves to locate a flaw in various materials, products.
- Applying apply the testing methods for inspecting materials in accordance with industry specifications and standards.
- Acquiring the knowledge on the selection of the suitable NDT technique for a given application.
UNIT I  INTRODUCTION TO NDT & VISUAL TESTING  
Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting.

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

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

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

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

TOTAL: 45 PERIODS

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

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

UNIT – V ACTUATORS AND MECHATRONICS SYSTEM DESIGN

TOTAL: 45 PERIODS
COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Select sensors to develop mechatronics systems.
CO2: Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.
CO3: Design appropriate interfacing circuits to connect I/O devices with microprocessor.
CO 4: Apply PLC as a controller in mechatronics system.
CO 5: Design and develop the apt mechatronics system for an application.

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TEXT BOOKS

REFERENCES

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

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

UNIT – III  ROBOT DRIVE SYSTEMS AND END EFFECTORS  9
Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo
Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison
of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic
Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection
and design considerations of a gripper

UNIT – IV  SENSORS IN ROBOTICS  9
Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety
considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and
compliance mechanism. Machine vision system – camera, frame grabber, sensing and
digitizing image data – signal conversion, image storage, lighting techniques, image processing
and analysis – data reduction, segmentation, feature extraction, object recognition, other
algorithms, applications – Inspection, identification, visual serving and navigation.

UNIT – V  PROGRAMMING AND APPLICATIONS OF ROBOT  9
Teach pendant programming, lead through programming, robot programming languages – VAL
programming – Motion Commands, Sensors commands, End- Effector Commands, and simple
programs - Role of robots in inspection, assembly, material handling, underwater, space and
medical fields.

TOTAL: 45 PERIODS

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

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TEXT BOOKS:
REFERENCES:

OAE352 FUNDAMENTALS OF AERONAUTICAL ENGINEERING

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

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

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

UNIT III BASICS OF AERODYNAMICS

UNIT IV BASICS OF AIRCRAFT STRUCTURES

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

TOTAL : 45 PERIODS

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 9

UNIT V DATA PRODUCTS AND INTERPRETATION 9
Photographic and digital products – Types, levels and open source satellite data products — selection and procurement of data– Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification

TOTAL:45 PERIODS
COURSE OUTCOMES:
On completion of the course, the student is expected to
CO 1 Understand the concepts and laws related to remote sensing
CO 2 Understand the interaction of electromagnetic radiation with atmosphere and earth material
CO 3 Acquire knowledge about satellite orbits and different types of satellites
CO 4 Understand the different types of remote sensors
CO 5 Gain knowledge about the concepts of interpretation of satellite imagery

TEXTBOOKS:

REFERENCES:

CO-PO MAPPING

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OAI351 URBAN AGRICULTURE L T P C 3 0 0 3

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

UNIT II VERTICAL FARMING

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

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

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CO-PO MAPPING

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| PSO1 | To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill | 1 | 2 | 1 | 1 | 2 | 1 |

| PSO2 | To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies. | 2 | 1 | 2 | 1 | 1 |

| PSO3 | To inculcate entrepreneurial skills through strong Industry-Institution linkage. | 1 | 2 | 1 | 2 | 1 |

**OEN351 DRINKING WATER SUPPLY AND TREATMENT**

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

**UNIT I SOURCES OF WATER**

**UNIT II CONVEYANCE FROM THE SOURCE**

**UNIT III WATER TREATMENT**
- Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation — sand filters - Disinfection - –Construction, Operation and Maintenance aspects.

**UNIT IV ADVANCED WATER TREATMENT**
UNIT V   WATER DISTRIBUTION AND SUPPLY

TOTAL: 45 PERIODS

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

TEXTBOOKS:

REFERENCES:

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

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

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

COURSE OBJECTIVES
- To provide knowledge about electric machines and special machine
- To understand the basics of power converters
- To know the concepts of controlling DC and AC drive systems
- To understand the architecture and power train components.
- To impart knowledge on vehicle control for standard drive cycles of hybrid electrical vehicles (HEVs)
UNIT I  ROTATING POWER CONVERTERS  9

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

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

UNIT IV  HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS  9

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

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:
4 Rashid M.H., “Power Electronics Circuits, Devices and Applications ”, Pearson, fourth Edition,
INTRODUCTION TO PLC PROGRAMMING

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

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

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

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

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

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

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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OCH351  NANO TECHNOLOGY  L T P C

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

UNIT II  SYNTHESIS OF NANOMATERIALS  8
Bottom up and Top-down approach for obtaining nano materials—Precipitation methods—sol gel technique—high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods—laser ablation, sputtering.

UNIT III  NANO COMPOSITES  10
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

Course articulation matrix

<p>| Course 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 | PSO 1 | PSO 2 | PSO 3 |
|-----------------|------------------------------------------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| CO1             | understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications | 2    | 3    | 2    | 3    | 3    | -    | -    | -    | -    | 1     | 1     | -     | 1     | 1     | 1     |
| CO2             | acquire knowledge about the different types of nano material synthesis | 2    | 3    | 1    | 3    | 3    | -    | -    | -    | -    | 1     | 1     | -     | 3     | 2     | 1     |
| CO3             | describes about the shape, size,structure of composite nano materials and their | 2    | 2    | 2    | 3    | 3    | 1    | 1    | -    | -    | 1     | 1     | -     | 3     | 2     | 1     |</p>
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**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**

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

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

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

**TEXT BOOK:**
COURSE OBJECTIVES:

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

UNIT I INTRODUCTION- INTELLECTUAL PROPERTY RIGHTS

Introduction, Types of Intellectual Property Rights - patents, plant varieties protection, geographical indicators, copyright, trademark, trade secrets.

UNIT II PATENTS

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

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

UNIT IV ENFORCEMENT AND PRACTICAL ASPECTS OF IPR


UNIT V INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY


TEXT BOOKS:


REFERENCES:

2. Basic Principles of patent law – Basics principles and acquisition of IPR. Ramakrishna T. CIPRA, NLSIU, Bangalore, 2005
access, Croatia, 2017.

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

CO – PO MAPPING

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OTT351 BASICS OF TEXTILE FINISHING

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

UNIT I RESIN FINISHING

UNIT II FLAME PROOF & WATERPROOF

UNIT III SOIL RELEASE AND ANTISTATIC FINISHES

UNIT IV MECHANICAL FINISHES

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

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

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

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

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

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

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
2. Chuter A. J., “Introduction to Clothing Production Management”, Wiley-Black well Science,
4. Rajesh Bheda, “Managing Productivity in Apparel Industry “CBS Publishers & Distributors,
   2008

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

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

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

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

UNIT V  
BASICS OF KNITTING AND NONWOVEN  

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

TEXTBOOKS
REFERENCES:

Course Articulation Matrix:

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

UNIT I  ORIGIN, FORMATION AND REFINING OF CRUDE OIL  9
Origin, Formation and Evaluation of Crude Oil. Testing of Petroleum Products. Refining of Petroleum -
Atmospheric and Vacuum Distillation.

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

UNIT III  REFORMING AND HYDROTREATING  9
Catalytic Reforming of Petroleum Feed Stocks. Lube oil processing- Solvent Treatment Processes,
Dewaxing, Clay Treatment and Hydrofining. Treatment Techniques: Removal of Sulphur Compounds
in all Petroleum Fractions to improve performance.

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

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

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

TEXT BOOKS
Sons,1986.

REFERENCES
CPE334  ENERGY CONSERVATION AND MANAGEMENT  L T P C

3 0 0 3

OBJECTIVES:

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

UNIT I  INTRODUCTION


UNIT II  ELECTRICAL SYSTEMS


UNIT III  THERMAL SYSTEMS


UNIT IV  ENERGY CONSERVATION IN MAJOR UTILITIES

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V  ECONOMICS

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

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to analyze the energy data of industries.

CO1: Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.

CO2: Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.

CO3: Skills on combustion thermodynamics and kinetics.

CO4: Apply calculation and design tube still heaters.

CO5: Studied different heat treatment furnace.

CO6: Practical and theoretical knowledge burner design.

TEXT BOOKS:


REFERENCES:

OPT351  BASICS OF PLASTICS PROCESSING  L T P C

3 0 0 3

COURSE OBJECTIVES

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

UNIT I  INTRODUCTION TO PLASTICS PROCESSING


UNIT II  EXTRUSION


UNIT III  INJECTION MOLDING


UNIT IV  COMPRESSION AND TRANSFER MOLDING

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

UNIT V  BLOW MOLDING, THERMOFORMING AND CASTING  9

TOTAL HOURS: 45

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
Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals -Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant& Time-invariant,Causal & Non-causal, Stable & Unstable.
UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9
Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and Properties

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 9

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

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

TEXT BOOKS:

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

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

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

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

UNIT IV FEEDBACK AMPLIFIERS AND OSCILLATORS

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

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

TEXT BOOKS:
REFERENCES:

CBM348 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT

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

UNIT I BASICS OF PRODUCT DEVELOPMENT

UNIT II REQUIREMENTS AND SYSTEM DESIGN

UNIT III DESIGN AND TESTING
Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation

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

UNIT V  BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY

TOTAL: 45 PERIODS

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

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

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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

UNIT I  CARDIAC ASSIST DEVICES  9
Cardiac functions and parameters, principle of External counter pulsation techniques, intra aortic balloon pump, Auxiliary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, cardiac pacemaker.

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

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

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

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

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
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:**

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OMA353 ALGEBRA AND NUMBER THEORY

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

UNIT I  MATRICES AND SYSTEM OF LINEAR EQUATIONS  9

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

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

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

UNIT V  EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION  9

TOTAL : 45 PERIODS

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

TEXT BOOKS

REFERENCES
5. Strang G, Linear Algebra and its applications, Thomson (Brooks / Cole) New Delhi, 4th
OBT352        BASICS OF MICROBIAL TECHNOLOGY          L T P C

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
9
Fermented products – Fermented Beverages, Curd, Cheese, Mushroom, Agricultural products – Biopesticide, Biofertilizers, Vermi compost, Pharmaceutical products - Antibiotics, Vaccines

TOTAL: 45 PERIODS

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

TEXT BOOKS
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

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

TOTAL: 45 PERIODS

TEXT BOOKS
REFERENCES

OBT354 FUNDAMENTALS OF CELL AND MOLECULAR BIOLOGY

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

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

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

UNIT III BIO-MEMBRANE TRANSPORT

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

UNIT V CENTRAL DOGMA

TOTAL: 45 PERIODS

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

TEXTBOOKS:
REFERENCES:

OPEN ELECTIVE IV

OHS352 PROJECT REPORT WRITING

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

UNIT I

UNIT II

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

UNIT IV

UNIT V

TOTAL:45 PERIODS

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

## CO-PO & PSO MAPPING

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

### REFERENCES


### OCE354 BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT

**OBJECTIVES**

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

**UNIT I OVERVIEW OF IWRM**


**UNIT II WATER USE SECTORS: IMPACTS AND SOLUTION**

Water users: People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management.

**UNIT III WATER ECONOMICS**

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

**UNIT IV RECENT TRENDS IN WATER MANAGEMENT**

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

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

TOTAL: 45 PERIODS

OUTCOMES

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

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

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

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

CO4 Illustrate the recent trends in water management.

CO5 Understand the implementation hitches and the institutional frameworks.

TEXT BOOKS


REFERENCES


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


OMA355 ADVANCED NUMERICAL METHODS

OBJECTIVE:

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

UNIT I ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEM


UNIT II INTERPOLATION

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

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.

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OMA357 QUEUEING AND RELIABILITY MODELLING

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

UNIT I RANDOM PROCESSES

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

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

UNIT IV SYSTEM RELIABILITY

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

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

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

TEXT BOOKS

REFERENCES

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OMG354 PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS

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

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

Production Systems- principles – Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning- Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry

UNIT III PRODUCTION & OPERATIONS PLANNING

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

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS


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

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

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

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

TOTAL: 45 PERIODS

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

REFERENCES:

OME352 ADDITIVE MANUFACTURING

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

UNIT I INTRODUCTION

UNIT II VAT POLYMERIZATION AND MATERIAL EXTRUSION

UNIT III POWDER BED FUSION AND BINDER JETTING

UNIT IV MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:
REFERENCES:

CME343 NEW PRODUCT DEVELOPMENT

COURSE OBJECTIVES
1. To introduce the fundamental concepts of the new product development
2. To develop material specifications, analysis and process.
3. To Learn the Feasibility Studies & reporting of new product development.
4. To 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.

280
UNIT – V
REPORTING & FORWARD-THINKING OF NPD

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

TOTAL : 45 PERIODS

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

1. Discuss fundamental concepts and customer specific requirements of the New Product development
2. Discuss the Material specification standards, analysis and fabrication, manufacturing process.
3. Develop Feasibility Studies & reporting of New Product development
4. Analyzing the New product qualification and MarketSurvey 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 AND RAPID PROTOTYPING TECHNIQUES

OBJECTIVES:
The course aims to

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

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

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

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

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

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

TOTAL: 45 PERIODS
COURSE OBJECTIVES:
At the end of this course the student should be able to
- Learn about the precision machine tools
- Learn about the macro and micro components.
- Understand handling and operating of the precision machine tools.
- Learn to work with miniature models of existing machine tools/robots and other instruments.
- Learn metrology for micro system

UNIT I INTRODUCTION TO MICROSYSTEMS
Design, and material selection, micro-actuators: hydraulic, pneumatic, electrostatic/ magnetic etc. for medical to general purpose applications. Micro-sensors based on Thermal, mechanical, electrical properties; micro-sensors for measurement of pressure, flow, temperature, inertia, force, acceleration, torque, vibration, and monitoring of manufacturing systems.

UNIT II FABRICATION PROCESSES FOR MICRO-SYSTEMS:
Additive, subtractive, forming process, microsystems-Micro-pumps, micro- turbines, micro engines, micro-robot, and miniature biomedical devices

UNIT III INTRODUCTION TO PRECISION ENGINEERING
Machine tools, holding and handling devices, positioning fixtures for fabrication/ assembly of microsystems. Precision drives: inch worm motors, ultrasonic motors, stick-slip mechanism and other piezo-based devices.

UNIT IV PRECISION MACHINING PROCESSES
Precision machining processes for macro components - Diamond turning, fixed and free abrasive processes, finishing processes.

UNIT V METROLOGY FOR MICRO SYSTEMS
Metrology for micro systems - Surface integrity and its characterization.

COURSE OUTCOMES:
Upon the completion of this course the students will be able to
- Select suitable precision machine tools and operate
- Apply the macro and micro components for fabrication of micro systems.
- Apply suitable machining process
- Able to work with miniature models of existing machine tools/robots and other instruments.
- Apply metrology for micro system

TEXT BOOKS:

REFERENCES:
OMF354  COST MANAGEMENT OF ENGINEERING PROJECTS  L  T  P  C
3  0  0  3

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

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

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

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

UNIT – IV  COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL  9

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

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

TEXT BOOKS:
REFERENCES:

AU3002 BATTERIES AND MANAGEMENT SYSTEM

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

UNIT I ADVANCED BATTERIES
Li-ion Batteries: different formats, chemistry, safe operating area, efficiency, aging. Characteristics-SOC, DOD, SOH. Balancing-Passive Balancing Vs Active Balancing. Other Batteries- NCM and NCA Batteries. NCR18650B specifications.

UNIT II BATTERY PACK
Battery Pack: design, sizing, calculations, flow chart, real and simulation Model. Peak power – definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging.

UNIT III BATTERY MODELLING

UNIT IV BATTERY STATE ESTIMATION

UNIT V BMS ARCHITECTURE AND REAL TIME COMPONENTS
Battery Management System- need, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex Ray-CANedge1 package. ARBIN Battery Tester. BMS Development with Modeling software and Model-Based Design.

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Acquire knowledge of different Li-ion Batteries performance.
2. Design a Battery Pack and make related calculations.
3. Demonstrate a Battery Model or Simulation.
5. Approach different BMS architectures during real world usage.

TOTAL = 45 PERIODS
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

COURSE OBJECTIVES:
- The objective of this course is to make the students to list common types of sensor and actuators used in automotive vehicles.

UNIT I INTRODUCTION TO MEASUREMENTS AND SENSORS

UNIT II VARIABLE RESISTANCE AND INDUCTANCE SENSORS
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT

UNIT III VARIABLE AND OTHER SPECIAL SENSORS
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostriective, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.

UNIT IV AUTOMOTIVE ACTUATORS

UNIT V AUTOMATIC TEMPERATURE CONTROL ACTUATORS
Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.

TOTAL =45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. List common types of sensor and actuators used in vehicles.
2. Design measuring equipment's for the measurement of pressure force, temperature and flow.
3. Generate new ideas in designing the sensors and actuators for automotive application
4. Understand the operation of the sensors, actuators and electronic control.
5. Design temperature control actuators for vehicles.

**TEXT BOOKS:**

**REFERENCES:**

**OAS353 SPACE VEHICLES**

**OBJECTIVES:**
- To interpret the missile space stations, space vs earth environment.
- To explain the life support systems, mission logistics and planning.
- To deploy the skills effectively in the understanding of space vehicle configuration design.
- To explain Engine system and support of space vehicle
- To interpret nose cone configuration of space vehicle

**UNIT I  FUNDAMENTAL ASPECTS**
Energy and Efficiencies of power plants for space vehicles – Typical Performance Values – Mission design – Structural design aspects during launch - role of launch environment on launch vehicle integrity.

**UNIT II  SELECTION OF ROCKET PROPULSION SYSTEMS**
Ascent flight mechanics – Launch vehicle selection process – Criteria for Selection for different missions – selection of subsystems – types of staging – Interfaces – selection and criteria for stages and their role in launch vehicle configuration design.

**UNIT III  ENGINE SYSTEMS, CONTROLS, AND INTEGRATION**

**UNIT IV  THRUST VECTOR CONTROL**
TVC Mechanisms with a Single Nozzle – TVC with Multiple Thrust Chambers or Nozzles – Testing – Integration with Vehicle – SITVC method – other jet control methods - exhaust plume problems in space environment
UNIT V  NOSE CONE CONFIGURATION 9
Aerodynamic aspects on the selection of nose shape of a launch vehicle - design factors in the
finalization of nose configuration with respect to payload - nose cone thermal protection system -
separation of fairings - payload injection mechanism

OUTCOMES:
On successful completion of this course, the student will be able to
• Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.
• Apply knowledge in selecting the appropriate rocket propulsion systems.
• Interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.
• Analyze aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.
• Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle
design

OIM352  MANAGEMENT SCIENCE

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
Concepts of Management and organization - nature, importance and Functions of Management,
Systems Approach to Management - Taylor's Scientific Management Theory- Fayal's Principles of
Management- Maslow's theory of Hierarchy of Human Needs- Douglas McGregor's
TheoryXandTheoryY-HertzbergTwoFactorTheoryofMotivation-LeadershipStyles, Social
responsibilities of Management, Designing Organisational Structures: Basic concepts related to
Organisation - Departmentation and Decentralisation.

UNIT II  OPERATIONS AND MARKETING MANAGEMENT 9
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 9
Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR,
Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and
Development, Wage and Salary Administration, Promotion, Transfer, Performance Appraisal,
Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating – Capability Maturity
Model (CMM) Levels.
UNIT IV   PROJECT MANAGEMENT  
Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method(CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

UNIT V   STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES  

COURSE OUTCOMES:
Upon completion of the course, Students will be able to
CO1: Plan an organizational structure for a given context in the organization to carry out production operations through Work-study.
CO2: Survey the markets, customers and competition better and price the given product appropriately.
CO3: Ensure quality for a given product or service.
CO4: Plan, schedule and control projects through PERT and CPM.
CO5: Evaluate strategy for a business or service organisation.

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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

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC
Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size-ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems-elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course,
- CO1:The students can able to prepare production planning and control act work study,
- CO2:The students can able to prepare product planning,
- CO3:The students can able to prepare production scheduling,
- CO4:The students can able to prepare Inventory Control.
- CO5:They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

TEXT BOOKS:

REFERENCES
7. Samson Eilon, “Elements of Production Planning and Control”, Universal Book Corp,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 9

UNIT IV MATERIALS MANAGEMENT 9

UNIT V SCHEDULING AND PROJECT MANAGEMENT 9
Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson’s Algorithm – Gantt charts; personnel scheduling in services.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: The students will appreciate the role of Production and Operations management in enabling and enhancing a firm’s competitive advantages in the dynamic business environment.
CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.
CO3: The students will be able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.
CO4: The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.
CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance.

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TEXT BOOKS
REFERENCES

OSF352 INDUSTRIAL HYGIENE

COURSE OBJECTIVES:
- Demonstrate an understanding of how occupational hygiene standards are set and used in work health and safety.
- Compare and contrast the roles of environmental and biological monitoring in work health and safety.
- Outline strategies for identifying, assessing and controlling risks associated with airborne gases, vapours and particulates.
- Discuss how personal protective equipment can be used to reduce risks associated with workplace exposures.
- Provide high-level advice on managing and controlling noise and noise-related hazards.

UNIT I INTRODUCTION AND SCOPE

UNIT II MONITORING FOR SAFETY, HEALTH & ENVIRONMENT
Occupational Health and Environment Safety Management System, ILO and EPA Standards Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.

UNIT III OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION

UNIT IV OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT
UNIT-V INDUSTRIAL HAZARDS


TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students able to
CO1: Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems.
CO2: Specify designs that avoid occupation related injuries.
CO3: Define and apply the principles of work design, motion economy, and work environment design.
CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.
CO5: Acknowledge the impact of workplace design and environment on productivity.

TEXT BOOKS:


REFERENCES:


CO’s- PO’s & PSO’s MAPPING

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OSF353 CHEMICAL PROCESS SAFETY L T P C

COURSE OBJECTIVES

- Teach the principles of safety applicable to the design, and operation of chemical process plants.
- Ensure that potential hazards are identified and mitigation measures are in place to prevent unwanted release of energy.
- Learn about the hazardous chemicals into locations that could expose employees and others to serious harm.
- Focuses on preventing incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals.
- Ensure that the general design of the plant is capable of complying with the dose limits in force and with the radioactive releases.

UNIT I SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES 9
Types of storage - general considerations for storage layouts - atmospheric venting, pressure and temperature relief - relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation - pipe line transport - safety in chemical laboratories.

UNIT II CHEMICAL REACTION HAZARDS 9
Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self-heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening.

UNIT III SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS 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
REFERENCES:

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Understanding the importance of various materials used in electrical, electronics and magnetic applications
2. Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
3. Gaining knowledge on the selection of suitable materials for the given application
4. Knowing the fundamental concepts in Semiconducting materials
5. Getting equipped with the materials used in optical and optoelectronic applications.

UNIT- I  DIELECTRIC MATERIALS
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

UNIT – II  MAGNETIC MATERIALS
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose
materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis

UNIT – III  SEMICONDUCTOR MATERIALS  
Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on specific superconducting materials; comments on fabrication and engineering applications.

UNIT – IV  MATERIALS FOR ELECTRICAL APPLICATIONS  
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

UNIT – V  OPTICAL AND OPTOELECTRONIC MATERIALS  

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
1. Understand various types of dielectric materials, their properties in various conditions.
2. Evaluate magnetic materials and their behavior.
3. Evaluate semiconductor materials and technologies.
4. Select suitable materials for electrical engineering applications.
5. Identify right material for optical and optoelectronic applications

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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
- Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications
- Gaining knowledge on dimensionality effects on different properties of nanomaterials
- Getting acquainted with the different processing techniques employed for fabricating nanomaterials
- Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
- Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

UNIT I  NANOMATERIALS 9
Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.

UNIT II  THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS 9
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.

UNIT III  PROCESSING 9
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.

UNIT IV  STRUCTURAL CHARACTERISTICS 9
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis

UNIT V  APPLICATIONS 9
Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries

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

TOTAL: 45 PERIODS
3. Process different nanomaterials and use them in engineering applications
4. Use appropriate techniques for characterising nanomaterials
5. Identify and use different nanomaterials for applications in different engineering fields.

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OMR352 HYDRAULICS AND PNEUMATICS L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To knowledge on fluid power principles and working of hydraulic pumps
2. To obtain the knowledge in hydraulic actuators and control components
3. To understand the basics in hydraulic circuits and systems
4. To obtain the knowledge in pneumatic and electro pneumatic systems
5. To apply the concepts to solve the trouble shooting

UNIT – I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS

UNIT – II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS
Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning –

UNIT – III HYDRAULIC CIRCUITS AND SYSTEMS 9
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT – IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

UNIT – V TROUBLE SHOOTING AND APPLICATIONS 9

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO 1: Analyze the methods in fluid power principles and working of hydraulic pumps
CO 2: Recognize the concepts in hydraulic actuators and control components
CO 3: Obtain the knowledge in basics of hydraulic circuits and systems
CO 4: Know about the basics concept in pneumatic and electro pneumatic systems
CO 5: Apply the concepts to solve the trouble shooting hydraulic and pneumatics

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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

UNIT – II DISPLACEMENT, PROXIMITY AND RANGING SENSORS

UNIT – III FORCE, MAGNETIC AND HEADING SENSORS

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

ORA352 CONCEPTS IN MOBILE ROBOTS
L T P C
3 0 0 3

COURSE OBJECTIVES
1. To introduce mobile robotic technology and its types in detail.
2. To learn the kinematics of wheeled and legged robot.
3. To familiarize the intelligence into the mobile robots using various sensors.
4. To acquaint the localization strategies and mapping technique for mobile robot.
5. To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT – I INTRODUCTION TO MOBILE ROBOTICS
Introduction – Locomotion of the Robots – Key Issues on Locomotion – Legged Mobile Roots –

302
Configurations and Stability – Wheeled Mobile Robots – Design Space and Mobility Issues – Unmanned Aerial and Underwater Vehicles

UNIT – II KINEMATICS

UNIT – III PERCEPTION

UNIT – IV LOCALIZATION

UNIT – V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS

TOTAL: 45 PERIODS

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

CO1: Evaluate the appropriate mobile robots for the desired application.
CO2: Create the kinematics for given wheeled and legged robot.
CO3: Analyse the sensors for the intelligence of mobile robotics.
CO4: Create the localization strategies and mapping technique for mobile robot.
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.

TEXTBOOK

REFERENCES:
COURSE OBJECTIVES:
1. To impart knowledge on basics of propulsion system and ship dynamic movements
2. To educate them on basic layout and propulsion equipment’s
3. To impart basic knowledge on performance of the ship
4. To impart basic knowledge on Ship propeller and its types
5. To impart knowledge on ship rudder and its types

UNIT I BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS
law of floatation - Basics principle of propulsion- Earlier methods of propulsion- ship propulsion machinery- boiler, Marine steam engine, diesel engine, ship power transmission system, ship dynamic structure, Marine propulsion equipment - shaft tunnel, Intermediate shaft and bearing, stern tube, stern tube sealing etc. degree of freedom, Modern propelling methods- water jet propulsion , screw propulsion.

UNIT II SHIPS MOVEMENTS AND SHIP STABILIZATION
Thrust augmented devices, Ship hull, modern ship propulsion design, bow thruster – Advantages, various methods to stabilize the ship- passive and active stabilizer, fin stabilizer, bilge keel - stabilizing and securing ship in port- effect of tides on ship – effect of river water and sea water sailing vessel, Load line and load line of marking- draught markings.

UNIT III SHIPS SPEED AND ITS PERFORMANCE
Ship propulsion factors, factors affecting ships speed, various velocities of ship, hull drag, effects of fouling on ships hull, ship wake, relation between powers, Fuel consumption of ship, cavitations - effects of cavitation’s, ship turning radius.

UNIT IV BASICS OF PROPELLER

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.

TEXT BOOKS:
1. GP. Ghose, “Basic Ship propulsion”,2015
REFERENCES BOOKS:

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OMV351 MARINE MERCHANT VESSELS

OBJECTIVES:
At the end of the course, students are expected to acquire
1. Knowledge on basics of Hydrostatics
2. Familiarization on types of merchant ships
3. Knowledge on Shipbuilding Materials
4. Knowledge on marine propeller and rudder
5. Awareness on governing bodies in shipping industry

UNIT I INTRODUCTION TO HYDROSTATICS
Archimedes Principle- Laws of floatation– Meta centre – stability of floating and submerged bodies-
Density, relative density - Displacement –Pressure –centre of pressure.

UNIT II TYPES OF SHIP
General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers-
Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gas carriers - Chemical tankers -
Passenger ships

UNIT III SHIPBUILDING MATERIALS
Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys, Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced Composites

UNIT IV MARINE PROPELLER AND RUDDER
Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its effects on propeller

UNIT V GOVERNING BODIES FOR SHIPPING INDUSTRY
Role of IMO (International Maritime Organization), SOLAS (International Convention for the Safety of Life at Sea), MARPOL (International Convention for the Prevention of Pollution from Ships ), MLC
(Maritime Labour Convention), **STCW 2010** (International Convention on Standards of Training, Certification and Watch keeping for Seafarers), Classification societies Administration authorities

**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**

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**OBJECTIVES:**
At the end of the course, students are expected to
1. Understand the role of Marine machinery systems
2. Be familiar with Marine propulsion machinery system
3. Acquaint with Marine Auxiliary machinery system
4. Have acquired basics of Marine Auxiliary boiler system
5. Be aware of ship propellers and steering system

**UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS**
Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems

**UNIT II MARINE PROPULSION MACHINERY SYSTEM**
Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system

**UNIT III MARINE AUXILIARY MACHINERY SYSTEM**
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications
UNIT IV  MARINE BOILER SYSTEM 9
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories

UNIT V  SHIP PROPELLERS AND STEERING MECHANISM 9
Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear

OUTCOMES:
At the end of the course, students should able to,
1. Distinguish the role of various marine machinery systems
2. Relate the components of marine propulsion machinery system
3. Explain the importance of marine auxiliary machinery system
4. Acquire knowledge of marine boiler system
5. Understand the importance of ship propellers and steering system

TEXT BOOKS:

REFERENCES:
1. Alan L.Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006
2. A.S.Tambwekar, “Naval Architecture and Ship Construction”, The Institute of Marine Engineers (India), Mumbai, 2015

COURSE OBJECTIVES:
1. To understand the basics of drone concepts
2. To learn and understand the fundamentals of design, fabrication and programming of drone
3. To impart the knowledge of an flying and operation of drone
4. To know about the various applications of drone
5. To understand the safety risks and guidelines of fly safely

UNIT – I  INTRODUCTION TO DRONE TECHNOLOGY 9
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

UNIT – II  DRONE DESIGN, FABRICATION AND PROGRAMMING 9
Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of
autonomy- Drones configurations - The methods of programming drone - Download program - Install program on computer - Running Programs - Multi rotor stabilization - Flight modes - Wi-Fi connection.

UNIT – III DRONE FLYING AND OPERATION
9
Concept of operation for drone - Flight modes - Operate a small drone in a controlled environment - Drone controls Flight operations - management tool - Sensors - Onboard storage capacity - Removable storage devices - Linked mobile devices and applications.

UNIT – IV DRONE COMMERCIAL APPLICATIONS
9
Choosing a drone based on the application - Drones in the insurance sector - Drones in delivering mail, parcels and other cargo - Drones in agriculture - Drones in inspection of transmission lines and power distribution - Drones in filming and panoramic picturing.

UNIT – V FUTURE DRONES AND SAFETY
9
The safety risks - Guidelines to fly safely - Specific aviation regulation and standardization - Drone license - Miniaturization of drones - Increasing autonomy of drones - The use of drones in swarms.

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Know about a various type of drone technology, drone fabrication and programming.
CO2: Execute the suitable operating procedures for functioning a drone.
CO3: Select appropriate sensors and actuators for Drones.
CO4: Develop a drone mechanism for specific applications.
CO5: Create the programs for various drones.

CO-PO MAPPING:

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1 – Slight, 2 – Moderate, 3 – Substantial.

TEXT BOOKS

REFERENCES

308
OBJECTIVES:
To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.

UNIT I   FUNDAMENTALS OF GIS

UNIT II   SPATIAL DATA MODELS

UNIT III   DATA INPUT AND TOPOLOGY

UNIT IV   DATA QUALITY AND STANDARDS
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure

UNIT V   DATA MANAGEMENT AND OUTPUT
Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS- distributed GIS.

COURSE OUTCOMES:
•On completion of the course, the student is expected to
CO1 Have basic idea about the fundamentals of GIS.
CO2 Understand the types of data models.
CO3 Get knowledge about data input and topology
CO4 Gain knowledge on data quality and standards
CO5 Understand data management functions and data output

TEXTBOOKS:

REFERENCES:
CO – PO – PSO MAPPING: GEOGRAPHIC INFORMATION SYSTEM

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OAI352 AGRICULTURE ENTREPRENEURSHIP DEVELOPMENT L T P C 3 0 0 3

OBJECTIVES
- To introduce the importance of Agri-business management, its characteristics and principles
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.

UNIT I ENTREPRENEURIAL ENVIRONMENT IN INDIAN CONTEXT 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
Entrepreneurship - Essence of managerial Knowledge -Management functions- Planning-organizing-Directing-Motivation-ordering-leading-supervision- communication and control-Understanding Financial Aspects of Business - Importance of financial statements-liquidity ratios-leverage ratios,

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

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CO-PO MAPPING

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<td>To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill</td>
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<td>To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.</td>
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<td>To inculcate entrepreneurial skills through strong Industry-Institution linkage.</td>
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OEN352                                BIODIVERSITY CONSERVATION

OBJECTIVE:
The identification of different aspects of biological diversity and conservation techniques.

UNIT I                                  INTRODUCTION  9
Concept of Species, Variation; Introduction to Major Plant Groups; Evolutionary relationships between Plant Groups; Nomenclature and History of plant taxonomy; Systems of Classification and their Application; Study of Plant Groups; Study of Identification Characters; Study of important families of Angiosperms; Plant Diversity Application.

UNIT II                                  INTRODUCTION TO ANIMAL DIVERSITY AND TAXONOMY  9
Principles and Rules of Taxonomy; ICZN Rules, Animal Study Techniques; Concepts of Taxon, Categories, Holotype, Paratype, Topotype etc; Classification of Animal kingdom, Invertebrates, Vertebrates, Evolutionary relationships between Animal Groups.
UNIT III   MICROBIAL DIVERSITY
Microbes and Earth History, Magnitude, Occurrence and Distribution. Concept of Species, Criteria for Classification, Outline Classification of Microorganisms (Bacteria, Viruses and Protozoa); Criteria for Classification and Identification of Fungi; Chemical and Biochemical Methods of Microbial Diversity Analysis

UNIT IV   MEGA DIVERSITY
Biodiversity Hot-spots, Floristic and Faunal Regions in India and World; IUCN Red List; Factors affecting Diversity, Impact of Exotic Species and Human Disturbance on Diversity, Dispersal, Diversity-Stability Relationship; Socio-economic Issues of Biodiversity; Sustainable Utilization of Bioresources; National Movements and International Convention/Treaties on Biodiversity.

UNIT V   CONSERVATIONS OF BIODIVERSITY
In-Situ Conservation- National parks, Wildlife sanctuaries, Biosphere reserves; Ex-situ conservation- Gene bank, Cryopreservation, Tissue culture bank; Long term captive breeding, Botanical gardens, Animal Translocation, Zoological Gardens; Concept of Keystone Species, Endangered Species, Threatened Species, Rare Species, Extinct Species

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

OUTCOMES
Upon successful completion of this course, students will:
CO1: An insight into the structure and function of diversity for ecosystem stability.
CO2: Understand the concept of animal diversity and taxonomy
CO3: Understand socio-economic issues pertaining to biodiversity
CO4: An understanding of biodiversity in community resource management.
CO5: Student can apply fundamental knowledge of biodiversity conservation to solve problems associated with infrastructure development.

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

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1. low, 2-medium, 3-high, `^-^`- no correlation
Note: The average value of this course to be used for program articulation matrix.
OEE353  INTRODUCTION TO CONTROL SYSTEMS  L T P C  3 0 0 3

OBJECTIVES
- To impart knowledge on various representations of systems.
- To familiarize time response analysis of LTI systems and steady state error.
- To analyze the frequency responses and stability of the systems
- To analyze the stability of linear systems in frequency domain and time domain
- To develop linear models mainly state variable model and transfer function model

UNIT I  MATHEMATICAL MODELS OF PHYSICAL SYSTEMS  9
Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction—Signal flow graphs.

UNIT II  TIME RESPONSE ANALYSIS & ROOTLOCUS TECHNIQUE  9

UNIT III  FREQUENCY RESPONSE ANALYSIS  9
Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV  STABILITY CONCEPTS & ANALYSIS  9

UNIT V  STATE VARIABLE ANALYSIS  9
Concept of state – State Variable & State Model – State models for linear & continuous time systems—Solution of state & output equation—controllability & observability.

TOTAL : 45 PERIODS

OUTCOMES:
Ability to
CO1: Design the basic mathematical model of physical System.
CO2: Analyze the time response analysis and techniques.
CO3: Analyze the transfer function from different plots.
CO4: Apply the stability concept in various criterion.
CO5: Assess the state models for linear and continuous Systems.

TEXTBOOKS

REFERENCES
2. Control System Dynamics* by Robert Clark, Cambridge University Press, 1996 USA.
OEI354  INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS  LT P C  3 0 03

COURSE OBJECTIVES:
1. To educate on design of signal conditioning circuits for various applications.
2. To introduce signal transmission techniques and their design.
3. Study of components used in data acquisition systems interface techniques
4. To educate on the components used in distributed control systems
5. To introduce the communication buses used in automation industries.

UNIT I  INTRODUCTION  9

UNIT II  AUTOMATION COMPONENTS  9
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT III  COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS  9
Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

UNIT IV  PROGRAMMABLE LOGIC CONTROLLERS  9
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for industrial automation, Application of PLC to process control industries.

UNIT V  DISTRIBUTED CONTROL SYSTEM  9
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL:45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)  5
1. Market survey of the recent PLCs and comparison of their features.
2. Summarize the PLC standards
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)

COURSE OUTCOMES:
Students able to
CO1 Design a signal conditioning circuits for various application (L3).
CO2 Acquire a detail knowledge on data acquisition system interface and DCS system (L2).
CO3 Understand the basics and Importance of communication buses in applied automation Engineering (L2).
CO4 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.(L3)
CO5 Able to develop a PLC logic for a specific application on real world problem. (L5)

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1. https://archive.nptel.ac.in/courses/108/105/108105062/
2. https://nptel.ac.in/courses/108105063

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</table>
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

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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 L T P C 3 0 0 3

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 9
Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, absorbate structure, Band and Vibrational structure, Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy
UNIT II ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT SURFACES 9
Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces. Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods

UNIT III LIQUID INTERFACES 9
Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells

UNIT IV HETEROGENEOUS CATALYSIS 9
Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, Fishcher-Tropsch and Automotive catalysis, Role of promoters and poisons, Bimetallic surfaces, surface functionalization and clusters in catalysis, Role of Sabatier principle in catalyst design, Rate oscillations and spatiotemporal pattern formation

UNIT V EPITAXIAL GROWTH AND NANO SURFACE-STRUCTURES 9

TOTAL: 45 PERIODS

OUTCOME:
- Upon completion of this course, the students can understand, predict and design surface properties based on surface structure. Students would understand the physics and chemistry behind surface phenomena

TEXT BOOK:

REFERENCE:

OPY353 NUTRACEUTICALS L T P C 3 0 0 3

OBJECTIVES:
- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease.

UNIT I INTRODUCTION AND SIGNIFICANCE 6
Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoochemicals and microbes in food, plants, animals and microbes.

UNIT II PHYTOCHEMICALS AS NUTRACEUTICALS 11
Phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, lycopene,
chitin, carotenoids. Manufacturing practice of selected nutraceuticals such as lycopene, isoflavonoids, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals - stability, analytical and labelling issues.

UNIT III ASSESSMENT OF ANTIOXIDANT ACTIVITY 11
In vitro and in vivo methods for the assessment of antioxidant activity, Comparison of different in vitro methods to evaluate the antioxidant, antioxidant mechanism, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

UNIT IV ROLE IN HEALTH AND DISEASE 11
The health benefit of - Soy protein, Spirulina, Tea, Olive oil, plant sterols, Broccoli, omega3 fatty acid and eicosanoids. Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and synbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

UNIT V SAFETY ISSUES 6
Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues International and national.

TOTAL: 45 PERIODS

TEXT BOOKS:
3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006

REFERENCES:
1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007

COURSE OUTCOME - NUTRACEUTICALS

| CO 1 | acquire knowledge about the Nutraceuticals and functional foods, their classification and benefits. |
| CO 2 | acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes |
| CO 3 | attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods. |
| CO 4 | distinguish the various In vitro and In vivo assessment of Antioxidant activity of compounds from plant sources. |
CO 5 Gain information about the health benefits of various functional foods and nutraceuticals in the prevention and treatment of various lifestyle diseases.

CO 6 Attain the knowledge of the regulatory and safety issues of nutraceuticals at national and international level.

CO – PO MAPPING

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<th>NUTRACEUTICALS</th>
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OTT354 BASICS OF DYEING AND PRINTING

**OBJECTIVE:**
- To enable the students to learn about the basics of Pretreatment, dyeing, printing and machinery in textile processing.

**UNIT I** INTRODUCTION 9
Impurities present in different fibres, Inspection of grey goods and lot preparation. Shearing.

**UNIT II** PRE TREATMENT 9

**UNIT III** DYEING 9

**UNIT IV** PRINTING 9
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 9

**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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<th>Course Outcomes</th>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
COURSE OBJECTIVES

- To enable the students to learn about the types of fibre and its properties

UNIT I INTRODUCTION TO TEXTILE FIBRES 9
Definition of various forms of textile fibres - staple fibre, filament, bicomponent fibres. Classification of Natural and Man-made fibres, essential and desirable properties of Fibres. Production and cultivation of Natural Fibers: Cotton, Silk, Wool -Physical and chemical structure of the above fibres.

UNIT II REGENERATED FIBRES 9
Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel ,Tencel

UNIT III SYNTHETIC FIBRES 9
Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass ,carbon .Introduction to spin finishes and texturization

UNIT IV SPECIALITY FIBRES 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:

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 labelling 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 labelling

TEXT BOOKS:
2. Gerry Cooklin, “Introduction to Clothing Manufacture” Blackwell Science Ltd., 1995. 64

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OPE353 INDUSTRIAL SAFETY 3 0 0 3

OBJECTIVES:
- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen's Compensation and other laws) enacted for the protection of employees health at work settings
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I INTRODUCTION
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  9

TOTAL: 45 PERIODS

OUTCOMES:
After completion of this course, the student is expected to be able to:
- Describe, with example, the common work-related diseases and accidents in occupational setting
- Name essential members of the Occupational Health team
- What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee

OPE354  UNIT OPERATIONS IN PETRO CHEMICAL INDUSTRIES  L T P C
3 0 0 3

OBJECTIVES:
- To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.

UNIT I  FLUID MECHANICS CONCEPTS  9
Fluid definition and classification of fluids, types of fluids, Rheological behaviour of fluids & Newton’s Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems).Basic equations of fluid flow - Continuity equation, Euler’s equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits - Hagen Poiseuille equation (no derivation). Flow through stagnant fluids – theory of Settling and Sedimentation – Equipment (cyclones, thickeners) Conceptual numericals.

UNIT II  FLOW MEASUREMENTS & MECHANICAL OPERATIONS  9

UNIT III  CONDUCTIVE & CONVECTIVE HEAT TRANSFER  9
Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).

UNIT IV  BASICS OF MASS TRANSFER  9
UNIT V MASS TRANSFER OPERATIONS
Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction). Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method. Drying- drying operations, batch and continuous drying. Conceptual numerical.

TOTAL: 45 PERIODS

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

- State and describe the nature and properties of the fluids.
- Study the different flow measuring instruments, the principles of various size reductions, conveying equipment’s, sedimentation and mixing tanks.
- Comprehend the laws governing the heat and mass transfer operations to solve the problems.
- Design the heat transfer equipment suitable for specific requirement.

TEXTBOOK(S)
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008

REFERENCE BOOKS
2. Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996

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, polyvinyl chloride-compounding, formulation, polypropylene (PP)

UNIT II ENGINEERING THERMOPLASTICS AND APPLICATIONS
Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polysters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides, PMMA, polyphenylene oxide, thermoplastic polyurethane (PU)
UNIT III THERMOSETTING PLASTICS
Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.

UNIT IV MISCELLANEOUS PLASTICS FOR END APPLICATIONS
Miscellaneous plastics- Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbazole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers- their synthesis, properties and applications

UNIT V PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS
Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers- poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications

TOTAL : 45 PERIODS

COURSE OUTCOMES
• To study the importance, advantages and classification of plastic materials
• Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics
• To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins
• Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU
• To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

REFERENCES

OPT353 PROPERTIES AND TESTING OF PLASTICS
L T P C
3 0 0 3

COURSE OBJECTIVES
• To understand the relevance of standards and specifications as well as the specimen preparation for polymer testing.
• To study the mechanical properties and testing of polymer materials and their structural property relationships.
• To understand the thermal properties of polymers and their testing methods.
• To gain knowledge on the electrical and optical properties of polymers and their testing methods.
• To study about the environmental effects and prevent polymer degradation.
INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS


MECHANICAL PROPERTIES

Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact strength, resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic fatigue, ageing properties, Basic concepts of stress and strain, short term tests: Viscoelastic behavior (simple models: Kelvin model for creep and stress relaxation, Maxwell-Voigt model, strain recovery and dynamic response), Effect of structure and composition on mechanical properties, Behavior of reinforced polymers.

THERMAL RHEOLOGICAL PROPERTIES

Thermal properties: Transition temperatures, specific heat, thermal conductivity, co-efficient of thermal expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness temperature, thermal stability and flammability. Product testing: Plastic films, sheeting, pipes, laminates, foams, containers, cables and tubes.

ELECTRICAL AND OPTICAL PROPERTIES

Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and power factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric co-efficient, dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive index, haze, gloss, clarity, birefringence.

ENVIRONMENTAL AND CHEMICAL RESISTANCE


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

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CBM370 WEARABLE DEVICES

OBJECTIVES:
The student should be made to:
- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS

UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES
Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS

UNIT IV SMART TEXTILE

UNIT V APPLICATIONS OF WEARABLE SYSTEMS
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

TOTAL: 45 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Describe the concepts of wearable system.
CO2: Explain the energy harvestings in wearable device.
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile
CO5: Compare the various wearable devices in healthcare system

**TOTAL PERIODS: 45**

**TEXT BOOKS**

**REFERENCES**

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**CBM356 MEDICAL INFORMATICS**

**L T P C**
3 0 0 3

**Preamble:**
1. To study the applications of information technology in health care management.
2. This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

**UNIT I**
**INTRODUCTION TO MEDICAL INFORMATICS**
9
Introduction - Structure of Medical Informatics – Internet and Medicine - Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics

**UNIT II**
**COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING**
9
Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

**UNIT III**
**COMPUTERISED PATIENT RECORD**
9
Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.
UNIT IV COMPUTER ASSISTED MEDICAL DECISION-MAKING
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 in clinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS
Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.

TOTAL : 45 PERIODS

Course Outcomes:
Upon completion of the course, students will be able to:
1. Explain the structure and functional capabilities of Hospital Information System.
2. Describe the need of computers in medical imaging and automated clinical laboratory.
3. Articulate the functioning of information storage and retrieval in computerized patient record system.
4. Apply the suitable decision support system for automated clinical diagnosis.
5. Discuss the application of virtual reality and telehealth technology in medical industry.

TEXT BOOKS:

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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OBT355 BIOTECHNOLOGY FOR WASTE MANAGEMENT

UNIT I BIOLOGICAL TREATMENT PROCESS

UNIT II WASTE BIOMASS AND ITS VALUE ADDITION
Types of waste biomass – Solid waste management - Nature of biomass feedstock – Biobased economy/process – Value addition of waste biomass – Biotransformation of biomass – Biotransformation of marine processing wastes – Direct extraction of biochemicals from biomass – Plant biomass for industrial application
UNIT III  BIOCONVERSION OF WASTES TO ENERGY  9
Perspective of biofuels from wastes - Bioethanol production – Biohydrogen Production – dark and photofermentative process - Biobutanol production – Biogas and Biomethane production - Single stage anaerobic digestion, Two stage anaerobic digestion - Biodiesel production - Enzymatic hydrolysis technologies

UNIT IV  CHEMICALS AND ENZYME PRODUCTION FROM WASTES  9
Production of lactic acid, succinic acid, citric acid – Biopolymer synthesis – Production of Amylases - Lignocellulolytic enzymes - Pectinolytic enzymes - Proteases – Lipases

UNIT V  BIOCOMPOSTING OF ORGANIC WASTES  9
Overview of composting process - Benefits of composting, Role of microorganisms in composting - Factors affecting the composting process - Waste Materials for Composting, Fundamentals of composting process - Composting technologies, Composting systems – Nonreactor Composting, Reactor composting - Compost Quality

TOTAL: 45 PERIODS

COURSE OUTCOMES
After completion of this course, the students should be able
1. To learn the various methods biological treatment
2. To know the details of waste biomass and its value addition
3. To develop the bioconversion processes to convert wastes to energy
4. To synthesize the chemicals and enzyme from wastes
5. To produce the biocompost from wastes
6. To apply the theoretical knowledge for the development of value added products

TEXT BOOKS

REFERENCE BOOKS

OBT356  LIFESTYLE DISEASES  L T P C  3 0 0 3

UNIT I  INTRODUCTION  9
Lifestyle diseases – Definition ; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use ; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise.
UNIT II CANCER 9
Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment

UNIT III CARDIOVASCULAR DISEASES 9
Coronary atherosclerosis – Coronary artery disease; Causes -Fat and lipids, Alcohol abuse -- Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation

UNIT IV DIABETES AND OBESITY 9
Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI

UNIT V RESPIRATORY DISEASES 9
Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing

TEXT BOOKS:

REFERENCES:

OBT357 BIOTECHNOLOGY IN HEALTH CARE L T P C 3 0 0 3

COURSE OBJECTIVES
The aim of this course is to
1. Create higher standard of knowledge on healthcare system and services
2. Prioritize advanced technologies for the diagnosis and treatment of various diseases

UNIT I PUBLIC HEALTH 9

UNIT II CLINICAL DISEASES 9
Communicable diseases: Chickenpox / Shingles, COVID-19, Tuberculosis, Hepatitis B, Hepatitis C, HIV / AIDS, Influenza, Swine flu. Non Communicable diseases: Diabetes mellitus, atherosclerosis, fatty liver, Obesity, Cancer

UNIT III VACCINOLOGY 9
History of Vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems. Instruments related to monitoring of temperature, sterilization, environment.
UNIT IV  OUTPATIENT & IN PATIENT SERVICES  
Radiotherapy, Nuclear medicine, surgical units, OT Medical units, G & Obs. units Pediatric, neonatal units, Critical care units, Physical medicine & Rehabilitation, Neurology, Gastroenterology, Endoscopy, Pulmonology, Cardiology.

UNIT V  BASICS OF IMAGING MODALITIES  

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE BOOKS

VERTICAL 1: FINTECH AND BLOCK CHAIN

CMG331  FINANCIAL MANAGEMENT  LT P C  
3 0 0 3

LEARNING OBJECTIVES
1. To acquire the knowledge of the decision areas in finance.
2. To learn the various sources of Finance
3. To describe about capital budgeting and cost of capital.
4. To discuss on how to construct a robust capital structure and dividend policy
5. To develop an understanding of tools on Working Capital Management.

UNIT I  INTRODUCTION TO FINANCIAL MANGEMENT  
Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of money- Risk and return concepts.

UNIT II  SOURCES OF FINANCE  
Long term sources of Finance -Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc

UNIT III  INVESTMENT DECISIONS  
Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV  FINANCING AND DIVIDEND DECISION  


UNIT V WORKING CAPITAL DECISION

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
2. Prasanna Chandra, Financial Management,

CMG332 FUNDAMENTALS OF INVESTMENT

OBJECTIVES:
1. Describe the investment environment in which investment decisions are taken.
2. Explain how to Value bonds and equities
3. Explain the various approaches to value securities
4. Describe how to create efficient portfolios through diversification
5. Discuss the mechanism of investor protection in India.

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

CMG334 INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS LT P C
3 0 0 3

UNIT I INTRODUCTION TO BLOCKCHAIN
Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.

UNIT II INTRODUCTION TO CRYPTOCURRENCY

UNIT III ETHEREUM
Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network

UNIT IV WEB3 AND HYPERLEDGE

UNIT V EMERGING TRENDS

TOTAL : 45 PERIODS

REFERENCE
2. Peter Borovykh, Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018

CMG335 FINTECH PERSONAL FINANCE AND PAYMENTS LT P C
3 0 0 3

UNIT I CURRENCY EXCHANGE AND PAYMENT
Implications of Crypto currencies, Payment systems and their regulations. Digital Payments Smart Cards, Stored-Value Cards, EC Micropayments, Payment Gateways, Mobile Payments, Digital and Virtual Currencies, Security, Ethical, Legal, Privacy, and Technology Issues

UNIT II DIGITAL FINANCE AND ALTERNATIVE FINANCE
A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity,. Introduction to the concept of Initial Coin Offering

UNIT III INSURETECH
InsurTech Introduction, Business model disruption AI/ML in InsurTech • IoT and InsurTech , Risk Modeling, Fraud Detection Processing claims and Underwriting Innovations in Insurance Services

UNIT IV PEER TO PEER LENDING
P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies, Concept of Crowdfunding Crowdfunding Architecture and Technology, P2P and Crowdfunding unicorns and business models, SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations

UNIT V REGULATORY ISSUES

TOTAL : 45 PERIODS

REFERENCE
5. IIBF, Digital Banking, Taxmann Publication, 2016

CMG336 INTRODUCTION TO FINTECH LT P C 3 0 0 3

OBJECTIVES:
1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I INTRODUCTION
Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry,
Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with FinTech.

UNIT II  PAYMENT INDUSTRY
FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III  INSURANCE INDUSTRY

UNIT IV  FINTECH AROUND THE GLOBE

UNIT V  FUTURE OF FINTECH
How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

REFERENCES
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
6. Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018

TOTAL : 45 PERIODS

VERTICAL 2: ENTREPRENEURSHIP

CMG337  FOUNDATIONS OF ENTREPRENEURSHIP  L T P C
3 0 0 3

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 9
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 - Characterisitcs 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

OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of Entrepreneurship
CO 2 Understand the business ownership patterns and environment
CO 3 Understand the Job opportunities in Industries relating to Technopreneurship
CO 4 Learn about applications of technopreneurship and successful technopreneurs
CO 5 Acquaint with the recent and emerging trends in entrepreneur ship

Text Books:
2) Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning,

References:
4) David Sheff 2002, China Dawn: The Story of a Technology and Business Revolution,
7) Basics of Technopreneurship: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP
8) Journal articles pertaining to Entrepreneurship

CMG338 TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS 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
Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) - Multicultural Teams.

UNIT II MANAGING AND DEVELOPING EFFECTIVE TEAMS
Team-based Organisations - Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.

UNIT III INTRODUCTION TO LEADERSHIP
Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership - Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment.

UNIT IV LEADERSHIP IN ORGANISATIONS

UNIT V LEADERSHIP EFFECTIVENESS

TOTAL 45 : PERIODS

OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of managing teams for business.
CO 2 Understand developing effective teams for business management.
CO 3 Understand the fundamentals of leadership for running a business.
CO 4 Learn about the importance of leadership for business development.
CO 5 Acquaint with emerging trends in leadership effectiveness for entrepreneurs.

REFERENCES:

CMG339 CREATIVITY & INNOVATION IN ENTREPRENEURSHIP

COURSE OBJECTIVES
- To develop the creativity skills among the learners
- To impart the knowledge of creative intelligence essential for entrepreneurs
- To know the applications of innovation in entrepreneurship.
- To develop innovative business models for business.

UNIT I CREATIVITY
Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Essence, 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 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 L T P C
3 0 0 3

COURSE OBJECTIVES:
- To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
- To provide an exposure to the students pertaining to the nature and scope of marketing, which they are expected to possess when they enter the industry as practitioners.
- To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.

UNIT I INTRODUCTION TO MARKETING MANAGEMENT 9

UNIT II MARKETING ENVIRONMENT 9

UNIT III PRODUCT AND PRICING MANAGEMENT 9

UNIT IV PROMOTION AND DISTRIBUTUION MANAGEMENT 9
UNIT V CONTEMPORARY ISSUES IN MARKETING MANAGEMENT


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:

CMG341 HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS

OBJECTIVES:
1. To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
2. To create an awareness of the roles, functions and functioning of human resource department.
3. To understand the methods and techniques followed by Human Resource Management practitioners.

UNIT I INTRODUCTION TO HRM

UNIT II HUMAN RESOURCE PLANNING
HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends

UNIT III RECRUITMENT AND SELECTION
Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources - eRecruitment - Selection Process- Selection techniques - eSelection- Interview Types- Employee Engagement.
UNIT IV TRAINING AND EMPLOYEE DEVELOPMENT

UNIT V CONTROLLING HUMAN RESOURCES

OUTCOMES:
Upon completion of this course the learners will be able:
CO 1 To understand the Evolution of HRM and Challenges faced by HR Managers
CO 2 To learn about the HR Planning Methods and practices.
CO 3 To acquaint about the Recruitment and Selection Techniques followed in Industries.
CO 4 To known about the methods of Training and Employee Development.
CO 5 To comprehend the techniques of controlling human resources in organisations.

REFERENCES

CMG342 FINANCING NEW BUSINESS VENTURES

COURSE OBJECTIVES
- To develop the basics of business venture financing.
- To impart the knowledge essential for entrepreneurs for financing new ventures.
- To acquaint the learners with the sources of debt and equity financing.
- To empower the learners towards fund raising for new ventures effectively.

UNIT I ESSENTIALS OF NEW BUSINESS VENTURE

UNIT II INTRODUCTION TO VENTURE FINANCING
UNIT III SOURCES OF DEBT FINANCING

UNIT IV SOURCES OF EQUITY FINANCING
Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.

UNIT V METHODS OF FUND RAISING FOR NEW VENTURES

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.
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
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 Wilson, C.I. Barnard. Peter Drucker

REFERENCES:
1. Crozior M: The Bureaucratic phenomenon (Chand)
3. Presthus. R: The Organizational Society (MAC)
5. Keith Davis: Organization Theory (MAC)

TOTAL: 45 PERIODS

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

UNIT V
Corruption – Ombudsman, Lok Pal & Lok Ayuktha

TOTAL: 45 PERIODS
REFERENCES:
1. S.R. Maheswari : Indian Administration
2. Khera, S.S : Administration in India
3. Ramesh K. Arora : Indian Public Administration
4. T.N. Chaturvedi : State administration in India
5. Basu, D.D : Introduction to the Constitution of India

CMG348 PUBLIC POLICY ADMINISTRATION

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

OBJECTIVE:
➢ To learn the applications of statistics in business decision making.

UNIT I INTRODUCTION
Basic definitions and rules for probability, Baye’s theorem and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT II SAMPLING DISTRIBUTION AND ESTIMATION
Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters.
UNIT III TESTING OF HYPOTHESIS - PARAMETRIC TESTS
Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.

UNIT IV NON-PARAMETRIC TESTS

UNIT V CORRELATION AND REGRESSION

TOTAL: 45 PERIODS

OUTCOMES:
- To facilitate objective solutions in business decision making.
- To understand and solve business problems
- To apply statistical techniques to data sets, and correctly interpret the results.
- To develop skill-set that is in demand in both the research and business environments
- To enable the students to apply the statistical techniques in a work setting.

REFERENCES:

CMG350 DATAMINING FOR BUSINESS INTELLIGENCE

OBJECTIVES:
- To know how to derive meaning form huge volume of data and information.
- To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION
Data mining, Text mining, Web mining, Data ware house.

UNIT II DATA MINING PROCESS
Datamining process – KDD, CRISP-DM, SEMMA
Prediction performance measures

UNIT III PREDICTION TECHNIQUES
Data visualization, Time series – ARIMA, Winter Holts,

UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES
Classification, Association, Clustering.
UNIT V  MACHINE LEARNING AND AI

Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization

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, Kauffmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
7. G. K. Gupta, Introduction to Data mining with Case Studies, Prentice hall of India, 2011
9. Elizabeth Vitt, Michael Luckevich Stacia Misner, Business Intelligence, Microsoft, 2011

CMG351  HUMAN RESOURCE ANALYTICS  L T P C

3 0 0 3

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 9
Social Media Policies - Etiquette, Privacy - ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV - WEB ANALYTICS 9
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 9
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

TOTAL: 45 PERIODS

OUTCOME:
➢ The Learners will understand social media, web and social media analytics and their potential impact.

REFERENCES:
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004

CMG353  OPERATION AND SUPPLY CHAIN ANALYTICS  L T P C
3 0 0 3

OBJECTIVE:
➢ To treat the subject in depth by emphasizing on the advanced quantitative models and methods in operations and supply chain management and its practical aspects and the latest developments in the field.

UNIT I - INTRODUCTION 9
Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains.

UNIT II - WAREHOUSING DECISIONS 9
P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.

UNIT III - INVENTORY MANAGEMENT 9
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV - TRANSPORTATION NETWORK MODELS 9

UNIT V - MCDM MODELS
Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the analytical network process (ANP), TOPSIS.

TOTAL: 45 PERIODS

OUTCOME:
➢ To enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.

REFERENCES:

CMG354 FINANCIAL ANALYTICS

OBJECTIVE:
➢ This course introduces a core set of modern analytical tools that specifically target finance applications.

UNIT I - CORPORATE FINANCE ANALYSIS
Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.

UNIT II - FINANCIAL MARKET ANALYSIS
Estimation and prediction of risk and return (bond investment and stock investment) – Time series-examining nature of data, Value at risk, ARMA, ARCH and GARCH.

UNIT III - PORTFOLIO ANALYSIS
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.

UNIT IV - TECHNICAL ANALYSIS

UNIT V - CREDIT RISK ANALYSIS
Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.
OUTCOME

➢ The learners should be able to perform financial analysis for decision making using excel, Python and R.

REFERENCES:

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

CES331 SUSTAINABLE INFRASTRUCTURE DEVELOPMENT L T P C
3 0 0 3

OBJECTIVE:

➢ To impart knowledge about sustainable Infrastructure development goals, practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.

UNIT I SUSTAINABLE DEVELOPMENT GOALS

UNIT II SUSTAINABLE INFRASTRUCTURE PLANNING

UNIT III SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES

UNIT IV SUSTAINABLE CONSTRUCTION MATERIALS

UNIT V SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS


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

CO1 Understand the environment sustainability goals at global and Indian scenario.

CO2 Understand risks in development of projects and suggest mitigation measures.

CO3 Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.

CO4 Explain Life Cycle Analysis and life cycle cost of construction materials.

CO5 Explain the new technologies for maintenance of infrastructure projects.

REFERENCES:
5. New Building Materials and Construction World magazine
7. Munier N, "Introduction to Sustainability", Springer2005
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CES332 SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT L T P C 3 0 0 3

OBJECTIVES:
- To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.

UNIT I AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS 9
- Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT 9
- Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT III WATER MANAGEMENT 9
- Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT IV ENERGY AND WASTE MANAGEMENT 9
- Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS 9
- Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS

OUTCOME
On completion of the course, the student is expected to be able to
CO1 Have an in-depth knowledge about the concepts, principles and advantages of sustainable
Discuss the sustainable ways in managing soil health, nutrients, pests and diseases
Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources
Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas
Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

REFERENCES:
1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020

CO – PO Mapping - SUSTAINABLE AGRICULTURE PRACTICES

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SUSTAINABLE BIOMATERIALS

OBJECTIVES
- To impart knowledge of biomaterials and their properties
- To learn about fundamentals aspects of biopolymers and their applications
- To learn about bioceramics and biopolymers
- To introduce the students about metals as biomaterials and their usage as implants
- To make the students understand the significance of bionanomaterials and its applications.

UNIT I INTRODUCTION TO BIOMATERIALS

UNIT II  BIO POLYMERS
Molecular structure of polymers -Molecular weight - Types of polymerization techniques – Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials -Polyethylene -Poly(methyl methacrylate) (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  NANOBIOMATERIALS

OUTCOMES
- Students will gain familiarity with Biomaterials and they will understand their importance.
- Students will get an overview of different biopolymers and their properties
- Students gain knowledge on some of the important Bioceramics and Biocomposite materials
- Students gain knowledge on metals as biomaterials
- Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

REFERENCES
6. Vasif Hasirci, Nesrin Hasirci “Fundamentals of Biomaterials” Springer, 2018
OBJECTIVES

- To familiarize the students about the challenges and demands of energy sustainability
- To provide fundamental knowledge about electrochemical devices and the materials used.
- To introduce the students to various types of fuel cell
- To enable students to appreciate novel materials and their usage in photovoltaic application
- To introduce students to the basic principles of various types Supercapacitors and the materials used.

UNIT I: SUSTAINABLE ENERGY SOURCE

Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy

UNIT II: ELECTROCHEMICAL DEVICES

Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O₂ battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO₂, LiFePO₄, LiMn₂O₄) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)

UNIT III: FUEL CELLS


UNIT IV: PHOTOVOLTAICS


UNIT V: SUPERCAPACITORS

Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite- conductive polypyrrolo hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon
composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL: 45 PERIODS

OUTCOMES
- Students will acquire knowledge about energy sustainability.
- Students understand the principles of different electrochemical devices.
- Students learn about the working of fuel cells and their application.
- Students will learn about various Photovoltaic applications and the performance of various materials.
- The students gain knowledge on different types of supercapacitors and the performance of various materials.

REFERENCES

CES335 GREEN TECHNOLOGY L T P C 3 0 0 3

COURSE OBJECTIVE:
- To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.
- To provide green engineering solutions to energy demand, reduced energy footprint.

UNIT I PRINCIPLES OF GREEN CHEMISTRY 9
Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.

UNIT II POLLUTION TYPES 9
Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT III GREEN REAGENTS AND GREEN SYNTHESIS 9
Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions.
UNIT IV DESIGNING GREEN PROCESSES
Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention

UNIT V GREEN NANOTECHNOLOGY
Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

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

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE BOOKS
1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

CES336 ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS

OBJECTIVES:
- to understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.

UNIT I ENVIRONMENTAL MONITORING AND STANDARDS

UNIT II MONITORING OF ENVIRONMENTAL PARAMETERS

UNIT III ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING
Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods -Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical
oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT IV  ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISKASSESSMENT

UNIT V  AUTOMATED DATA ACQUISITION AND PROCESSING
Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks -Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

COURSE OUTCOMES
After completion of this course, the students will know

| CO1 | Basic concepts of environmental standards and monitoring. |
| CO2 | the ambient air quality and water quality standards; |
| CO3 | the various instrumental methods and their principles for environmental monitoring |
| CO4 | The significance of environmental standards in monitoring quality and sustainability of the environment. |
| CO5 | the various ways of raising environmental awareness among the people. |
| CO6 | Know the standard research methods that are used worldwide for monitoring the environment. |

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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<tr>
<th>Course Outcomes</th>
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TOTAL: 45 PERIODS

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COURSE OBJECTIVES:
1. To create awareness on the energy scenario of India with respect to world
2. To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation
3. Familiarisation on the concept of sustainable development and its benefits
4. Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development
5. Acquainting with energy policies and energy planning for sustainable development

UNIT I   ENERGY SCENARIO
Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security

UNIT II   ENERGY AND ENVIRONMENT
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

UNIT III SUSTAINABLE DEVELOPMENT

UNIT IV RENEWABLE ENERGY TECHNOLOGY

UNIT V ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the world and Indian energy scenario
2. Analyse energy projects, its impact on environment and suggest control strategies
3. Recognise the need of Sustainable development and its impact on human resource development
4. Apply renewable energy technologies for sustainable development
5. Fathom Energy policies and planning for sustainable development.

REFERENCES:
7. https://www.niti.gov.in/verticals/energy

CES338 ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT

COURSE OBJECTIVES:
1. To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
2. To create awareness on energy audit and its impacts
3. To acquaint the techniques adopted for performance evaluation of thermal utilities
4. To familiarise on the procedures adopted for performance evaluation of electrical utilities
5. To learn the concept of sustainable development and the implication of energy usage

UNIT I ENERGY AND ENVIRONMENT
Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT II ENERGY AUDITING
Need and types of energy audit. Energy management (audit) approach-understanding energy costs, benchmarking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES
Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression

UNIT IV ENERGY CONSERVATION IN ELECTRICAL UTILITIES
Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

UNIT V SUSTAINABLE DEVELOPMENT

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the prevailing energy scenario
2. Familiarise on energy audits and its relevance
3. Apply the concept of energy audit on thermal utilities
4. Employ relevant techniques for energy improvement in electrical utilities
5. Understand Sustainable development and its impact on human resource development
REFERENCES: