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

B.TECH. PHARMACEUTICAL TECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- To prepare students for prosperous spectrum of career avenues in academia, advanced research, industries of pharmaceutical technology, biomedicine, biotechnology, law, business and government and other pharmaceutical pursuits through dissemination of knowledge and proficiency in engineering and technology fundamentals related to pharmaceutical technology and the ability to solve problems.
- To transfuse in students the sense of confidence in professional endeavors by application of the derived knowledge and appreciation of economical impact in a societal context.
- To provide collegial and nurturing environment for the students to realize the professional, ethical obligations and their concern to protect the health and welfare of the public, and to be accountable for the social and environmental impact of their practice.
- To create an enjoyable educational environment in which students participate in multi-disciplinary, team oriented, open-ended curricular and co-curricular activities that prepare them to work either individually and as an integrated team member.
- To facilitate the students to gain the wisdom of fundamentals and advances to practice pharmaceutical technology and interdisciplinary research as career of constructive service to society and higher learning.

PROGRAM OUTCOMES (POs)

After completion of graduation in Pharmaceutical Technology, the students will be able to demonstrate the ability to:

a. Apply knowledge of mathematics, science and technology in the discipline.
b. Identify, formulate, research literature, and analyse complex engineering problems for its solution.

c. Design and develop system processes that meet the specified needs with appropriate consideration for public health, safety, cultural, societal, and environmental.

d. Design the experiments, its analysis and interpretation of data, synthesis of the information using research-based knowledge for complex problems.

e. Use modern engineering tools, software and equipment to meet the needs in the area of Pharmaceutical Technology.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues relevant to the professional engineering practices.

g. Apply knowledge of the impact of pharmaceutical technology solutions in a societal and global context.

h. Demonstrate ethical principles and commitment to responsibilities and norms of the Pharmaceutical technology practices.

i. Work effectively as an individual and as well as member in teams of diversified professionals.

j. Communicate effectively.

k. Understand the philosophies of project management principles in Pharmaceutical technology.


**PROGRAMME SPECIFIC OBJECTIVES**

After successful completion of the program the graduate will be able to

1. Develop active pharmaceutical ingredients, drug intermediates and pharmaceutical products.

2. Apply data driven decisions and predictive analytical tools in smaller and larger molecule producing industries.

3. Identify technical issues related to the design, manufacturing of chemicals & pharmaceuticals and provide effective interdisciplinary solutions.

4. Adapt continuously changing technologies and play pivotal professional role in sustainable societal development.
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**SEMESTER 1**

**YEAR 1**

**SEMESTER 2**
| YEAR 2 | SEMESTER 3 |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  | and Instrumentation Engineering Laboratory | 2.4 | 2.8 | 3 | 3 | 1.8 | 3 | 3 | 3 | 3 | 3 | - |
|  | Communication Laboratory / Foreign Language |  |  |  |  |  |  |  |  |  |  |  |
|  | Transform and Partial Differential Equations | 3 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 3 |
|  | Chemical Process Calculations | 3 | 3 | 2.2 | 5 | 3 | 2.5 | 2 | 2 | 2 | 3 | 2 | |
|  | Microbiology | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
|  | Pharmaceutical Chemistry | 3 | 1.8 | 3 | 3 | - | 2 | 1.3 | 2 | 2 | 2 | - | 2 | 2.3 | - |
|  | Biochemistry | 2 | 3 | 3 | 2 | 2 | 3 | 1 | 3 | 2 | 1 | 3 | 3 | 3 | 2 | 3 |
|  | Human Anatomy and Physiology | 3 | 3 | 3 | 3 | 2.2 | - | 2.4 | 1 | 2 | 1 | - | 3 | 2.3 | 3 | 2.5 | 2.5 |
|  | Microbiology Laboratory | 3 | 3 | 3 | 3 | 2 | 3 | 1.7 | - | 2 | 2 | - | 2 | 1.6 | 3 | 2.5 | 2 |
|  | Biochemistry and Physiology Laboratory | 3 | 2 | 3 | 3 | 2.5 | - | 2.5 | 2 | - | 2 | - | 3 | 2.3 | 3 | 2.5 | 2.5 |
|  | Applied Chemical Engineering Thermodynamics | 3 | 3 | 3 | 2.6 | 6 | 2.3 | 3 | 1.5 | 0.66 | 1.33 | 1.5 | 2 | 3 | 3 | 2.6 | 6 | 2.6 |
|  | Fluid Mechanics | 3 | 3 | 2.5 | 2.7 | 5 | 2.3 | 3 | 1.5 | 1 | 2 | 1.5 | 3 | 3 | 2.5 | 2 |
|  | Cell and Molecular Biology | 3 | 2.3 | 2.5 | 2 | 2 | - | 1.6 | 1 | - | - | - | 1.5 | 1.6 | - | 1.5 | 2 |
| SEMESTER 4 | Physical Pharmaceutics | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 6 | - | 2.3 | 1 |
|  | Pharmaceutical Analysis | 3 | 2.7 | 2 | - | 3 | 2 | 2 | - | - | - | 2 | 3 | 1 | 2 | - |
|  | Environmental Sciences and Sustainability | 2.8 | 1.8 | 1 | 1 | - | 2.2 | 2.4 | - | - | - | - | 1.8 | - | - | - |
|  | Pharmaceutical Chemistry Laboratory | 3 | 1.5 | 2.3 | 2.3 | 2 | 1 | 2 | 2.8 | 2.3 | 2.4 | 2.3 |
|  | Physical Pharmaceutics Laboratory | 3 | 3 | 2 | - | 1 | 1 | 1 | 3 | 1 | 2 |
|  | Pharmacological Dosage Forms | 3 | 3 | 2 | 2 | - | 2 | 2 | - | - | - | 3 | 2 | 2 | 2 | 2 |
| Course                                                                 | Unit Operations in Pharmaceutical Industries | Pharmacology | 2.1 | 2.5 | 2.3 | 2.5 | 2 | 3 | 3 | 2 | 2 | - | - | - | 1 | 2 | 3 | 1 | 2 | - |
|-----------------------------------------------------------------------|---------------------------------------------|--------------|-----|-----|-----|-----|---|---|---|---|---|---|---|---|---|---|---|---|---|
|                                                                      | Dosage Forms Laboratory                      |              | 3   | 2   | -   | 2   | 2  | - | - | - | 2 | - | - | - | 2.6 | 2.5 | 2.25 | 2.6 | 2.5 |
|                                                                      | Pharmacology Laboratory                      |              | 3   | 2   | 3   | 3   | 2.5 | - | 2.5 | 2   | - | 2   | - | 3 | 2.3 | 3 | 2.5 | 2.5 |
| **YEAR 4**                                                            | **SEMESTER 7**                               |              |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Biopharmaceutics and Pharmacokinetics                                | 3   | 2   | 1   | 2   | -   | 1   | -   | -   | -   | -   | 2   | 1   | 1   | 3   | 3   |
| Regulations in Pharmaceutical Industries                             | 2   | 2.5 | 3   | 2.5 | 2   | 2.6 | -   | 2.5 | 2   | -   | -   | -   | -   | 2.4 | 2   | -   | -   | -   | -   |
| Instrumental Techniques in Drug Analysis                             | 2   | 2   | -   | 2   | -   | 1   | -   | -   | -   | -   | 2   | 1   | 1   | 3   | 3   |     |     |     |     |

1-Low, 2-Medium, 3-High, "-"=no correlation
# Choice Based Credit System

## Curriculum and Syllabi for For I to VIII Semesters

### Semester I

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**THEORY**

1. HS3152 Professional English - I | HSMC | 3 0 0 | 3 | 3
2. MA3151 Matrices and Calculus | BSC | 3 1 0 | 4 | 4
3. PH3151 Engineering Physics | BSC | 3 0 0 | 3 | 3
4. CY3151 Engineering Chemistry | BSC | 3 0 0 | 3 | 3
5. GE3151 Problem Solving and Python Programming | ESC | 3 0 0 | 3 | 3
6. GE3152 முன்னோடிப்படுத்தல் /Heritage of Tamils | HSMC | 1 0 0 | 1 | 1

**PRACTICALS**

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

**TOTAL** 16 1 10 27 22

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

**$ Skill Based Course**

### Semester II

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2. MA3251 Statistics and Numerical Methods | BSC | 3 1 0 | 4 | 4
3. PH3258 Physics of Materials | BSC | 3 0 0 | 3 | 3
4. BE3252 Basic Electrical, Electronics and Instrumentation Engineering | HSMC | 3 0 0 | 3 | 3
5. GE3251 Engineering Graphics | ESC | 2 0 4 | 6 | 4
6. GE3252 தமிழ் வல்லுனரின் செயல்பாடு / Tamils and Technology | HSMC | 1 0 0 | 1 | 1
7. NCC Credit Course Level 1* | - | 2 0 0 | 2 | 2

**PRACTICALS**

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

**TOTAL** 14 1 16 31 23

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

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

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

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

### SEMESTER VI

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

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

* Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC- II)
NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

### SEMESTER VII/VIII

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*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/VII

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

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

**TOTAL CREDITS: 166**

### ELECTIVE – MANAGEMENT COURSES

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# MANDATORY COURSES I*

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* Mandatory Courses are offered as Non–Credit Courses

# MANDATORY COURSES II*

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

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<td>Formulation and Manufacturing</td>
<td>Quality Control and Quality Assurance</td>
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<td>Development</td>
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<td>Medicinal Chemistry</td>
<td>Technology of Fine Chemicals and</td>
<td>Biological spectroscopic techniques</td>
<td>Pharmaceutical Production Management</td>
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<td>Safety and Disaster Management</td>
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<td>Validation in Pharmaceutical Industries</td>
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<td>Quality Management system</td>
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<td>Pharmaceutical Packaging Technology</td>
<td>Product development and technology transfer</td>
<td>Management</td>
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<td>and Pharmacovigilance</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: DRUG DESIGN & DEVELOPMENT

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### VERTICAL II: FORMULATION AND MANUFACTURING TECHNOLOGY

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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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</table>
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)**

<table>
<thead>
<tr>
<th>Vertical I</th>
<th>Vertical II</th>
<th>Vertical III</th>
<th>Vertical IV</th>
<th>Vertical V</th>
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<tr>
<td>Fintech and Block Chain</td>
<td>Foundations of Entrepreneurship</td>
<td>Principles of Public Administration</td>
<td>Statistics For Management</td>
<td>Sustainable infrastructure Development</td>
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<td>Fundamentals of Investment</td>
<td>Team Building &amp; Leadership Management for Business</td>
<td>Constitution of India</td>
<td>Data Mining For Business Intelligence</td>
<td>Sustainable Agriculture and Environmental Management</td>
</tr>
<tr>
<td>Banking, Financial Services and Insurance</td>
<td>Creativity &amp; Innovation in Entrepreneurship</td>
<td>Public Personnel Administration</td>
<td>Human Resource Analytics</td>
<td>Sustainable Bio Materials</td>
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<tr>
<td>Introduction to Blockchain and its Applications</td>
<td>Principles of Marketing Management For Business</td>
<td>Administrative Theories</td>
<td>Marketing And Social Media Web Analytics</td>
<td>Materials for Energy Sustainability</td>
</tr>
<tr>
<td>Fintech Personal Finance and Payments</td>
<td>Human Resource Management for Entrepreneurs</td>
<td>Indian Administrative System</td>
<td>Operation And Supply Chain Analytics</td>
<td>Green Technology</td>
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<td>Introduction to Fintech</td>
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<td>Public Policy Administration</td>
<td>Financial Analytics</td>
<td>Environmental Quality Monitoring and Analysis</td>
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<td>-</td>
<td>Integrated Energy Planning for Sustainable Development</td>
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<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Energy Efficiency for Sustainable Development</td>
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(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

**VERTICAL 1: FINTECH AND BLOCK CHAIN**

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<tr>
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<th>COURSE TITLE</th>
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<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
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<td>PEC</td>
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<td>CMG333</td>
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**VERTICAL 2: ENTREPRENEURSHIP**

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### VERTICAL 3: PUBLIC ADMINISTRATION

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<th>PERIODS PER WEEK</th>
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<td>CMG344</td>
<td>Constitution of India</td>
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### VERTICAL 4: BUSINESS DATA ANALYTICS

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<td>Marketing And Social Media Web Analytics</td>
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<td>Operation And Supply Chain Analytics</td>
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### VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

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<td>CES331</td>
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<td>CES333</td>
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<td>4.</td>
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This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

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

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

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

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

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

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

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

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

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

(v) Proficiency Modules
This would address some 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 grammatical structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners’ ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

**UNIT I**
**INTRODUCTION TO EFFECTIVE COMMUNICATION**

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

**INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION**
Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Wh/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).
UNIT II  NARRATION AND SUMMATION  
Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar –Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

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

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

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

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

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.
MA3151  MATRICES AND CALCULUS

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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].

**REFERENCES:**

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**PH3151 ENGINEERING PHYSICS**

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

**UNIT I MECHANICS**

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

UNIT III OSCILLATIONS, OPTICS AND LASERS 9

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

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

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

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

REFERENCES:
5. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag,
CO’s-PO’s & PSO’s MAPPING

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

CY3151 ENGINEERING CHEMISTRY

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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 NANOChemistry

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.

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

UNIT V ENERGY SOURCES AND STORAGE DEVICES

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

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

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

TEXT BOOKS:

REFERENCES:

CO-PO & PSO MAPPING

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

UNIT I
COMPUTATIONAL THINKING AND PROBLEM SOLVING

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

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

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

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

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

TEXT BOOKS:

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

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

GE3152  கணினி மரம்  L T P C
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அமைப்பு I  பணியின் மேம்பாத்துடன் தொல்கோளியம் 3
சோத்து பட்டுச்செயல்: பானோரியம் - பார்மையம் - தொன்முதல் தொன்முதல் -
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அமைப்பு II  பொருள் - பொருள் திறன்காலம் தொடர் தொடர் திறன்காலம் தொடர் - திறன்காலம்
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அமைப்பு III  உலகப் பணியாளர் குறிப்பிட்டன வரிசை சுண்டாப்பாணியம் 3
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**TOTAL: 15 PERIODS**

**UNIT I - LANGUAGE AND LITERATURE**

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE  3
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

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

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

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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. குறிப்பிட்டுச் சொல்வது - மத்தியக் கல்வியுடன் - புத்தாண்டு பெண்கள் (தொல்கன்பிறல்: தொல்கன்பிறல் பாப்டுத்து முன் புனை குரு மூன்று வருடகாலத்தில் குறிப்பிட்டு).
2. முக்திவெளி குறிப்பிட்டு - மத்தியக் கல்வியுடன். (தொல்கன்பிறல் புரிந்து).
3. கதையா குறிப்பிட்டு கதைப் பேசும் கதைகளின் குறிப்பிட்டு (தொல்கன்பிறல் குறிப்பிட்டு).
4. பப்குவது குறிப்பிட்டு - அரங்குகளின் குறிப்பிட்டு (தொல்கன்பிறல் புத்தாண்டு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - “Sangam City Civilization on the banks of river Vaigai” (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

GE3171 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

OBJECTIVES:
- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
● To do input/output with files in Python.

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

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

TOTAL: 60 PERIODS

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

TEXT BOOKS:

REFERENCES:
4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to
5. https://www.python.org/

COs- PO’s & PSO’s MAPPING

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BS3171
PHYSICS AND CHEMISTRY LABORATORY
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PHYSICS LABORATORY : (Any Seven Experiments)

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

LIST OF EXPERIMENTS

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

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.

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

CHEMISTRY LABORATORY: (Any seven experiments)

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

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

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

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 6

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

UNIT II NARRATION AND SUMMATION 6

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

UNIT III DESCRIPTION OF A PROCESS / PRODUCT 6

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

UNIT IV CLASSIFICATION AND RECOMMENDATIONS 6

Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about 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 text information
- To listen to and understand different points of view in a discussion
- To speak fluently and accurately in formal and informal communicative contexts
- To describe products and processes and explain their uses and purposes clearly and accurately
- To express their opinions effectively in both formal and informal discussions

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

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

HS3252  PROFESSIONAL ENGLISH -II

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

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

UNIT IV  REPORTING OF EVENTS AND RESEARCH
UNIT V  
THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY

Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.

TOTAL: 30 PERIODS

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

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

REFERENCE BOOKS:

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

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

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

MA3251  STATISTICS AND NUMERICAL METHODS  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 derivateis using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson’s 1/3 rules.

UNIT V  NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS  9+3

TOTAL: 60 PERIODS

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

TEXT BOOKS:

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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:

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

UNIT I  ELECTRICAL CIRCUITS  9
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm’s Law - Kirchhoff’s Laws – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)
Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only), Three phase supply – star and delta connection – power in three-phase systems

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

UNIT III  ELECTRICAL MACHINES  9

UNIT IV  ANALOG ELECTRONICS  9

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

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:
2. A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements &
3. S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
4. James A Svoboda, Richard C. Dorf, Dorf’s Introduction to Electric Circuits, Wiley, 2018

REFERENCES:

CO’s, PO’s & PSO’s MAPPING

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GE3251 ENGINEERING GRAPHICS

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

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

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

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

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

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

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

TEXT BOOKS:

REFERENCES:

Publication of Bureau of Indian Standards:

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

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TEXT-CUM-REFERENCE BOOKS

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

GE3252 TAMILS AND TECHNOLOGY L T P C

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

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

UNIT III MANUFACTURING TECHNOLOGY 3

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

TOTAL: 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. சுருக்கக் கலக்குறிப்பு – சுற்றுநிலை பட்டியலில் – இடைவன. பிரித்தானிய (கோஷ்பிள்ளி: சுருக்கக் கலக்குறிப்பு பட்டியல் புகழ்பெறும் வருடத்தின் குழுப்ப).
2. கலாச்சாரம் சுருக்கக் – புதுச்செடி தொலை. தொழில்பாடு. (கோஷ்பிள்ளி: பிரித்தானிய).
3. சுருக்கக் – சுற்றுநிலை பட்டியலில் – சுற்றுநிலை பட்டியலில் (கோஷ்பிள்ளி: சுற்றுநிலை பட்டியலில்
4. சுருக்கக் – சுற்றுநிலை பட்டியலில் (கோஷ்பிள்ளி: சுற்றுநிலை பட்டியலில்)
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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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11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

NCC Credit Course Level 1*
NX3251  (ARMY WING) NCC Credit Course Level - I  L T P C
2 0 0 2

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

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

PERSONALITY DEVELOPMENT  7
PD 1  Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving  2
PD 2  Communication Skills  3
PD 3  Group Discussion: Stress & Emotions  2

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

SOCIAL SERVICE AND COMMUNITY DEVELOPMENT  8
| SS 1 | Basics, Rural Development Programmes, NGOs, Contribution of Youth | 3 |
| SS 4 | Protection of Children and Women Safety | 1 |
| SS 5 | Road / Rail Travel Safety | 1 |
| SS 6 | New Initiatives | 2 |
| SS 7 | Cyber and Mobile Security Awareness | 1 |
| **TOTAL**: 30 PERIODS |

### NCC Credit Course Level 1*

**NX3252** *(NAVAL WING)*

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### NCC Credit Course Level 1*

**NX3253** *(AIR FORCE WING)*

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NATIONAL INTEGRATION AND AWARENESS

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

PERSONALITY DEVELOPMENT

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

LEADERSHIP

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

SOCIAL SERVICE AND COMMUNITY DEVELOPMENT

SS 1 Basics, Rural Development Programmes, NGOs, Contribution of Youth
SS 4 Protection of Children and Women Safety
SS 5 Road / Rail Travel Safety
SS 6 New Initiatives
SS 7 Cyber and Mobile Security Awareness

TOTAL : 30 PERIODS

GE3271 ENGINEERING PRACTICES LABORATORY

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

PLUMBING WORK:

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

WOOD WORK:

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

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

PART II  ELECTRICAL ENGINEERING PRACTICES  15

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

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 airconditioner.

SHEET METAL WORK:  
  a) Making of a square tray

FOUNDRY WORK:
  a) Demonstrating basic foundry operations.

PART IV  ELECTRONIC ENGINEERING PRACTICES  15

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

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

ELECTRONIC EQUIPMENT STUDY:  
  a) Study an elements of smart phone.  
b) Assembly and dismantle of LED TV.  
c) Assembly and dismantle of computer/ laptop
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:

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

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

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
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 - discussing arrangements - discussing plans and decisions - discussing purposes and reasons - understanding common technology terms - Writing: writing different types of emails.

UNIT III

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

UNIT IV

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

UNIT V

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

TOTAL: 60 PERIODS

LEARNING OUTCOMES

At the end of the course, learners will be able

- Speak effectively in group discussions held in a formal/semi formal context.
- Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions.
- Write emails, letters and effective job applications.
- Write critical reports to convey data and information with clarity and precision.
- Give appropriate instructions and recommendations for safe execution of tasks.
Assessment Pattern
- One online / app based assessment to test speaking and writing skills
- Proficiency certification is given on successful completion of speaking and writing.

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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.

MA3351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

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

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

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

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

UNIT IV FOURIER TRANSFORMS
UNIT V  Z-TRANSFORMS AND DIFFERENCE EQUATIONS  9 + 3
TOTAL: 60 PERIODS

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

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PY3301 CHEMICAL PROCESS CALCULATIONS L T P C
2 1 0 3

OBJECTIVES
The course aims to,
• learn about the basic calculation techniques used in process industries
learn the laws about the behaviour of gases, liquids and solids, for analysing and designing chemical processing equipment with the help of data sources containing relevant physical and chemical properties.

UNIT I UNITS AND DIMENSIONS 9
Fundamental and derived units, conversion, dimensional consistency of equations, conversions of equations, Dimensional and dimensionless constants, mass and volume relations, Stoichiometric and composition relations.

UNIT II IDEAL GASES AND VAPOUR PRESSURE 9
Ideal gas law, Dalton’s Law, Amagat’s Law and Average molecular weight of gaseous mixtures. Effect of temperature on vapour pressure, Vapour pressure plot (Cox chart), Vapour pressures of miscible and immiscible liquids and solutions, Raoult’s Law and Henry’s Law.

UNIT III HUMIDITY AND SOLUBILITY 9
Partial saturation, Humidity- Absolute Humidity, Vaporization process, Molal humidity, Relative and percentage saturation, dew point, humid heat, wet bulb and dry bulb temperatures, use of humidity charts, adiabatic vaporization and adiabatic saturation temperature.

UNIT IV MATERIAL BALANCE 9

UNIT V ENERGY BALANCE 9

SELF STUDY TOPICS (NOT FOR EXAMINATIONS)
Process flow diagram/chart for material and energy balances, Material and energy balances for Chemical reactors.

COURSE OUTCOMES:
1. Have a clear idea of various types of unit systems and students will be able to convert units from one form to another.
2. Comprehend the different gas laws, and students would be able to solve the problems on stoichiometry quantity of gaseous substances in industry.
3. Know the various measurements of humidity and clear about applying humidity charts, psychrometric charts, and concepts of vaporization and vapor pressure laws.
4. analyze the behaviour of recycle processes, performing approximate material balances by hand and setting up calculations for rigorous solution by computer.
5. attain the energy balance concepts necessary for solution of energy balance of different chemical engineering processes in industries.
6. Independently develop a stoichiometry problem solving ability in a number of useful mathematical and chemical operations.

TEXT BOOKS:
REFERENCES:

Course articulation matrix

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

BT3352 MICROBIOLOGY L T P C 3 0 0 3

OBJECTIVES
- To introduce students to the principles of Microbiology to emphasize structure and biochemical aspects of various microbes.
- To solve the problems in microbial infection and their control.

UNIT I INTRODUCTION 9
Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

UNIT II MICROBES- STRUCTURE AND MULTIPLICATION 9
Structural organization and multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages.

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM 9
Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methods to quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

UNIT IV CONTROL OF MICROORGANISMS 9
Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms.
UNIT V  INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vitamin B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control; biosensors

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students would be able to understand about
CO1: Microorganisms and examination of microorganisms
CO2: Structural organization of microorganisms
CO3: Nutritional requirements of microorganisms, their growth and metabolism
CO4: Control of microorganisms
CO5: Metabolites, bioremediation, biofertilizers, biopesticides and biosensors

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AVERAGE CO: 3
OBJECTIVES:
- To inculcate understanding of the properties and principles of medicinal agents that originates from organic and inorganic sources and their application in pharmaceutical industry.
- To provide knowledge on the basic functional group identification, molecular rearrangement, chemical bonding with their reaction mechanism.
- To provide the knowledge on fundamental principles involved in the identification, preparation of pharmaceutical aids and to apply the principle of coordination compounds in pharmaceutical substances.

UNIT I STRUCTURE AND PROPERTIES
Atomic orbitals, molecular orbitals theory, wave equation, bonding and antibonding orbitals, hybrid orbitals, covalent bond, polarity of bonds and molecules, dipole moment, resonance, inductive, mesomeric and electromeric effects, intramolecular and intermolecular hydrogen bonding, Isomers, optical activity, stereoisomerism, specification of configuration, chirality,

UNIT II CHEMISTRY OF ALIPHATIC, AROMATIC AND HETEROAROMATIC COMPOUNDS

UNIT III QUALITY CONTROL OF DRUGS AND PHARMACEUTICALS
Importance of quality control, significant errors, methods used for quality control, History of Pharmacopoeia, Identification and characterization of impurities in Pharmaceutical substances, Limit tests: Definition, importance, general procedure for limit test for chlorides, sulphates, iron, arsenic, heavy metals and lead with suitable examples. Identification test for Magnesium hydroxide, Ferrous sulphate, Calcium gluconate, Copper sulphate. Test for purity: Swelling power of Bentonite, Neutralizing capacity of aluminum hydroxide gel, Determination of potassium iodate and iodine in potassium Iodide Preparation of inorganic pharmaceuticals: Boric acid, Potash alum and Ferrous sulphate.

UNIT IV STUDY OF ORGANIC REACTIONS AND MOLECULAR REARRANGEMENTS
Alder Reaction, Formylation reactions, Gattermann Reaction, Gattermann-Koch reaction, Vilsmeier reaction, Azide-Alkyne Cycloaddition, Catalytic hydrogenation, Meerwein-Ponndorf-Verley, Birch reduction, Clemmenson, Sandmeyer, Haloform reactions, Azo coupling, Beckmann Rearrangement, Benzidine rearrangement.

UNIT V RADIOPHARMACEUTICALS AND CO-ORDINATION COMPOUNDS

TOTAL: 45 PERIODS

SELF STUDY TOPICS (NOT FOR EXAMINATIONS)
Indian Pharmacopoeia, United States Pharmacopoeia, British Pharmacopoeia, European Pharmacopoeia, International Pharmacopoeia

COURSE OUTCOMES:
After completion of the course the student will be able to
• identify the relationship between structure and physical properties of pharmaceutical substances and make predictions of chemical bonding along with their reaction mechanism.
• draw the structures and outline the synthesis of simple pharmaceutically active organic compounds having five and six membered heterocyclic compounds.
• describe the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals.
• distinguish between various reaction mechanisms and well acquainted with the synthesis of some important class of drugs.
• apply the knowledge in the handling of radiopharmaceuticals and synthesis of new drug molecule with special reference to organic, inorganic and coordination chemistry.

TEXT BOOKS:

REFERENCES:

Course Articulation Matrix

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BT3392 BIOCHEMISTRY

OBJECTIVE
• To enable students learn the fundamentals of Biochemical Processes and Biomolecules

UNIT I INTRODUCTION TO BIOMOLECULES - CARBOHYDRATES:
Basic principles of organic chemistry, role of carbon, types of functional groups, chemical, nature of water, pH and biological buffers, bio molecules structure and properties of
Carbohydrates (mono, di, oligo & polysaccharides) Proteoglycans, glucosaminoglycans. mutarotation, glycosidic bond, reactions of monosaccharides, reducing sugars. Starch, glycogen, cellulose and chitin. Proteoglycans, glucosaminoglycans. hyaluronic acid, chondroitin sulfate

UNIT II STRUCTURE AND PROPERTIES OF OTHER BIOMOLECULES 9
Structure and properties of Important Biomolecules.
Lipids: fatty acids, glycerol, saponification, iodination, hydrogenation, phospholipids, glycolipids, sphingolipids, cholesterol, steroids, prostaglandins.
Protein: Amino Acids, Peptides, Proteins, measurement, structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins. Determine of primary structure.
Nucleic acids: purines, pyrimidines, nucleoside, nucleotide, RNA, DNA-Watson-Crick structure of DNA, reactions, properties, measurement, nucleoprotein complexes

UNIT III METABOLISM CONCEPTS AND CARBOHYDRATE METABOLISM 9

UNIT IV INTERMEDIARY METABOLISM AND REGULATION 9
Fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, Bioenergetics - High energy compounds, electronegative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.

UNIT V PROTEIN TRANSPORT AND DEGRADATION 9
Protein targeting, signal sequence, secretion; Folding, Chaperone and targeting of organelle proteins, Protein degradation, receptor-mediated endocytosis, turnover.

TOTAL: 45 PERIODS

OUTCOMES
Upon completion of this course the student will be able to
- Ensure students have a strong foundation in the structure and reactions of biomolecules.
- Introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions.
- Correlate biochemical processes with biotechnology application.
- Understand in detail about structures, types and classifications of amino acid.
- Illustrate the metabolism of carbohydrates through various anabolic and catabolic pathways.
- Relate the structure of DNA with its function in replication and gene expression.

TEXT BOOKS

REFERENCES
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**PY3391**  
**HUMAN ANATOMY AND PHYSIOLOGY**  
**L T P C**  
3 0 0 3

**OBJECTIVES:**
- To explain the gross morphology, structure and functions of various organs of the human body and describe the various homeostatic mechanism and their imbalance.

**UNIT I**  
**HEMOPOIETIC SYSTEM**  
Composition and functions of blood, Hemopoiesis, blood components, blood groups, clotting factors and mechanism of coagulation, platelets.

**UNIT II**  
**CARDIOVASCULAR SYSTEM**  
Anatomy and function of the heart, circulation: pulmonary, coronary, and systematic circulation; electrocardiogram (ECG), cardiac cycle and heart sounds, blood pressure - its maintenance and regulation.

**UNIT III**  
**RESPIRATORY SYSTEM**  
Anatomy of respiratory organs and functions, mechanism/physiology of respiration and regulation of respiration, transport of respiratory gases, respiratory volumes and capacities.

**UNIT IV**  
**NERVOUS SYSTEM**  
Classification of the nervous system, anatomy, physiology, and functional areas of the cerebrum, cerebellum, midbrain, thalamus, hypothalamus and basal ganglia, spinal cord: structure and reflexes.

**UNIT V**  
**ENDOCRINE SYSTEM**  
Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal glands, pancreas, pineal gland, thymus.

**TOTAL 45 PERIODS**

**COURSE OUTCOMES:**
At the end of the course, the students will be able to
- Acquire the gross histology, structure and functions of various organs of the human body
- Implement the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of human body
- Perform basic physiological and pharmacological experiments and to record and interpret the results for its clinical significance.
- Demonstrate laboratory procedures used to examine anatomical structures and evaluate physiological functions of each organ system
- Interpret graphs of anatomical and physiological data.
- Apply the methods to evaluate the potency of drugs, toxicity of drugs in animal models.
TEXTBOOKS
2. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterjee, Academic Publishers Kolkata.

REFERENCE BOOKS
7. Anatomy and Physiology 2e J. Gordon Betts, Tyler, Texas Kelly A. Young, Long Beach, California James A Wise, Hampton, Virginia Copyright Year: 2021

Course Articulation Matrix

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OBJECTIVES:
- To practically demonstrate various experimental techniques to identify the morphology, culture characteristics, propagation and control of microbes and industrial applications of microbes.

EXPERIMENTS
1. Demonstration of efficiency of sterilization techniques.
2. Preparation of various types of culture media: nutrient broth and agar
3. Culture techniques: isolation and preservation of cultures: broth: flask, test tubes; agar: pour plates, streak plates, slants, stabs
4. Microscopic identification of bacteria
5. Staining techniques: simple, differential- gram’s staining, spore /capsule staining
6. Quantification of microbes: sampling and serial dilution; bacterial count, total count and viable count.
7. Determination of phenol coefficient to demonstrate efficiency of a disinfectant
8. Perform and report sensitivity of antibiotics (Disc diffusion and well diffusion)
9. Inoculate, Incubate and plot the growth curve of bacteria (E.coli)
10. Effect of pH, Temperature, UV radiation on Growth of bacteria (E.coli)
11. Determination of microbial inhibitory concentration (MIC).
12. Biochemical identification of unknown microbes

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students will be able to
1. Understand the advanced technical information pertaining to laboratory bio-safety and preventive measures from pathogenic microorganism.
2. Develop the minimum skills to work on several important techniques using equipment for the study of microorganisms. Microscopically examine living microorganisms.
3. Familiar with the types of laboratory equipment and culture media needed to develop and maintain pure cultures.
4. Carry out the technique for aseptic removal and transfer of microorganisms for subculturing.
5. Determine the cultural characteristics of microorganisms as an aid in identifying and classifying organisms into taxonomic groups.
6. Practical use of the compound microscope for visualization of cellular morphology from stained slide preparations.

REFERENCE BOOKS

Course Articulation Matrix

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PY3312 BIOCHEMISTRY AND PHYSIOLOGY LABORATORY

OBJECTIVES
The course aims the students to,
- Learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.).
- To learn the gross histology, structure and functions of various organs of the human body and perform the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of human body

65
LISTOFEXPERIMENTS
Biochemistry
1. Qualitative tests for carbohydrates—distinguishing reducing from non-reducing sugars and keto from aldo sugars.
2. Quantitative method for aminoacid estimation usingbnnihydrin—distinguishing amino from imino acid.
3. Quantitative analysis of carbohydrates (Benedict’s method etc.,)
4. Protein estimation by Biuret, Lowry’s method, Bradford and spectroscopic methods
5. Extraction of lipids and analysis byTLC.
8. Estimation of chloride, glucose, ammonia and creatinine in urine.

Physiology
1. Study of different systems with the help of models (axial skeleton, appendicular skeleton, cardiovascular system, respiratory system, digestive system, urinary system, nervous system, special senses, reproductive system)
2. Determination of bleeding and clotting time
3. Determination of R.B.C. and W.B.C count of blood
4. Estimation of Haemoglobin
5. Determination of differential count of blood WBCs.
6. Enumeration of RBC
7. Determination of Erythrocyte Sedimentation Rate
8. Blood group determination
9. Observation of osmotic fragility of RBCs
10. Determination of packed cell volume and calculation of blood indices
11. Heart rate and blood pressure recording
12. ECG recording
13. Examination of respiratory system and recording of respiratory movements

TOTAL:45 PERIODS

COURSE OUTCOMES:
On completion of the course, the students would be able to
1. Apply basic principles of chemistry to biological systems and molecular biology.
2. Correlate molecular structure and interactions present in proteins, nucleic acids, carbohydrates and lipids
3. Perform procedure to characterize the biomolecules using microscopy.
4. Understand the gross histology, structure and functions of various organs of the human body
5. Implement the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of human body
6. Perform basic physiological and pharmacological experiments and to record and interpret the results for its clinical significance.

REFERENCE BOOKS:
Course Articulation Matrix

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GE3361 PROFESSIONAL DEVELOPMENT

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

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

10 Hours

MS EXCEL:
- Create worksheets, insert and format data

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

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

OUTCOMES:
On successful completion the students will be able to
- Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
- Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
- Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

TOTAL: 30 PERIODS

PY3401 APPLIED CHEMICAL ENGINEERING THERMODYNAMICS

OBJECTIVES
- Students will learn about the behavior of fluids, laws of thermodynamics, thermodynamic property relations and their application in different chemical processes.

UNIT I CONCEPTS OF THERMODYNAMICS

UNIT II LAWS OF THERMODYNAMICS

UNIT III THERMODYNAMIC POTENTIALS
Thermodynamic Potentials, thermodynamic correlation, Maxwell relations, criteria for Equilibria and stability. Clapeyron equation, partial molar properties, ideal and non-ideal solutions, standard states definition and choice

68
UNIT IV ACTIVITY COEFFICIENT
Activity coefficient-composition models, Gibbs-Duhem equation, effect of pressure and temperature on activity co-efficient, activity and property change of mixing, excess properties of mixtures.

UNIT V PHASE EQUILIBRIA
Thermodynamic consistency of phase equilibria, phase equilibria in single and multicomponent systems, Duhem’s theorem, vapor-liquid equilibria and non-ideal solutions. Chemical reaction equilibria, Extent of reaction, equilibrium constant and standard free energy change

COURSE OUTCOMES:
On completion of the course, the students would be able to
1. Understand the basic concepts, laws and different process related to chemical engineering thermodynamics.
2. Identify the laws related to chemical engineering thermodynamics, thermodynamic principles, flow process and its thermodynamic application.
3. Understand the thermodynamic potential, its correlation and analyze and distinguish between ideal and non-ideal solution.
4. Understand and demonstrate the activity coefficient and activity property of solution.
5. Demonstrate the Chemical and phase equilibria equations.
6. Understand the interrelationships between different thermodynamic properties and become familiar with the Thermodynamic plots.

TEXT BOOKS:

REFERENCES:

Course articulation matrix

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

TOTAL: 45 PERIODS
OBJECTIVES:

➢ To provide the basic fundamental knowledge about the flow properties of different types of fluids and its momentum balance.
➢ To provide the knowledge about the various transporting and flow measurement and fluid machineries.

UNIT I  FUNDAMENTAL CONCEPTS  6
Methods of analysis and description - fluid as a continuum – Velocity and stress field - Newtonian and non-Newtonian fluids – Classification of fluid motion

UNIT II  FLUID STATICS  9
Fluid statics – basic equation - equilibrium of fluid element – pressure variation in a static fluid - application to manometry – Differential analysis of fluid motion – continuity, equation of motions, Bernoulli equation and Navier- Stokes equation.

UNIT III  DIMENSIONAL ANALYSIS  9
The principle of dimensional homogeneity – dimensional analysis, Rayleigh method and the Pi-theorem - non-dimensional action of the basic equations - similitude - relationship between dimensional analysis and similitude

UNIT IV  FLOW IN PIPES  12
Reynolds number regimes, internal flow - flow through pipes – pressure drop under laminar and turbulent flow conditions – major and minor losses; Line sizing; External flows - boundary layer concepts, boundary layer thickness under laminar and turbulent flow conditions- Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds.

UNIT V  FLOW MEASUREMENT  9
Flow measurement - Constant and variable head meters; Velocity measurement techniques; Types, characteristics and sizing of valves; Classification, performance characteristics and sizing of pumps.

TOTAL : 45 PERIODS

COURSE OUTCOMES
On completion of the course, the students would be able to
1. Understand the fluid properties, apply the knowledge and equipments to determine the pressure by different techniques.
2. Ability to solve and analyze the mathematical model associated with physical fluid-flow system and its applications.
3. Describe the different flow pattern in various fluid ducts like pipes and fittings
4. Understand the fluid flow properties through solids and its application.
5. Know the various transporting and metering devices of fluid flow in bulk pharmaceutical manufacturing and in chemical process.
6. Understand the interrelationships between different fluid flow properties and become familiar with the graphs to utilize these properties during various manufacturing processes.

TEXT BOOKS:

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Course articulation matrix

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PY3403

CELL AND MOLECULAR BIOLOGY

OBJECTIVES
The course aims to,

- Enable students understand the structure and function of the prokaryotic and eukaryotic cell with its organelles.
- Expose the concepts on the genetic information in the eukaryotic cell and its regulation.
- Provide knowledge on the application of recombinant DNA technology in biotechnological research.
- Illustrate creative use of modern tools and techniques for sequencing and amplification of DNA.
- Develop students in strategizing research methodologies employing genome analysis.

UNIT I
CELL STRUCTURE AND FUNCTIONS OF THE ORGANELLES
Prokaryotic, Eukaryotic cells, Sub-cellular organelles, membrane systems and functions
Differences and similarities between prokaryotic and eukaryotic cells. Cytoskeletal proteins. Extra cellular matrix, cell-cell junctions, Cell division: mitosis, Extra- and intracellular signal transduction

UNIT II
MOLECULAR GENETICS

UNIT III
RECOMBINANT DNA TECHNOLOGY
UNIT IV  SEQUENCING AND AMPLIFICATION OF DNA
Amplification of DNA; Types of PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Site directed mutagenesis. Maxam Gilbert’s and Sanger Coulson’s and automated methods of DNA sequencing, Next generation sequencing technologies, Genetic maps and Physical maps.

UNIT V  GENOME ANALYSIS AND GENOMICS
Gene therapy and Transgenic technology, Introduction to Functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Web resources for Genomics, Regulation of Eukaryotic Gene Expression by Small RNAs (RNA Interference, RNAi).

COURSE OUTCOMES:
After completion of the course the student will be able to
1. Acquire knowledge on the structure and functions of prokaryotic and eukaryotic cells.
2. Illustrate an overview of nucleic acids and the central dogma of life and its significance
3. Employ the knowledge of DNA manipulation techniques in the production of commercially important recombinant proteins.
4. Understand the concepts of PCR techniques and genome sequencing techniques in biotechnological applications.
5. Apply the knowledge of genome analysis and genomics in disease diagnostics and therapy.
6. Integrate knowledge of molecular biology principles for understanding of various disorders and genetic engineering principles for its diagnosis and therapy.

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TOTAL 45 PERIODS
OBJECTIVES:

- To impart knowledge on fundamental principles and concepts involved in pharmaceutical powders, liquid flow and dispersions
- To provide the knowledge about kinetics and drug stability

UNIT I  
MICROMERITICS AND POWDER RHEOLOGY  
Particle size and distribution, particle number, methods for determining particle volume, optical microscopy, sieving, sedimentation, Dynamic light scattering (DLS) technique, measurement of particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness and flow properties.

UNIT II  
SURFACE AND INTERFACIAL PHENOMENA  
Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tensions, free energy, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interface, solid gas and solid-liquid interface, complex films, electrical properties of interface.

UNIT III  
VISCOSITY AND RHEOLOGY  
Newtonian system, Law of flow, kinematic viscosity, effect of temperature on viscosity, non-Newtonian systems, plastic, pseudoplastic, dilatant, thixotropy, thixotropy in formulation, determination of viscosity: capillary, falling ball, rotational viscometers

UNIT IV  
DISPERSION SYSTEMS  
Colloidal dispersions: Definition, types, properties of colloids, protective colloids, applications of colloids in pharmacy. Suspensions and Emulsions: Interfacial properties of suspended particles, settling in suspension, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicle, rheological considerations, emulsions; types, theories, physical stability.

UNIT V  
KINETICS AND DRUG STABILITY  
General considerations and concepts of drug reaction kinetics; zero order, first order and pseudo first order, half-life determination, Influence of temperature, light, catalytic species, solvent and other factors, Stabilization of drugs, Accelerated stability study, expiration dating.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course the students will able to:

- CO1 Explain the methods used for determining particle size, particle volume and surface area along with the derived properties of powders
- CO2 Differentiate the surface and interfacial phenomenon,
- CO3 Distinguish between Newtonian and non-Newtonian system and to identify methods for determining viscosity.
- CO4 Describe the types and properties of colloidal dispersions, suspensions and emulsions along with its applications
- CO5 Understand drug reaction kinetics, stabilization of drugs and its accelerated stability testing
- CO6 Apply the knowledge of physical properties of powders, liquids, colloidal and coarse dispersions in the design of pharmaceutical dosage forms

TEXT BOOKS:


REFERENCES:

Course articulation matrix

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PY3405 PHARMACEUTICAL ANALYSIS

OBJECTIVE:
- To facilitate students to acquire knowledge about the principles and applications of pharmaceutical analysis.

UNIT I PROCESS ANALYTICAL TECHNOLOGY

UNIT II SAMPLE PREPARATION AND SPECIFIC METHODS
Strategies of sample preparation – liquid – liquid extraction, solid-liquid extraction – solid phase extraction techniques – radiometric analysis – Analysis of biological compounds – analysis of water.

UNIT III PHYSICAL ANALYTICAL METHODS

UNIT IV CHEMICAL ANALYTICAL METHODS
Appearance, absorbance, pH, related substances, residual solvents, foreign anions, sulfated ash, elemental impurities, loss on drying, moisture and water, oxidizing substances, acid value, hydroxyl value, iodine value, peroxide value, saponification value, unsaponifiable matter – Functional group analysis
UNIT V CONTROL OF THE QUALITY OF ANALYTICAL METHODS


SELF STUDY TOPICS (NOT FOR EXAMS)
Different types of biological analysis of pharmaceutical substances and dosage forms.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students would be able to
1. highlight the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals.
2. demonstrate the skills on various types of extraction techniques
3. develop skills on range of physical analytical methods
4. determine the chemical properties of pharmaceutical compound
5. control the errors in the analysis of drug sample
6. illustrate the methods used for quality control of drug samples.

TEXT BOOKS

REFERENCE BOOKS

Course Articulation Matrix

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<thead>
<tr>
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OBJECTIVES:

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

UNIT I  ENVIRONMENT AND BIODIVERSITY  6

UNIT II  ENVIRONMENTAL POLLUTION  6

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

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

UNIT V  SUSTAINABILITY PRACTICES  6

TOTAL:30 PERIODS

OUTCOMES:

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

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

**REFERENCE BOOKS:**

**CO-PO & PSO MAPPING**

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*1-low, 2-medium, 3-high, “-”: no correlation*
### PERSONALITY DEVELOPMENT
- **PD 3** Group Discussion: Change your mindset, Time Management, Social Skills  
- **PD 5** Public Speaking

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

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

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

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

### ARMED FORCES
- **AF 1** Armed Forces, Army, CAPF, Police

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

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

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

### LEADERSHIP
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- **DM 2** Initiative Training, Organising Skills, Do’s & Don’ts, Natural Disasters, Man Made Disasters  
- **DM 3** Fire Service & Fire Fighting

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

### GENERAL AWARENESS
### NCC Credit Course Level 2*

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

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**TOTAL: 45 PERIODS**

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### Personality Development

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**TOTAL: 7 PERIODS**

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### Disaster Management

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### Environmental Awareness & Conservation

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**TOTAL: 3 PERIODS**

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### General Awareness

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**TOTAL: 4 PERIODS**

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### General Service Knowledge

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### Adventure

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### Border & Coastal Areas

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**TOTAL: 2 PERIODS**

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### Objectives:
- To provide students with the practical laboratory skills of pharmaceutical chemistry.
- To demonstrate the effect of the different synthetic methodology.

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• To clarify theoretical concepts of chemical synthesis of drug molecules.

LIST OF EXPERIMENTS
1. To determine the strength of a given unknown solution of HCl by titrating it against with the help of a known solution of NaOH using phenolphthalein indicator.
2. To determine the strength of a given unknown solution of NaOH by titrating it against with the help of a known solution of HCl using methyl orange indicator.
3. To prepare and standardize 200 ml of 0.1 M silver nitrate solution.
5. Determination of partition coefficient of any medicinal compound by shake flask method.
6. Preparation and identification tests of the following official (IP) compounds: Magnesium sulphate, Calcium Carbonate, Ferrous sulphate, Boric acid
7. Determination of impurities by limit test
8. Synthesis of compounds by hydrolysis reaction: Salicylic acid from Alkyl Benzoate.
9. Synthesis of compounds by oxidation reaction: Benzoic acid from Benzyl chloride.
10. Synthesis of compounds involving Electrophilic substitution reaction:
    Benzylation: Benzanilide, Phenyl benzoate, 2-Naphthyl benzoate
    Acetylation: Aspirin
    Nitration: Picric acid, p-nitro aniline, m - dinitro benzene
    Halogenation: p-bromo acetanilide
    Haloform: Iodoform
11. Synthesis of compounds by naming reaction: 7- hydroxy -4- methyl coumarin (Pechmann reaction), 1- phenyl azo-2-naphthol (Diazotization and Coupling reaction)
12. Synthesis of major industrial compounds: Paracetamol from p-aminophenol, Benzocaine from p-nitro benzoic acid

TOTAL: 45PERIODS

COURSE OUTCOMES:
The students will be able to
1. Apply safe laboratory practices in the preparation of reagents, handling and storage of chemicals.
2. Identify/confirm the unknown organic compounds by melting point determination, pKa, boiling point, Viscosity etc.
3. Carry out quality control tests for fine chemicals and bulk drugs.
4. Implement the knowledge of chemistry in designing the synthetic scheme of organic compounds.
5. Demonstrate feasible synthesis of some important class of drugs using chemical reactions.
6. Develop the reaction mechanism and orientation of chemical bonds in the synthesis of major industrial compounds.

REFERENCES:
Course Articulation Matrix

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PY3412 PHYSICAL PHARMACEUTICS LABORATORY

OBJECTIVES:
- To practice the determination of fundamental properties of dosage forms of powders and dispersions.
- To study the kinetics and stability aspects of pharmaceuticals.

LIST OF EXPERIMENTS:
1. Determination of particle size, particle size distribution using various methods of particle size analysis.
2. Determination of surface area of powders.
3. Determination of derived properties of powders like density, porosity, compressibility, angle of repose, etc.
4. Determination of effect of glidant on angle of repose of powder.
5. Determination of surface/interfacial tension, HLB value.
6. Determination of critical micellar concentration (CMC) of surfactants.
7. Study of rheological properties of various types of systems using different viscometers.
8. Study of different types of colloids and their properties.
9. Preparation of various types of suspensions and determination of their sedimentation parameters.
11. Determination of half-life, rate constant and order of reaction.
12. Preparation of pharmaceutical buffers and determination of buffer capacity.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course the students will be able to
- CO1 Characterize and evaluate the properties of powders by suitable methods.
- CO2 Plan and carry out the determination of interfacial property of liquids.
- CO3 Plan and carry out the determination of viscosity.

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Plan and carryout the physical stability study of suspension and emulsion dosage forms.
Plan and carryout the preparation of buffer and to determine the buffer capacity and isotonicity of solutions
Calculate the rate constant and order of reactions.

TEXT BOOKS:

REFERENCES:

Course articulation matrix

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<th>Programme Outcome</th>
<th>Programme Specific outcome</th>
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PY3513              INDUSTRIAL TRAINING / INTERNSHIP I*  L T P C  0 0 0 2

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

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

No. of Weeks: 04

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

SEMESTER V
PY3501 PHARMACEUTICAL DOSAGE FORMS

OBJECTIVES
- To acquaint the concepts of pharmaceutical dosage forms in respect of their formulation and development

UNIT I POWDERS AND GRANULES
Advantages and disadvantages of powdered and granulated products, Mixing and dividing of powders, Problems in manufacturing powders, Reasons for granulation, Granulation mechanisms, Granulation methods, Pharmaceutical granulation equipments.

UNIT II TABLETS AND COATING
Types of tablets, Formulation, Manufacturing of tablets, Tableting problems, Evaluation of Tablets, Tablet coating, Film coating, Sugar Coating, Enteric coating, Evaluation of coated tablets, Applications, Large Scale Manufacture.

UNIT III CAPSULES

UNIT IV SEMISOLID FORMULATIONS

UNIT V ADVANCES IN TABLETING TECHNIQUES
Buccal Tablets – Chewable Tablets — Inlay tablets, Layer tablets, Mouth dissolving tablet, Tablets in tablets – Compression coating.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The student will be able to
1. comprehend the factors influencing the development of various solid dosage forms.
2. recognize the formulation concepts and evaluate different dosage forms to meet out the compendial requirements.
3. execute and involve in the manufacturing process for the tablet and capsule dosage forms.
4. design microencapsulation techniques in the multiparticulate dosage forms
5. apprehend the advances in solid dosage forms
6. apply the technology of solid dosage forms in pharmaceutical industries

TEXT BOOKS:
REFERENCES:

Course Articulation Matrix

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

PY3502 UNIT OPERATIONS IN PHARMACEUTICAL INDUSTRIES  L  T  P  C
3 1 0 4

OBJECTIVES:
- To provide the basics of unit operations.
- To recognize various unit operations such as size reduction, separation, filtration, centrifugation, crystallization, and mixing.

UNIT I INTRODUCTION

UNIT II SIZE REDUCTION & SEPARATION
Properties and characterization of particulate solids - Analytical methods for size determination of powders - Size reduction- Mechanism- equipment – Size separation –mechanism -equipment

UNIT III CRYSTALLIZATION

UNIT IV FILTRATION AND CENTRIFUGATION

12

UNIT V MIXING 12
Mixing of powdered materials – Mechanism of random mixing and interactive mixing. Factors affecting the mixing process - Types of mixers - Characteristics and operation of Liquid, Semisolid and Solid Mixers.

COURSE OUTCOMES:
The student will be able to
1. Elucidate the various materials for pharmaceutical plant construction and industrial hazards
2. Recognize the properties of particulate matter and size reduction and separation equipment.
3. Describe the properties of crystals and working of crystallisers
4. Appreciate the theory of filtration and centrifugation and the equipment used for these unit operations
5. Define the principle of mixing and the working of mixers in pharma industries.
6. Recognize the applications of principles of unit operations in industry

TEXT BOOKS:
3. Cooper and Gunn's Tutorial Pharmacy, Edited by S J Carter, CBS Publishers, New Delhi, 2005

REFERENCES:

Course Articulation Matrix

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OBJECTIVES:
- To provide general pharmacological principles.
- To make understand the pharmacology of different types of drugs acting on various physiological system.

UNIT I  INTRODUCTION TO PHARMACOLOGY
Drugs, routes of drug administration, factors modifying drug action, tolerance and dependence, Pharmacodynamics and pharmacokinetics, Adverse drug reactions, Drug interactions, Overview of drug discovery and development.

UNIT II  DRUGS ACTING ON NERVOUS SYSTEM
Pharmacology of parasympathomimetics, parasympatholytics, sympathomimetics, sympatholytics, general anaesthetics, sedatives, hypnotics, antipyretic, analgesic, anti-inflammatory (NSAIDS) and CNS stimulants.

UNIT III  DRUGS ACTING ON CARDIOVASCULAR SYSTEM
Pharmacology of cardiac glycosides and other drugs for congestive heart failure, antiarrythmatic, antianginal and antihypertensive drugs.

UNIT IV  DRUGS ACTING ON GASTROINTESTINAL SYSTEM
Antacids, anti-secretory and anti-ulcer drugs, Laxatives and Anti-diarrhoeal drugs, Appetite stimulants and suppressants, Emetics and anti-emetics.

UNIT V  CHEMOTHERAPY OF MICROBIAL DISEASES
General principles of chemotherapy; Inhibitors of cell wall synthesis - penicillins, Protein synthesis inhibitors – aminoglycosides, chloramphenicol, Chemotherapy of tuberculosis and malaria.

SELF STUDY TOPICS: (NOT FOR EXAMINATIONS) Topics related to toxicology i.e., OECD guidelines for testing acute, sub-acute, and chronic toxicity, genotoxicity, carcinogenicity, teratogenicity and mutagenicity of drugs and chemicals.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The student will be able to
1. Realize the various principles of general pharmacology.
2. Comprehend the Mechanism of action of different types of drugs acting on various physiological systems.
3. Know the pharmacology of various categories of drugs acting on nervous, cardiovascular and gastrointestinal systems.
4. Illustrate the principles of chemotherapy.
5. Understand the pharmacology of antimicrobial agents.
6. Able to contribute in the drug discovery, potency evaluation, toxicological screening and drug development.

TEXT BOOKS
REFERENCE BOOKS

Course Articulation Matrix

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COURSE OUTCOMES:
The student will be able to
- Acquire knowledge to prepare and evaluate various liquid, semi-solid dosage forms

TOTAL: 45 PERIODS
• Acquire knowledge to prepare and evaluate solid dosage forms and parenteral dosage forms
• Experiment and interpret the granule manufacturing process
• Demonstrate the concepts in formulation and evaluation of capsules
• Apply the knowledge to formulate new dosage forms
• Experiment various quality control parameters of pharmaceutical dosage forms

TEXT BOOKS:
3. Indian Pharmacopoeia, Indian Pharmacopoeia commission, Ghaziabad, 2016.

REFERENCES:

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PY3512  PHARMACOLOGY LABORATORY

OBJECTIVE:
To instill the knowledge of various pharmacological experiments for better understanding the drug action in various systems.

EXPERIMENTS
1. Practical &/ Online demonstration of laboratory animals handling and various routes of drug administration.
2. Virtual study of use of anaesthetics in various laboratory animals.
3. Virtual demonstration of determination of toxicity LD50.
4. To demonstrate the bioassay of Ach using isolated ileum /rectus abdominis muscle preparation using online videos.
5. Bioassay of 5-HT using rat fundus strip or Bioassay of oxytocin using rat uterus using simulation software’s / online gadgets.
7. Study of alternative methods for drug evaluation.
8. Computational identification of biomarker genes for lung cancer/ prostate cancer/ Diabetes etc.,
9. Insilico ADMET analysis by molinspiration software
10. Determination of drug likeness properties using SWISSADME

BASIC READING
1. Study of common laboratory animals and handling of lab animals (demonstration).
2. CPCSEA guidelines for laboratory animal facility.
3. Study of different routes of drug administration.
4. Study of commonly used instruments in experimental pharmacology and its uses

TOTAL: 45 PERIODS

Equipments / Infrastructure requirements
1. Valid CPCSEA registered airconditioned animal house facility for housing experimental animals and its maintenance furnished as per the CPCSEA norms.
2. Computers (Atleast 10 Nos with a network printer) and multiuser software license e.g., Expharm or other equivalent simulation softwares for teaching.
3. Pharmacology experiment kit (animal cages, dissection kit, animal feed, bed materials, autoclave, incinerator, dissection table, standard drugs, anesthetic drugs, minor consumables and gadgets, personnel protective equipments,)

COURSE OUTCOMES:
Students would be able to
1. Acquire knowledge on handling of Laboratory animals.
2. Implement the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of human body
3. Perform basic physiological and pharmacological experiments and to record and interpret the results for its clinical significance.
4. Demonstrate laboratory procedures used to examine anatomical structures and evaluate physiological functions of each organ system
5. Interpret graphs of anatomical and physiological data.
6. Apply the methods to evaluate the potency of drugs, toxicity of drugs in animal models.

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OBJECTIVE:
- To recognize the principles and applications of heat transfer
- To understand the principles of mass transfer operations.

UNIT I  FUNDAMENTAL CONCEPTS AND CONDUCTIVE HEAT TRANSFER  12

UNIT II  HEAT TRANSFER: CONVECTION  12

UNIT III  HEAT TRANSFER: RADIATION  12
Radiation heat transfer – concept of black and grey body - monochromatic total emissive power – Kirchoff’s law – Planck’s law - Stefan-Boltzman’s law – heat exchange through non-absorbing media - solving problems in heat transfer by radiation.

UNIT IV  MASS TRANSFER DIFFUSION, EXTRACTION AND ABSORPTION  12
Introduction to Mass transfer - Fick’s law for molecular diffusion - molecular diffusion in gases, liquids and solids - Introduction to Absorption- Equilibrium in gas liquid system- Minimum Liquid rate- Height equivalent to theoretical plate. Liquid - liquid extraction - solvent characteristics.

UNIT V  DISTILLATION AND ADSORPTION  12
Concept of distillation, Vapour liquid equilibria, Henry’s Law, Raoults Law –Volatility- relative volatility. Methods of distillation- Simple or Differential distillation, Rayleigh’s equation - Steam distillation. Adsorption - Types of adsorption, nature of adsorbents, adsorption equilibria, adsorption isotherms

TOTAL: 60 PERIODS

COURSE OUTCOMES:
The students will be able to
1. Elucidate the theory behind conduction mode of heat transfer and solving problems related to it.
2. Recognize the theory behind convection mode of heat transfer and solving problems related to it.
4. Appreciate the principle behind heat exchangers and its working
5. Define the theory of mass transfer.
6. Recognize the problems related to heat and mass transfer in pharmaceutical industry

TEXT BOOKS:
REFERENCES:

Course Articulation Matrix

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PY3602 INSTRUMENTAL TECHNIQUES IN DRUG ANALYSIS

OBJECTIVE:
To facilitate students to acquire knowledge about the principles and operations of various modern analytical instruments.

UNIT I UV-VISIBLE SPECTROSCOPY
Theory of atomic and molecular spectra. Electronic transitions, Beer and Lambert’s law, Derivation and deviations, Chromophores, Auxochromes, Spectral shifts, Solvent effect on absorption spectra. Instrumentation - Sources of radiation, wavelength selectors, sample cells, Detectors- Barrier layer cell, Photo tube, PMT, PDA detectors; Applications in pharmaceuticals.

UNIT II ATOMIC ABSORPTION SPECTROSCOPY
Principles, Instrumentation, Operation – single and double beam spectroscopy; sampling technique – Detection limit, Difference between Atomic absorption spectroscopy and Flame spectroscopy; Applications in pharmaceuticals.

UNIT II INFRARED and NMR SPECTROSCOPY
Principles of vibrational spectroscopy – Instrumentation and sampling techniques – Applications in pharmaceutical sciences – NMR principles – Instrumentation – Applications in pharmaceuticals.

UNIT IV MASS SPECTROMETRY
Basic principles, instrumentation and ionization methods; atmospheric pressure ionization (API), chemical ionization (CI), electron impact ionization (EI), fast atom bombardment (FAB), matrix assisted laser desorption ionization (MALDI), time of flight (TOF); Applications in pharmaceuticals.

UNIT V CHROMATOGRAPHIC METHODS
History, origin and classification of chromatography: Column Chromatography: principle, theory, column operations, instrumentation, derivatisation methods and applications; High Performance
Liquid Chromatography: Principle, instrumentation, solvents system, packing materials and applications; Thin Layer Chromatography: Principle, instrumentation, solvents, packing materials and applications in pharmaceuticals.

**COURSE OUTCOMES:**
At the end of the course the students will be able to,
1. Discuss the principle, theory and instrumentation of UV/Visible spectroscopy; Applications in pharmaceuticals.
2. Describe the principle, instrumentation and operation of AAS; Difference between AAS and FES; Applications in pharmaceuticals.
3. Illustrate the principle and instrumentation of IR and NMR spectroscopy; Applications in pharmaceuticals.
4. Discuss the basic principle, instrumentation and ionization methods of Mass spectroscopy; Applications in pharmaceuticals.
5. Describe the principle, instrumentation, solvents and packing materials of CC, TLC and HPLC; Applications in pharmaceuticals.
6. Apply the theoretical knowledge of instruments, new analytical methods may be developed and validated for the screening of various pharmaceutical agents.

**TEXTBOOKS:**

**REFERENCES:**

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

**NX3651** *(ARMY WING) NCC Credit Course - III*  
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#### PERSONALITY DEVELOPMENT
- PD 3: Group Discussion: Team Work  
- PD 4: Career Counselling, SSB Procedure & Interview Skills  
- PD 5: Public Speaking  

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

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

#### COMMUNICATION
- C 1: Introduction to Communication & Latest Trends  

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

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

TOTAL: 45 PERIODS

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**NX3652** *(NAVAL WING) NCC Credit Course - III*  
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#### PERSONALITY DEVELOPMENT
- PD 3: Group Discussion: Team Work  
- PD 4: Career Counselling, SSB Procedure & Interview Skills  
- PD 5: Public Speaking  

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

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

#### NAVAL COMMUNICATION
- NC 1: Introduction to Naval Communications  
- NC 2: Semaphore  

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

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

#### FIRE FIGHTING FLOODING & DAMAGE CONTROL
- FFDC 1: Fire Fighting  
- FFDC 2: Damage Control  

#### SHIP MODELLING
- SM: Ship Modelling Capsule  

TOTAL: 45 PERIODS
### PERSONALITY DEVELOPMENT
- PD 3: Group Discussion: Team Work (9)
- PD 4: Career Counselling, SSB Procedure & Interview Skills (3)
- PD 5: Public Speaking (4)

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

### AIRMANSHP
- A 1: Airmanship (1)

### BASIC FLIGHT INSTRUMENTS
- FI 1: Basic Flight Instruments (3)

### AERO MODELLING
- AM 1: Aero Modelling Capsule (3)

### GENERAL SERVICE KNOWLEDGE
- GSK 4: Latest Trends & Acquisitions (2)

### AIR CAMPAIGNS
- AC 1: Air Campaigns (6)

### PRINCIPLES OF FLIGHT
- PF 1: Principles of Flight (3)
- PF 2: Forces acting on Aircraft (3)

### NAVIGATION
- NM 1: Navigation (2)
- NM 2: Introduction to Met and Atmosphere (3)

### AERO ENGINES
- E 1: Introduction and types of Aero Engine (3)
- E 2: Aircraft Controls (3)

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**PY3611 HEAT AND MASS TRANSFER OPERATIONS LABORATORY**

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**OBJECTIVE:**
- To provide basic understanding of chemical engineering principles and operations
- To train the students to work on different types of Heat transfer equipment.
- To train the students to develop sound working knowledge on different types of mass transfer equipment.

**LIST OF EXPERIMENTS**
1. To determine the Thermal Conductivity of metal rod.
2. To determine individual heat transfer film coefficient in forced convection.
4. To determine overall heat transfer coefficient of double pipe heat exchanger by parallel flow.
5. To determine overall heat transfer coefficient of double pipe heat exchanger by counter flow.
6. To determine overall heat transfer coefficient of shell and tube heat exchanger.
7. Determination of diffusivity of acetone in air
8. Determination of mass transfer coefficient for steady state surface evaporation of water at different temperature.
9. Conduction of liquid-liquid extraction studies
10. Conduction of Adsorption studies
11. Separation of binary mixture using Simple distillation
12. Separation of binary mixture using Steam distillation

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students would be able to
- Determine heat transfer coefficient.
- Apprehend the conduction parameters.
- Determine heat transfer film coefficient.
- Demonstrate the separation of Binary mixtures
- Determine diffusivity and Drying characteristics
- Demonstrate distillation, extraction, diffusivity and drying principles which are having wide applications in various industries.

REFERENCES

Course Articulation Matrix

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PY3612
INSTRUMENTAL TECHNIQUES IN DRUG ANALYSIS
LABORATORY

OBJECTIVE:
To carry out analytical experiments related to spectroscopic and chromatographic techniques.

LIST OF EXPERIMENTS
1. Calibration of volumetric glasswares.
2. Establishing standard operating procedure (SOP) and Calibration records for analytical balance, pH meter and UV/Vis spectroscopy.
3. Determination of $\lambda_{max}$.
4. Quantitative analysis by titrimetric methods.
5. Effect of change in physio-chemical parameters on absorbance spectrum of a drug molecule.
6. Quantitative and qualitative analysis of drug molecule using standard comparison method by UV/Vis spectroscopy.
7. Quantitative analysis of drug molecule using calibration graph method by UV/Vis Spectroscopy.
8. Quantitative analysis of drug molecule using E1%1cm method by UV/Vis spectroscopy.
9. Simultaneous analysis of drug molecules using UV/Vis Spectroscopy.
10. Separation and identification of mixtures of drugs by TLC.
13. Quantitative and qualitative analysis of drug molecule using standard comparison method by HPLC.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
1. Discuss the principle, theory and instrumentation of UV/Visible spectroscopy; Applications in pharmaceuticals.
2. Describe the principle, instrumentation and operation of AAS; Difference between AAS and FES; Applications in pharmaceuticals.
3. Illustrate the principle and instrumentation of IR and NMR spectroscopy; Applications in pharmaceuticals.
4. Discuss the basic principle, instrumentation and ionization methods of Mass spectroscopy; Applications in pharmaceuticals.
5. Describe the principle, instrumentation, solvents and packing materials of CC, TLC and HPLC; Applications in pharmaceuticals.
6. Apply the theoretical knowledge of instruments, new analytical methods may be developed and validated for the screening of various pharmaceutical agents.

REFERENCES:
### 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
SEMMESTER VII
PY3701 REGULATORY REQUIREMENTS IN PHARMACEUTICAL INDUSTRIES

OBJECTIVE
• To acquire the knowledge of pharmaceutical industry regulations and research

UNIT I REGULATORY CONCEPTS
Quality assurance – Quality control – Practice of cGMP – WHO Guidelines – Schedule M – USFDA.

UNIT II REGULATORY ASPECTS
Pharmaceuticals: Bulk drug manufacture; Personnel, Buildings and Facilities, Process Equipment, Documentation and Records, Materials Management, Production and In-Process Controls, Packaging and Identification Labelling of API's and Intermediates, Storage and distribution, – Biotechnology derived products; Principles, Personnel, Premises and equipments, Animal quarters and care, production, labelling, Lot processing records and distribution records, quality assurance and quality control.

UNIT III INTELLECTUAL PROPERTY RIGHTS

UNIT IV ICH GUIDELINES
Quality guidelines – Impurities in new drug substances (Q3A(R2)) – Impurities in new drug products(Q3B(R2)) – Validation of analytical procedures text and methodology (Q2 (R1)).

UNIT V QUALITY AUDIT AND SELF INSPECTIONS
SOPs – Documentation – Loan license auditing – Common technical documentation (CTD) – Drug master file (DMF) – Batch manufacturing record (BMR).

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The student will be able to
• Familiarize with the pharmaceutical industry manufacturing practices and regulatory
• Implement and judge the requirements of regulatory agencies for the pharmaceutical
• Understand the process of patenting activities.
• Know the quality guidelines followed for pharmaceutical products and few of the aspects involved in document preparation for pharmaceutical product registration
• Aware about the technical process of quality audit and inspections.
• Fulfill the regulatory requirements for pharmaceutical products

TEXT BOOKS:

REFERENCES:
PY3702 BIOPHARMACEUTICS AND PHARMACOKINETICS

OBJECTIVES:
The course aims to
• learn important parameters involved in drug disposition and its principles in living systems.
• make the students to understand how the drug disposition takes place in the in vitro and in vivo conditions.
• understand the concepts of bioavailability and bioequivalence of drug products and their significance

UNIT I DRUG ABSORPTION AND DISTRIBUTION

UNIT II ELIMINATION

UNIT III BIOAVAILABILITY AND BIOEQUIVALENCE
Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, in-vitro drug dissolution models, in-vitro-in-vivo correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

UNIT IV PHARMACOKINETICS
Introduction to Pharmacokinetics, Pharmacokinetic models, One compartment open model Intravenous Bolus Injection – Intravenous infusion - Extra vascular administrations. Determination of pharmacokinetics parameters and their significance - Absorption Rate Constant (ka), Elimination Rate Constant (K) & Elimination Half- life (t½), AUC, Cmax, and tmax. Apparent Volume of Distribution (Vd) & Renal Clearance (Q).
UNIT V  MULTIPLE DOSAGE REGIMENS AND NONLINEAR PHARMACOKINETICS


TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course the students will be able to
1. identify the factors affecting the rate of drug absorption.
2. study the various factors influencing the drug disposition, various pharmacokinetic parameters.
3. Estimate various pharmacokinetic parameters using plasma and urine drug level data.
4. design and interpret the bioavailability and bioequivalence of dosage forms.
5. Predict the effects of dosage form design and routes of drug administration on drug levels in the body.
6. Demonstrate the technical skills acquired in the field of pharmaceutical technology

TEXT BOOKS:

REFERENCES:

Course Articulation Matrix

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

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

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

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

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

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

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

TOTAL: 30 PERIODS

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

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

**PY3811 PROJECT WORK / INTERNSHIP**

**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**

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

**UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS**

**UNIT II PLANNING**
UNIT III ORGANISING

UNIT IV DIRECTING

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

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

TEXT BOOKS:

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

UNIT II  TQM PRINCIPLES  9

UNIT III  TQM TOOLS & TECHNIQUES I  9

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

UNIT V  QUALITY MANAGEMENT SYSTEM  9

TOTAL: 45 PERIODS

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

CO’s- PO’s & PSO’s MAPPING

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TEXT BOOK:

REFERENCES:

GE3753 ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING

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

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

UNIT II PRODUCTION AND COST ANALYSIS

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

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

UNIT V CAPITAL BUDGETING (ELEMENTARY TREATMENT)
Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.
COURSE OUTCOMES:
Students able to
CO1: Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions
CO2: Evaluate the economic theories, cost concepts and pricing policies
CO3: Understand the market structures and integration concepts
CO4: Understand the measures of national income, the functions of banks and concepts of globalization
CO5: Apply the concepts of financial management for project appraisal

TEXT BOOKS:

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

MAPPING OF COS AND POS:

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GE3754 HUMAN RESOURCE MANAGEMENT

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

UNIT I INTRODUCTION TO HUMAN RESOURCE MANAGEMENT

UNIT II HUMAN RESOURCE PLANNING

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

UNIT IV EMPLOYEE COMPENSATION

UNIT V PERFORMANCE EVALUATION AND CONTROL

TOTAL: 45 PERIODS

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

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  9

UNIT III  KNOWLEDGE MANAGEMENT-THE TOOLS  9
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  9
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  9
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.

TOTAL: 45 PERIODS

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.

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TEXT BOOK:

REFERENCE:
COURSE OBJECTIVES

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

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

UNIT – II  FUNCTIONS OF MANAGEMENT - I  9
Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.

UNIT – III  FUNCTIONS OF MANAGEMENT - II  9
Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students would be able to

CO1 Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.

CO2 Discuss the planning; organizing and staffing functions of management in professional organization.

CO3 Apply the leading; controlling and decision making functions of management in professional organization.
Discuss the organizational theory in professional organization.

Apply principles of productivity and modern concepts in management in professional organization.

**TEXTBOOKS:**

**REFERENCES:**

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**VERTICAL 1 : DRUG DESIGN & DEVELOPMENT**

**PY3001 MEDICINAL CHEMISTRY**

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**OBJECTIVES:**
- To impart comprehensive understanding of the physicochemical basis of drug action including steric and stereoisomerism.
- To provide knowledge on the classification, chemical nomenclature, generic names and synthesis of various categories of medicinal drugs.
- To enable the students to learn and understand the structure activity relationship, biochemical/molecular basis of mechanism of action and uses of different classifications of drugs.

**UNIT I PRINCIPLES OF MEDICINAL CHEMISTRY**

Physicochemical properties in relation to biological action: Ionization, Drug distribution and pKa values and their relation to drug transport, hydrogen bonding, redox potential, surface activity and chelation. Conformational isomerism, optical and geometrical isomerism; Bioisosterism in drug design.
UNIT II DRUGS ACTING ON AUTONOMIC NERVOUS SYSTEM 9
Classification, biochemical/molecular basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties and synthesis of selected drugs belonging to the class of Cholinergics, Anticholinergics and Adrenergics.

UNIT III DRUGS ACTING ON THE CENTRAL NERVOUS SYSTEM 9
Classification, molecular basis of mechanism of action, structure activity relationship and synthesis of Sedatives, Hypnotics and anxiolytics; Opioid analgesics; Anticonvulsants and antidepressants.

UNIT IV DRUGS ACTING ON CARDIOVASCULAR SYSTEM 9
Structural basis of mechanism of action, structure activity relationship including physiochemical properties and synthesis of selected drugs belonging to the class of anti-anginal, vasodilators, calcium channel blockers and cardiac glycosides.

UNIT V EICOSANOIDS, ANTIHISTAMINE AND ANTIINFLAMMATORY DRUGS 9
Synthetic procedures, uses, structure activity relationship including physicochemical properties of the following classes of drugs Antihistamines, Eicosanoids, Non-steroidal anti-inflammatory drugs (NSAIDs).

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES:
The student will be able to
- Correlate the relationship between the physicochemical properties, steric properties and structural features of the drugs with its biological action.
- Explain the biochemical/molecular mechanism of action, Structure Activity Relationship, therapeutic use and depict the synthesis of drugs acting on autonomic nervous system.
- Describe the molecular basis of mechanism of action, therapeutic use, Structure Activity Relationship and synthesis of drugs acting on central nervous system.
- Illustrate the mechanism of action, therapeutic use and synthesis of drugs acting on cardiovascular system.
- Outline the chemical structure, mechanism of action, Structure Activity Relationship and therapeutic uses of eicosanoids and eicosanoid blocking agents.
- Apply the working knowledge of chemical structures, Structure Activity Relationship and molecular mechanism of drug action to suggest drug design ideas and to develop suitable techniques to synthesis different drug molecules.
## COURSE ARTICULATION MATRIX

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### PY3002 BIOINFORMATICS AND CHEMINFORMATICS

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**OBJECTIVE:**

- This course is to provide an introduction to cheminformatics - an interdisciplinary area on the interface of chemistry, informatics and biology.
- The student will be able to learn and understand the fundamentals of cheminformatics and its applications.

### UNIT I BIOINFORMATICS AND BIOLOGICAL DATABASES

Introduction and scope of Bioinformatics, DNA and protein sequences, genome and transcriptome, extracting, collecting and storing sequences; various file formats for bio-molecular sequences: GenBank, FASTA, GCG, MSF, NBRF-PIR. Introduction to Biological Databases; nucleic acid sequence databases: GenBank, EMBL, DDBJ; protein sequence databases: Uniprot-KB: SWISS-PROT, TrEMBL; repositories for high throughput genomic sequences: EST, STS GSS; Genome databases at NCBI, EBI, TIGR, SANGER; structure databases: PDB, NDB, PubChem, ChemBank. Identification and interpretation of patterns in sequences; sequence patterns: InterPro, Prosite, Pfam, ProDom; structure patterns: FSSP, DSSP.

### UNIT II SEQUENCE ALIGNMENT

Pairwise and Multiple sequence alignments: basic concepts of sequence alignment, Use of pairwise alignments and Multiple sequence alignment for analysis of Nucleic acid and protein sequences and interpretation of results. Algorithms used in sequence alignments: Needleman–Wunsch algorithm & Smith–Waterman algorithm. Sequence-based Database Searches: BLAST and FASTA, various versions of basic BLAST. Dot plot, basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues; Scoring matrices: basic concept of a scoring matrix, PAM and BLOSUM series.

### UNIT III PHYLOGENETIC METHODS

Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits,

UNIT IV CHEMINFORMATICS
9


UNIT V ADVANCED CHEMINFORMATICS
9

Self study: Open source tools, techniques, data in cheminformatics, simulation and predictive tools, applications

TOTAL: 45 PERIODS

TEXT BOOKS:
1. Introduction to Bioinformatics by Lesk, Arthur M., Oxford University Press

REFERENCES:
4. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O’Reilley

COURSE OUTCOMES:
- Have the knowledge of the basic ligand/structure based drug design approaches.
- Understand the basic algorithms used in the established software to carry out the most common CADD project.
- Understand the importance of proper use of various parameters in cheminformatics application programs.
- Practical use of various computational tools available for computer aided drug design including 2D/3D structural database.
- Identify cheminformatics problems that are suitable for applying machine learning techniques.
- Know the kinds of descriptors available for chemical structures.

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**PY3003 PROTEIN STRUCTURE, FUNCTION AND PROTEOMICS**

**OBJECTIVES:**
To enable the students
- To identify the importance of protein biomolecules to access, use and evaluate the information available in protein databases to find about a protein of interest.
- To realize and explain key concepts in protein function such as affinity and specificity, allosteric regulation.

**UNIT I PROTEIN STRUCTURE**
Amino Acids Structure and Properties - Peptide Bond Formation and Primary Protein Structure - Secondary Protein Structure - Superssecondary Structure and Protein Motifs - Tertiary and Quaternary Protein Structure - Protein Folding, Denaturation and Hydrolysis.

**UNIT II INVESTIGATING PROTEINS**
Protein Purification - Protein Identification and Visualization - Protein Synthesis and Sequencing - Protein Structure Elucidation - Proteome Analysis

**UNIT III PROTEIN REGULATION AND DEGRADATION**
Isozymes - Post-Translational Modifications - Allosteric Regulation - Zymogen Activation - Intracellular Protein Degradation

**UNIT IV TECHNIQUES IN DETERMINING PROTEIN STRUCTURE AND FUNCTION**
Structure-function relations - Protein Fluorescence Spectroscopy - Protein Circular Dichroism Spectroscopy - Protein EPR spectroscopy - Protein NMR Spectroscopy - Protein X-ray crystallography.

**UNIT V PROTEOMICS**
Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays.
Self study (not for examination): Virtual labs and E-learning proteomics tools.

TOTAL: 45 PERIODS

TEXT BOOKS:
4. Peptides and Proteins, RSC - ROYAL SOCIETY OF CHEMISTRY, SHAWN DOONAN
6. Recent review articles from peer reviewed journals.

REFERENCES:

COURSE OUTCOMES:
Students completing this course will
- have a foundational level of understanding of the principles of protein structure-dynamics-function relations
- explain the molecular principles behind the structure of proteins
- describe entropy - enthalpy compensation in macromolecular systems and how it controls stability and structural properties
- have a foundational level of understanding of multiple techniques that are collectively used to determine structures of dynamic protein complexes (NMR, cryo-electron microscopy, small angle X-ray scattering)
- understand selective pressure at the level of protein structure and dynamics in the evolution of new functions
- gain experience reading and critically discussing original literature in this field

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OBJECTIVES

The objective of this course is to
- find a chemical compound that can fit to a specific cavity on a protein target both geometrically and chemically.
- to know the informatics approaches to the prediction of chemical properties of new drugs
- to present the appropriate tools for such a modelling, ranging from electronic Structure methods, Molecular modelling, Structure Activity Relationships in drug design, QSAR, Molecular docking and Molecular dynamics

UNIT I ELECTRONIC STRUCTURE METHODS

Quantum chemical methods semi-empirical and ab initio methods. Conformational analysis, energy minimization, predicting the mechanism of organic reactions using electronic structure methods.

UNIT II MOLECULAR MODELING


UNIT III STRUCTURE ACTIVITY RELATIONSHIPS IN DRUG DESIGN


UNIT IV QSAR: ELECTRONIC EFFECTS

Hammett equation, lipophilicity effects. Hansch equation, steric effects. Taft equation. Experimental and theoretical approaches for the determination of physicochemical parameters, parameter interdependence: Regression analysis, Descriptor calculation. The importance of biological data in the correct form; 2D QSAR; 3D-QSAR examples of CoMFA and CoMSIA.

UNIT V MOLECULAR DOCKING

Rigid docking, flexible docking, manual docking. Advantages and disadvantages of Flex-X, Flex-S, Autodock and Dock softwares, with successful examples. Dynamics of drugs, biomolecules, drug receptor complexes, Monte Carlo simulations and Molecular dynamics in performing conformational search and docking.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to
1. Gain knowledge about fundamental concepts, challenges, and rich opportunities in developing and applying algorithms for structural bioinformatics and healthcare.
2. Interpret and practice the fundamental concepts of Molecular Modeling and Computer aided Drug Design.
3. Develop practical skills in computational approaches to analyse, predict, and engineer biomolecules and biomolecular systems.
4. Find a chemical compound that can fit to a specific cavity on a protein target both geometrically and chemically.
5. Present the appropriate tools for such a modelling, ranging from electronic Structure methods, Molecular modelling, Structure Activity Relationships in drug design, QSAR, Molecular docking and Molecular dynamics.
6. Apply the fundamental tools in techniques like docking, modelling, electronic structure methods which leads to new drug target design.
TEXT BOOKS:

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PY3004 REGULATORY TOXICOLOGY L T P C 3 0 0 3

OBJECTIVES:
The objective of the course is to
- Provide up-to-date information of the international, and national regulatory processes concerning chemical risk assessment in humans, biomaterials and medical devices.
- Develop awareness of how toxicology is applied in real world regulatory situations and to develop knowledge of the complexities and competing interests that are part of the regulatory decision making
- Know the methods used to evaluate risk and produce safety guidelines, including laboratory testing, epidemiological studies and evaluation of the literature and of the online resources available to gather this information.

UNIT I INTRODUCTION 9
Regulatory aspects and strategy in medical device and biomaterials safety evaluation. Regulations affecting cosmetic and over-the- counter drug products.
UNIT II REGULATIONS GOVERNING TOXICOLOGY 9
Aim and mission, working areas, regulatory process in toxicology, quality assurance in regulatory toxicology, toxicological risk assessment.

UNIT III TOXICOLOGY AND DRUG PRODUCT REGULATIONS 8
Introduction, aspects of the IND / NDA process, toxicology and other issues, paediatric drug products, drug combinations, excipients and reformulations, conclusions.

UNIT IV TOXICGENEOMICS, GENETIC TOXICOLOGY AND REGULATORY POLICY10
Microarrays in toxicology, proteomics and metabolomics, case examples, toxicogenomics in regulatory environment. Initiation of genetic toxicology testing, ICPEMC, NTP, Genetic toxicology technologies and concepts. Influence of genetic toxicology research on regulatory policy, future role in safety testing strategies.

UNIT V ALTERNATIVES IN TOXICOLOGY 9
Introduction, Societal need for information about toxic chemicals, evolution of alternatives in toxicology, humane science and animal welfare, assessing alternatives, challenges and future.

TOTAL 45 PERIODS

TEXT BOOKS:

REFERENCES:
1. Regulatory Toxicology in the European Union, Ian Dewhurst, Royal Society of Chemistry, 2017

COURSE OUTCOMES:
The student shall be able to
- Describe the general principles in toxicological risk assessment
- Apprehend both ecotoxicology, human toxicology, and Quality Assurance
- Understand the basic principles of and have current, cutting-edge knowledge in IND/NDA regulatory process.
- Demonstrate an understanding of Toxicogenomics
- Describe the Genetic Toxicology and ethical considerations relating to toxicology within the broader societal context
- Comprehend alternative options in toxicology.
PY3005 CLINICAL RESEARCH AND PHARMACOVIGILANCE

OBJECTIVES:
- give an opportunity to learn the different types and designs of clinical trials, requirements for conducting clinical trials, an opportunity to conceptualize, conduct, manage and report clinical trials
- teach the students on conceptualizing, designing, conducting, managing, and reporting of clinical trials.
- focus on global scenario of pharmacovigilance in different methods that can be used to generate safety data.
- teach the students in developing drug safety data in pre-clinical, clinical phases of drug development and post market surveillance

UNIT I REGULATORY PERSPECTIVES OF CLINICAL TRIALS

UNIT II CLINICAL TRIALS- TYPES AND DESIGN
Experimental Study- Randomised Clinical Trials and Non Randomised Clinical Trials, Observation Study: Cohort, Case Control, Cross sectional; Roles and responsibilities of Clinical Trial Personnel: Investigator, Study Coordinator, Sponsor, Contract Research Organization and its management.

UNIT III CLINICAL TRIAL DOCUMENTATION

UNIT IV BASIC ASPECTS/TERMINOLOGIES OF PHARMACOVIGILANCE
History and progress of pharmacovigilance, Significance of safety monitoring, Pharmacovigilance in India and international aspects, WHO international drug monitoring programme, WHO and Regulatory terminologies of Adverse Drug Reactions, evaluation of medication safety, Establishing pharmacovigilance centres in Hospitals, Industry and National programmes related to pharmacovigilance.
UNIT V METHODS, ADR REPORTING, TOOLS FOR PHARMACOVIGILANCE 9


TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to,
CO1 apply the knowledge of the regulatory requirements for conducting clinical trials.
CO2 apply the knowledge of different clinical trial designs in conducting clinical trials.
CO3 explain the responsibilities of key players involved in clinical trials and execute safety monitoring, reporting, close-out activities etc.
CO4 elucidate the principles of pharmacovigilance and detect new adverse drug reactions and their assessment.
CO5 comprehend the various pharmacovigilance methods and reporting systems.
CO6 analyze and compare the data generated during clinical research and pharmacovigilance study.

TEXT BOOKS:

REFERENCES:
PY3006 TECHNOLOGY OF FINE CHEMICALS AND BULK DRUGS

OBJECTIVES
This course aims to
- Understand the basic concept of bulk drug and their intermediates involved in the manufacture.
- Understand the diverse aspects in bulk drug industry like unit processes, equipments used and process optimization.
- Acquire the knowledge on plant design, process development and chemical hazards in fine chemical and bulk drug industry.

UNIT I INTRODUCTION OF FINE CHEMICALS AND BULK DRUGS 9
Concept of fine and Bulk drugs and their salient features – Evolution of process – Process chemistry – Research and development strategies in pharmaceutical industries, Chemical process life cycle, Legislative requirements for safe process development and scale up.

UNIT II PRODUCTION, PLANNING AND CONTROL 9

UNIT III PROCESS DEVELOPMENT AND HAZARDS 9
Developing the best synthetic route; Selection of the best route for scale-up, Choice of raw materials and reagents, Development techniques for safe process design, Effect of process variables on yield and quality of products, Unit operations posing particular hazards during development, Strategies for chemical hazards assessment, Hazards of gas and vapor generation, Identification of highly-energetic materials.

UNIT IV BASE CHEMICALS, DRUG INTERMEDIATES AND FINE CHEMICAL PRODUCTION 9
UNITV           BULK DRUGS PRODUCTION


TOTAL: 45 PERIODS

Course outcomes: The student will be able to

CO.1 Apply legislative requirements and obtain official approval of the regulatory authorities for safe process development and scale up of fine chemicals and bulk drugs industries.

CO.2 Demonstrate the importance of flow sheets, flow symbols, plant design, layout and plant construction materials for the production of bulk drugs and fine chemicals and to implement the concept of effluent treatment and solvent recovery in pharmaceutical industries.

CO.3 Develop and optimize the best synthetic scheme and pilot plant procedure to manufacture compounds and to insist development techniques for safe process considering the hazard assessment.

CO.4 Apply the knowledge of process chemistry in the production techniques of fine chemicals.

CO.5 Analyze the different processes involved in bulk drug manufacturing chemical and manufacturing processes associated with the production of small molecule drugs.

CO.6 Understand and apply the kinetics, thermodynamics and the concept of process economics in multipurpose plants.

TEXT BOOKS:


REFERENCES


Course Articulation Matrix

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(1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively)
PY3007  PREFORMULATION TECHNOLOGY  
OBJECTIVES:
- To recognize the principles of preformulation
- To understand the role of preformulation in drug and formulation development.

UNIT I  INTRODUCTION  
Preformulation studies of drug substances, proteins and peptides- Fundamental and derived properties in preformulation profiling -Preformulation worksheet.

UNIT II  ROLE OF PREFORMULATION IN FORMULATION DEVELOPMENT  
Preformulation as a support for formulation development- identification of ‘developmental challenges’ during pharmaceutical development - dosage form specific studies.

UNIT III  SALT SELECTION  
Role of salt selection in drug discovery and development - theoretical concepts for selection of counter ions for salt formation- ‘pKa rule’ for salt formation- decision tree for salt selection-appropriate case studies.

UNIT IV  SOLUBILIZATION  
Solubility and solubilization of non-electrolyte- drug solubilization in surfactant systems -use of cosolvents for development of liquid formulations-solid state manipulations including use of metastable solid forms like amorphous state.

UNIT V  OPTIMIZATION TECHNIQUES IN PHARMACEUTICAL FORMULATION AND PROCESSING  
Introduction- optimization parameters- statistical design-response surface method, contour diagrams, factorial design, partial factorial design, simplex methods, mixture designs, and Box Benken method- applications in pharmaceutical formulation.

TOTAL:45 PERIODS

TEXT BOOKS

REFERENCES

COURSE OUTCOMES:
The students will be able to
- Apprehend the principles of preformulation
- Demonstrate the role of preformulation in Formulation
- Comprehend the strategy of salt selection of drugs
- Understand the solubilisation role in preformulation
- Know the optimization techniques
- Give an overview of preformulation in drug development and formulation
### Course articulation matrix

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### PY3008 MANUFACTURING TECHNOLOGY OF DOSAGE FORMS

#### Objectives:

The course aims to,

- Impart the knowledge of the various types and stages of process of liquid and sterile pharmaceutical products.
- Understand the principles of formulating Parenterals and ophthalmics.

#### Unit I - Introduction to Liquids

- **Unit Title**: Introduction to Liquids
- **Module**: 9
- **Description**: Liquid dosage forms: Types, Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques

#### Unit II - Monophasic Liquids

- **Unit Title**: Monophasic Liquids
- **Module**: 9
- **Description**: Definition, preparation and evaluation of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions

#### Unit III - Parenterals

- **Unit Title**: Parenterals
- **Module**: 9
- **Description**: Introduction, historical perspective - parenteral routes of administration - formulation additives. Small volume parenterals - large volume parenterals - packaging - labelling - storage of injections.

#### Unit IV - Sterilization

- **Unit Title**: Sterilization
- **Module**: 9
- **Description**: Sterilization methods – Steam - Dry heat – Filtration – Gas - Ionizing radiation with their advantages and disadvantages, Validation of sterility, Particulate contamination.

#### Unit V - Ophthalmics

- **Unit Title**: Ophthalmics
- **Module**: 9
- **Description**: Absorption of drugs in the eye - raw materials - ocular penetration enhancers - general safety consideration. Formulation of various ophthalmic products with their characterization.

#### Outcomes:

At the end of the course the students will be able to

- CO1 Acquire the concepts of liquid dosage form
- CO2 Attain the knowledge of liquid dosage form preparation
- CO3 Acquire the concepts in the formulation of parenterals
- CO4 Get the knowledge of sterilisation process for the sterile products
- CO5 Know the technology used in the formulations of ophthalmic products
- CO6 Acquire the knowledge of pharmaceutical liquid and sterile products manufacturing.

**Total: 45 Periods**
TEXT BOOKS:

REFERENCES:

Course articulation matrix

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PY3009 INDUSTRIAL PROCESS AND SCALE UP TECHNIQUES LT P C 3 0 0 3

OBJECTIVES
* To develop the concepts of pilot plant and scale-up techniques in industrial processes
* To know the principle, design, methods, and equipment involved in scale – up processes

UNIT I PILOT PLANT AND SCALE-UP TECHNIQUES 9

UNIT II PRINCIPLE 9
Principle of similarity – Dimensional analysis – Scale up equations – Extrapolations – Analog models.

UNIT III DESIGN 9
Pilot plant design for flow ducts – Mixing equipments – Heat transfer equipments.

UNIT IV METHODS 9
Design methods for packed towers – Batch and continuous distillation columns.

UNIT V EQUIPMENTS 9
Pilot plants for reactors – Furnaces – Filters and mechanical operations equipments.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course the students will be able to,
CO1 Acquire the knowledge of pilot plant scale-up techniques for pharmaceutical products
CO2 Describe the principle behind the industrial scale – up process
CO3 Explains pilot plant design for flow, mixing and heat transfer equipments
CO4 Attain the knowledge of design methods for distillation columns.
CO5 Acquire the knowledge of filters and mechanical operations equipments.
CO6 Apply the knowledge of industrial process and scale – up techniques.

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PY3010 NOVEL DRUG DELIVERY SYSTEMS L T P C 3 0 0 3

OBJECTIVES:
To enable the students to
• Understand the properties of polymer and its significance in drug delivery systems.
• Interpret physicochemical properties of the drug with the drug delivery system modules.
• Apply the concepts of newer method of drug delivery systems involved in the pharmaceutical sciences and relevance of their drug delivery strategies.

UNIT I POLYMERS 9
Polymers used in controlled drug delivery modules – Classification – Advantages and disadvantages of polymers – Polymer Characterisation - Various classes of controlled release systems.

UNIT II CONTROLLED RELEASE FORMULATIONS 9
Introduction, concept, advantages and disadvantages. Physicochemical and physiological properties of drugs influencing design of oral controlled drug delivery systems.
UNIT III  TRANSDERMAL DRUG DELIVERY SYSTEMS  9

UNIT IV  TARGETED DRUG DELIVERY SYSTEMS  9

UNIT V  DRUG DELIVERY LARGE MOLECULES  9
Delivery system for Peptides and Proteins – Delivery strategies of nucleic acids – Antibodies and siRNA.

TOTAL:45 PERIODS

COURSE OUTCOMES:
1. Understands the properties, importance and influence of polymers in novel drug delivery systems.
2. Gains the importance of various physicochemical and biological properties of the drug with the drug delivery systems.
3. Discuss the concepts of transdermal drug delivery systems.
4. Relate the importance of various targeted drug delivery systems.
5. Illustrate the concepts of large molecules based delivery systems.
6. Apply the knowledge in developing various drug delivery modules

TEXT BOOKS:

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OBJECTIVE:
To instill the cognizant of packaging technology and its requirements in pharmaceutical products.

UNIT I     PHARMACEUTICAL PACKAGING AND LABELLING
9

UNIT II PRIMARY PACKAGING MATERIAL
9

UNIT III SOLID DOSAGE FORM PACKAGING
9

UNIT IV LIQUID FORMULATION AND STERILE PRODUCT PACKAGING
9
Liquid Formulation - Factors influencing selection of liquid filling machinery - balanced and unbalanced constant level filling – volumetric – gravimetric - level sensing - time fill - peristaltic and overflow liquid filling machinery. Sterile product packaging- various types of containers used for sterile products like ampoules – vials - bottles for I.V. fluid, etc. Types of closures used for the sterile products. Sterile product filling and sealing machinery i.e. ampoule filling and sealing machine.

UNIT V QUALITYCONTROL AND REGULATIONS OF PACKAGING MATERIALS
9

TOTAL:45 PERIODS

COURSE OUTCOMES:
The student will be able to
1. Understand the various categories of packaging materials used in pharmaceutical industry.
2. Differentiate proper packaging materials for different pharmaceutical dosage forms.
3. Select and evaluate the appropriate packaging materials for the different dosage forms.
4. Recognize the factors influencing the packaging of liquid and sterile products.
5. Understand the regulations of the packaging materials.
6. Excel in the technology of pharmaceutical packaging process

TEXT BOOKS:

REFERENCES:

**Course Articulation Matrix**

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**VERTICAL 3**

**QUALITY CONTROL AND QUALITY ASSURANCE**

**PY3012** BIOLOGICAL SPECTROSCOPIC TECHNIQUES

**L T P C**

3 0 0 3

**OBJECTIVES:**
- To deliver the knowledge of spectroscopic techniques and its functions
- To provide the technical information of spectroscopy for biological applications

**UNIT I** EXTRACTION OF DRUGS FROM THE BIOLOGICAL MATRIX


**UNIT II** GAS CHROMATOGRAPHY


**UNIT III** X-RAY DIFFRACTION


**UNIT IV** BIOANALYTICAL METHOD DEVELOPMENT AND VALIDATION

Key steps for analytical method development - General principles – ligand binding assays – incurred sample reanalysis – practical and cross validation – additional consideration.
UNIT V  MICROSCOPIC TECHNIQUES AND HIGH THROUGHPUT SCREENING

Electron microscopy – transmission and scanning electron microscopy – scanning tunnelling and atomic force microscopy – combinatorial chemistry and high throughput screening methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student would be able to
1. Understand and demonstrate the separation of drugs from the biological matrix.
2. Understand the basic principle and instrumentation methods of gas chromatography and its applications in pharmaceuticals.
3. Describe the theory and operation of X-ray diffraction; Determination of crystal structure of drug molecule.
4. Understand and demonstrate the key steps in analytical method development and validation.
5. Apply the techniques in material science for research, quality control and analysis.
6. Apply the theoretical knowledge of modern analytical tools, new screening methods for the estimation of micro and macro molecules.

TEXT BOOKS:

REFERENCES
1. ICH Harmonized Guideline BIOANALYTICAL METHOD VALIDATION M10.

Course articulation matrix

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OBJECTIVE:
- To understand the importance of cGMP aspects in a pharmaceutical industry.
- To understand the responsibilities of QA and QC departments.

UNIT I  GOOD LABORATORY PRACTICE  9
Concept and evolution and scopes of Quality Control and Quality Assurance. Good Laboratory Practices: Scope of GLP, The principles of good laboratory practice, Test facility management, Quality assurance programme, protocol for conduct of non-clinical testing, CPCSEA guidelines.

UNIT II  ANALYSIS OF RAW MATERIAL  9
Developing specification for new drug substances, new drug products and impurities as per ICH Q6 and Q3.

UNIT III  IN-PROCESS QUALITY CONTROL  9
Laboratory control, testing and release for distribution, in-process control, water for pharmaceutical use, aseptic process control, deviation procedure, stability testing.

UNIT IV  QUALITY ASSURANCE  9
Quality assurance of finished products - tablets, capsules, ointments, parenteral, creams according to Indian Pharmacopoeias.

UNIT V  GUIDANCE FOR INDUSTRY PAT  9

TOTAL : 45 PERIODS

COURSE OUTCOMES:
1. Apply GLP regulation in pharmaceutical manufacturing.
2. Perform an experiment using modern equipment’s in identifying the drug substance, drug products and impurities.
3. Design and develop process to ensure the critical systems in pharmaceutical industries and products.
4. Demonstrate the different assessments involved in the finished products.
5. Understand the principle and process involved in the process analytical technology
6. Understand the various regulations, modern methods and assessment techniques in maintaining the quality of the product in pharmaceutical industries.

TEXT BOOKS:

REFERENCES
### QUALITY ASSURANCE IN PHARMACEUTICAL INDUSTRIES

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**PY3014 AUDITS AND REGULATORY COMPLIANCE**

**OBJECTIVE:**

- To understand the importance and methodology of auditing.
- To prepare check list for audit process, audit report and regulatory compliance.

**UNIT I INTRODUCTION – AUDIT**

Objectives, Management of audit, Responsibilities, Audit checklist for drug industries, factory acceptance test (FAT), site acceptance test.

**UNIT II VENDOR AUDIT & PRE-APPROVAL INSPECTIONS/INVESTIGATIONS**

Vendor certification- Objectives, vendor appraisal, Vendor rating, Assessment of new vendor, vendor preferences, rewards system. Pre-Approval Inspections- Facility cGMP compliance and the capability to produce the product, Data accuracy and completeness, Laboratory methodology, manufacturing changes to approved drugs.

**UNIT III AUDITING OF MICROBIOLOGICAL LABORATORY**

Auditing the process, Product and process information, General areas of interest in the building raw materials, Water, Packaging materials.

**UNIT IV AUDITING OF QUALITY ASSURANCE AND ENGINEERING DEPARTMENT**


**UNIT V QUALITY AUDIT AND REGULATORY COMPLIANCE**

Scope, objective, quality audit, periodic evaluation, self-inspection, quality audit – internal audit, external audit, regulatory audit, role of GMP audits in QC and QA, benefits of GMP audits, elements of a systemic audit.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

1. Perform the auditing in pharmaceutical industries.
2. Design and develop the check list for vendor auditing and inspection of the pharmaceutical industries.
3. Design and develop process in checking the microbial laboratory facility.
4. Perform and verify the critical engineering systems in pharmaceutical manufacturing area.
5. Demonstrate the different auditing process and prepare the compliance report for approval pharmaceutical products.
6. Understand the various auditing and inspection process to ensure the quality of the pharmaceutical product.

**TEXT BOOKS:**

**REFERENCES:**

**Course articulation matrix**

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**PY3015 VALIDATION IN PHARMACEUTICAL INDUSTRIES**

**OBJECTIVE:**
- To provide the basic fundamental knowledge about the flow properties of different types of fluids and its momentum balance.
- To provide the knowledge about the various transporting and flow measurement and fluid machineries.

**UNIT I CONCEPTS OF VALIDATION**
UNIT II  EQUIPMENT VALIDATION  9

UNIT III  CLEANING VALIDATION  9

UNIT IV  ANALYTICAL METHOD VALIDATION  9
Introduction – Premarketing activities in assay validation methods development- Validation on analytical procedures(Q2A) - Validation for a NDA, ANDA – Validation in the quality control laboratory and transfer of methods from one laboratory to another.

UNIT V  PROCESS VALIDATION  9
Process validation as a quality assurance tool-General QA tools, purpose of process validation, Qualification activities, Process validation activities. Prospective process validation-Organization, documentation, product development, development of manufacturing capability, full scale production development, defining experimental programs, experimental design and analysis.

TOTAL : 45 PERIODS

COURSE OUTCOMES
1. Understand about the validation approach in pharmaceutical industries.
2. Perform the different equipment validation process for successful installation of equipment.
3. Design and develop process in cleaning the equipment based on cleaning validation in pharmaceutical industries.
4. Design, develop an experiment process using modern equipment tools in identifying the drug substances and products.
5. Demonstrate the different process and activities involved in the new product development.
6. Understand the various process and procedure to ensure the quality of the pharmaceutical product.

TEXT BOOKS:

REFERENCES:
Course articulation matrix

VALIDATION IN PHARMACEUTICAL INDUSTRIES

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COURSE OUTCOMES:

1. Understand and develop different standards for the quality management.
2. Understand, design, develop and implement the systems in pharmaceutical industries.
3. Demonstrate and verify the process to ensure the product quality and quality systems.
4. Verify and assess the quality risk process and manage to ensure the products quality in the manufacturing.
5. Develop the quality culture by adopting new strategies for improving the process and quality of the product.
6. Understand the various standards, systems, process to ensure the quality of the product in

PY3016 QUALITY MANAGEMENT SYSTEMS

OBJECTIVE:

- To provide the basic fundamental knowledge and importance of quality in pharmaceutical products.
- Analysis the issues in quality and provides tools for quality improvement.

UNIT I QUALITY MANAGEMENT

UNIT II QUALITY SYSTEMS
Personal hygiene, sanitation, training, calibration, cleaning and monitoring of equipment, packaging and labeling, product coding, documentation, inventory control, warehousing.

UNIT III QUALITY SYSTEM INSPECTION
Out of Specifications (OOS), Out of Trend (OOT), Complaints and evaluation of complaints, handling of returned goods and its disposal, product recalls, rejects and scrap disposal, annual product reviews, batch review and batch release, area clearance, line clearance.

UNIT IV QUALITY RISK ASSESSMENT
Quality risk management - Introduction, risk assessment, risk control, risk review, risk management tools, HACCP, risk ranking and filtering according to ICH Q9 guideline.

UNIT V QUALITY CULTURE DEVELOPMENT
Quality by design – Definition, overview, elements of QbD program tools according to ICH Q8 (R2) guideline, measuring process control and quality improvement.

TOTAL: 45 PERIODS
pharmaceutical industries.

**TEXT BOOKS:**

**REFERENCES**

**Course articulation matrix**

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**PY3017** PRODUCT DEVELOPMENT AND TECHNOLOGY TRANSFER  

**OBJECTIVE:**
- To understand the new drug substance development process.
- To understand the information to pilot plant scale up and technology transfer from R&D to manufacturing premises.

**UNIT I** PRINCIPLES OF DRUG DISCOVERY AND DEVELOPMENT  
Development and informational content for Investigational New Drugs Application (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA), Supplemental New Drug Application (SNDA), Scale Up Post Approval Changes (SUPAC), Post marketing surveillance, Product registration.
UNIT II PRE-FORMULATION STUDIES
Introduction/concept, organoleptic properties, purity, impurity profiles, particle size, shape and surface area. Solubility, Methods to improve solubility of Drugs: Surfactants & its importance, co-solvency. Techniques for the study of Crystal properties and polymorphism.

UNIT III PHARMACEUTICAL PACKAGING

UNIT IV PILOT PLANT SCALE TECHNIQUES
Concept, significance, pilot plant scale up activities – general consideration for solids, semisolids, liquid, its relevant documentation and contract manufacturing.

UNIT V TECHNOLOGY TRANSFER
Scope, organization and management, production, quality control, premises and equipment, documentation, qualification and validation.

COURSE OUTCOMES
1. Understand the process in developing new drug substances.
2. Perform an experiment using modern equipment to investigate the physicochemical properties of the drug substances.
3. Design, develop and perform an experiment using modern equipment to evaluate the packing materials.
4. Demonstrate the different process and activities involved in the pilot plant scale up of the products.
5. Design and develop the process for successful transfer of the developed product.
6. Understand the systems and process for the development and transfer of the product into the pharmaceutical industries.

TEXT BOOKS:

REFERENCES
VERTICAL 4
PHARMACEUTICAL INDUSTRIAL MANAGEMENT

PY3018 PHARMACEUTICAL PRODUCTION MANAGEMENT

OBJECTIVE:
To make understand the process involved in the pharmaceutical industries and its management.

UNIT I PILOT PLANT AND SCALE-UP TECHNIQUES

UNIT II FORMULATION PRODUCTION MANAGEMENT

UNIT III PRODUCTION, PLANNING, SCHEDULING AND FORECASTING
Production systems – Production department Personnel – Production process, routing, loading and Scheduling – Despatching of records – Production control.

UNIT IV MATERIAL MANAGEMENT

UNIT V HUMAN RESOURCE MANAGEMENT

TOTAL : 45 PERIODS

COURSE OUTCOMES:
The student will be able to
1. illustrate the general considerations of pilot plant scaleup
2. identify the various factors influencing for choosing a suitable location for pharmaceutical plant and its construction
3. analyse the different categories of Pharmaceutical Plant maintenance
4. handle and execute various process of pharmaceutical product manufacturing and manage the materials and human resources.
5. measure performance in inventory management
6. apply the learned knowledge in the management of human resources

TEXT BOOKS:

REFERENCES:

Course articulation matrix

| Course outcome | Programme Outcome | | | | | | | | | | Programme Specific outcome |
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| CO3            | 2 | 1 | 2 |   |   | 2 |   |   |   |   |   |   |   | 2 | 3 | 3 |
| CO4            | 2 | 3 | 2 |   |   | 3 |   |   |   |   |   |   |   | 2 | 3 | 3 |
| CO5            | 2 | 2 | 3 | 3 |   | 3 |   |   |   |   |   |   |   | 1 | 3 | 3 |
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| Average CO     | 2 | 1.3 | 2.25 | 2 | 3 | 3 | 3 | 2.5 | 3 | 2.5 | 2 | 2.3 | 2.5 | 2.7 |

PY3019 PHARMACEUTICAL SUPPLY CHAIN MANAGEMENT

COURSE OBJECTIVES
- To develop an understanding of basic concepts and role of Logistics and supply chain management in business.
- To understand how supply chain drivers play an important role in redefining value chain excellence of Firms.
- To develop analytical and critical understanding & skills for planning, designing and operations of supply chain.
- To understand, appraise and integrate various supply chain strategies.

UNIT I DEVELOPMENT OF SCM CONCEPTS
Concept of supply chain management, scope of SCM in Pharma Sector -Key decision areas – strategic. Supply Chain Management and Key components, External Drivers of Change. Dimensions of Logistics – The Macro perspective and the macro dimension – Logistic system analysis.
UNIT II SOURCING STRATEGY 9

UNIT III DISTRIBUTION STRATEGY 9
Choice of Market – network design – warehouse designed operation and distribution planning – transportation – packaging.

UNIT IV INVENTORY STRATEGY AND CHANNELS OF DISTRIBUTION 9

UNIT V LOGISTICS IN SUPPLY CHAIN 9
Reverse Logistics, Networks in Reverse Logistics, Decision options in Reverse Logistics, Entities in Reverse Logistics, Small Intermediate logistics, Clinical trial Logistics

TOTAL : 45 PERIODS

COURSE OUTCOMES:
On completion of this course, the students will be able to:
1. understand the fundamentals of elements and functions of supply chain, role of drivers and demand forecasting.
2. apply various techniques of inventory management and their practical situations.
3. analyze how supply chain decisions related to facility location can be applied to various industries and designing the supply chain.
4. describe warehousing management system and transportation practiced in various industries
5. analyze logistics and supply chain strategies to create value generation and utilise IT applications
6. measure supply chain performance using various models

TEXT BOOKS
1. Supply Chain Management in the Drug Industry Delivering Patient Value for Pharmaceuticals and Biologics by Hedley Rees · 2011.

REFERENCES
1. Supply Chain Management: A Global Perspective by Nada R. Sanders · 2011
2. Supply Chain Science books by Wallace J. Hopp · 2011

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OBJECTIVE:

- To provide comprehensive knowledge about the safety management, safety procedures and handling techniques of the chemicals in Industry.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

UNIT I INDUSTRIAL SAFETY
9
Concepts of safety – Hazard classification chemical, physical, mechanical, ergonomics, biological and noise hazards – Hazards from utilities like air, water, steam.

UNIT II HAZARD IDENTIFICATION AND CONTROL
9

UNIT III RISK MANAGEMENT
9

UNIT IV TYPES OF DISASTERS
9
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc. - Differential impacts in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change - Dos and Don’ts during various types of Disasters.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS
9
Landslide Hazard Zonation: Case Studies, 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, ManMade disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
The student will be able to
1. illustrate the various aspects of industrial safety, hazard identification and control.
2. highlight the various risk management systems in chemical industry.
3. describe safety procedure and handling of chemicals used in the various process.
4. differentiate the types of disasters, causes and their impact on environment and society.
5. assess vulnerability and various methods of risk reduction measures as well as mitigation.
6. draw the hazard and vulnerability profile of India, scenarios in the Indian context, Disaster damage assessment and management process.

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PY3021 MANAGEMENT INFORMATION SYSTEM

OBJECTIVE:
- To describe the role of information technology and decision support systems in business and record the current issues with those of the firm to solve business problems.
- To introduce the fundamental principles of computer-based information systems analysis and design and develop an understanding of the principles and techniques used.
- To enable students understand the various knowledge representation methods and different expert system structures as strategic weapons to counter the threats to business and make business more competitive.

UNIT I INTRODUCTION TO INFORMATION TECHNOLOGY
Impact of IT on Individuals, Organisations and Society - Information Technology Developments and Trends – Role of IT in an Organisation – Information System Concept and Types - IT Infrastructure and Architecture- Emerging Computing Environments (SaaS, SOA, etc.).

UNIT II DATABASE MANAGEMENT AND ANALYTICS

UNIT III ENTERPRISE INFORMATION SYSTEM
UNIT IV: MANAGERIAL AND DECISION SUPPORT SYSTEMS

UNIT V ESTABLISHING AND MANAGING IT SECURITY

TOTAL 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, students will be able to:
1. Relate the basic concepts and technologies used in the field of management information systems;
2. Compare the processes of developing and implementing information systems.
3. Outline the role of the ethical, social, and security issues of information systems.
4. Translate the role of information systems in organizations, the strategic management processes, with the implications for the management.
5. Apply the understanding of how various information systems like DBMS work together to accomplish the information objectives of an organization.
6. Describe the theoretical models used in database management systems to answer business question

TEXT BOOKS

REFERENCE BOOKS

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OBJECTIVES
1. This course equips students with human resource management skills
2. To be able to function effectively in their professional careers.
3. To develop their soft skills for organizational culture.

UNIT I INTRODUCTION AND OVERVIEW OF HUMAN RESOURCE MANAGEMENT
Introduction and Overview, Management Theories- Taylor, Fayol, Weber, Hawthorne; Basic types of structures; Span of Control, Delegation, Authority, Responsibility, Recruitment- Philosophies, Different methods of attracting candidates, Selection- Application blanks, Interviews, Induction

UNIT II PERFORMANCE MANAGEMENT, TRAINING AND DEVELOPMENT
Performance management - Goal setting process, Performance appraisal methods, Appraisal interviews, Rating errors, Training & Development- Identifying training needs, Training methods (on the job and off the job techniques), Evaluation of training, Change Management- Types of change, Theories of change management, Hurdles to change, Olmosk change strategies

UNIT III KNOWLEDGE MANAGEMENT AND MOTIVATION
Knowledge management - Innovation, Importance and benefits of Knowledge Management, Framework, Motivation Theories-Classification of motives, Various theories (Maslow, Herzberg, ERG, Vroom, Equity and Nohria’s 4 drive model)

UNIT IV LEADERSHIP AND ORGANIZATIONAL CULTURE
Leadership Theories- Blake Mouton model, Hersey Blanchard Model, Michigan Model, Organizational Culture-Types of cultures, Understanding and influencing cultures, Conflict Management- Stages of conflict, Types of conflict and sources of conflicts, Conflict resolution

UNIT V POWER, POLITICS, PERSONALITY AND PERCEPTION
Power &Politics- Bases of power, Politicking strategies, Personality- Theories of personality, Behaviour and personality styles, Perception- Perception versus sensation, Perceptual process, Perceptual errors

OUTCOMES:
On completion of the course the students will be able to
CO1 Explain the fundamental concepts of industrial psychology and human resource management
CO2 Analyze practical solutions.
CO3 Provide applicable solutions
CO4 Provide leadership qualities
CO5 Enhance their Entrepreneurship skills
CO6 Personality and behaviour development

TOTAL: 45 PERIODS

TEXT BOOKS/

REFERENCES:
### PY3023 PROJECT MANAGEMENT FOR PHARMACEUTICAL TECHNOLOGY

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**TOTAL: 45 PERIODS**

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### Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

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3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution;

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1. Identify characteristics of project and formulate Phases of project life cycle
2. estimate cost of project and means of financing
3. select, and apply the tools and techniques for project management,
4. measure the risk involved in a project and analyse the sensitivity, scenario of market using Information technology tools.
5. estimate of cost of project and means of financing, sales and production, cost of production, working capital requirement and its financing.
6. Plan human aspects of project management and pre-requisites for successful project implementation.

**TEXT BOOKS**

**REFERENCES**
2. Project management a system approach to planning scheduling and controlling- Harold Kerzner, CBS Publisher and distributors, 2002.
## MANDATORY COURSES I

### MX3081  INTRODUCTION TO WOMEN AND GENDER STUDIES  

**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

**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**

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

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

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

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

3. READINGS:


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

4. OTHER SESSION:

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

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

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

MX3083  
FILM APPRECIATION  
L T P C  
3 0 0 0

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

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

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

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

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

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

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

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

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS

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

UNIT II DISASTER RISK REDUCTION (DRR)

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

UNIT III DISASTER MANAGEMENT

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

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT


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

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

CO’s – PO’s & PSO’s MAPPING

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MANDATORY COURSES II
MX3085 WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA L T P C 3 0 0 0

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

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


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

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

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


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

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

**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.

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

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

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

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

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

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

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

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

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

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

TOTAL : 45 PERIODS

MX3087  POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY  L T P C
3 0 0 0

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

OBJECTIVES:

• This course will begin with a short overview of human needs and desires and how different political-economic systems try to fulfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.
COURSE TOPICS:
Considerations for humane society, holistic thought, human being’s desires, harmony in self, harmony in relationships, society, and nature, societal systems. (9 lectures, 1 hour each)

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

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

(Refs: Adam smith, J S Mill)

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

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

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

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

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

(Refs: M K Gandhi, Schumacher, Kumarappa)

Essential elements of Indian civilization. (3 lectures)

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

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

Conclusion (2 lectures)

Total lectures: 39

Preferred Textbooks: See Reference Books

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

GRADING:

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TOTAL: 45 PERIODS

OUTCOME:
- The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared.
OBJECTIVE:
The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.

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

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

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

1857 and the national awakening.

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

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

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

SUGGESTED READING:


TOTAL : 45 PERIODS
OBJECTIVES

- To understand the introduction and basic terminologies of safety.
- To enable the students to learn about the important statutory regulations and standards.
- To enable students to conduct and participate in 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

Toolbox talk - Role of safety committee - Responsibilities of safety officers and safety representatives - Safety training and safety incentives - Mock drills - On-site emergency action plan - Off-site emergency action plan - Safety poster and display - Human error assessment

UNIT IV  WORKPLACE HEALTH AND SAFETY

Noise hazard - Particulate matter - Musculoskeletal disorder - Improper sitting poster and lifting - Ergonomics - RULE & REBA - Unsafe act & Unsafe Condition - Electrical hazards - Crane safety - Toxic gas release

UNIT V  HAZARD IDENTIFICATION TECHNIQUES

Job safety analysis - Preliminary hazard analysis - Failure mode and effects analysis - Hazard and operability - Fault tree analysis - Event tree analysis - Qualitative and quantitative risk assessment - Checklist analysis - Root cause analysis - What-if analysis - And hazard identification and risk assessment

COURSE OUTCOMES

On completion of this course the student will be able:

- Understand the basic concept of safety.
- Obtain knowledge of statutory regulations and standards.
- Know about the safety activities of the working place.
- Analyze on the impact of occupational exposures and their remedies.
- Obtain knowledge of risk assessment techniques.

TEXTBOOKS


REFERENCES

5. Society of Safety Engineers, USA

ONLINE RESOURCES
Indian Standard code of practice on occupational safety and health audit
Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006
https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf
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<th>Statement</th>
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<td>Know about the safety Activities of the Working Place.</td>
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<td>Analyze on the impact of Occupational Exposures and their Remedies</td>
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OBJECTIVES:
The main objectives of this course are to:
1. Understand the importance, principles, and search methods of AI
2. Provide knowledge on predicate logic and Prolog.
3. Introduce machine learning fundamentals
4. Study of supervised learning algorithms.
5. Study about unsupervised learning algorithms.

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH 6

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

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

UNIT IV SUPERVISED LEARNING 6

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

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

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

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

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

TOTAL PERIODS: 60

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

REFERENCES
UNIT IV  OPEN PLATFORMS AND PROGRAMMING

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

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

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

TOTAL PERIODS: 60

TEXTBOOKS

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

OCS353 DATA SCIENCE FUNDAMENTALS

COURSE OBJECTIVES:
- Familiarize students with the data science process.
- Understand the data manipulation functions in Numpy and Pandas.
- Explore different types of machine learning approaches.
- Understand and practice visualization techniques using tools.
- Learn to handle large volumes of data with case studies.

UNIT I INTRODUCTION
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:
30 PERIODS

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

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

TOTAL PERIODS: 60

TEXT BOOKS

REFERENCES

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.

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

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TOTAL PERIODS: 60

OUTCOMES:
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TEXTBOOKS:
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OPEN ELCTIVE III

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

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

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

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

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

TOTAL: 45 PERIODS
- 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

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

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

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

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

**TEXTBOOKS:**

**REFERENCE BOOKS:**

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

**OCE353**

**LEAN CONCEPTS, TOOLS AND PRACTICES**

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

**UNIT I**

**INTRODUCTION**

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

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

UNIT III CORE CONCEPTS IN LEAN


UNIT IV LEAN TOOLS AND TECHNIQUES


UNIT V LEAN IMPLEMENTATION IN CONSTRUCTION INDUSTRY

Lean construction implementation- Enabling lean through information technology - Lean in design - Design Structure - BIM (Building Information Modelling) - IPD (Integrated Project Delivery) – Sustainability through lean construction approach.

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:
5. Salem, O., Solomon, J., Genaidy, A. and Luegring, M., Site implementation and Assessment of Lean Construction Techniques, Lean Construction Journal, 2005

OMG352 NGOS AND SUSTAINABLE DEVELOPMENT

COURSE OBJECTIVES
- to understand the importance of sustainable development
- to acquire a reasonable knowledge on the legal frameworks pertaining to pollution control and environmental management
- to comprehend the role of NGOs in attaining sustainable development
UNIT I  ENVIRONMENTAL CONCERNS  9
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  9
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  9
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  9
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  9
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 (9)
Structure and Process of Governance: Indian Model of Democracy, Parliament, Party Politics and Electoral Behaviour, Federalism, the Supreme Court and Judicial Activism, Units of Local Governance

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

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

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

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

TOTAL 45 : PERIODS

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

CME365 RENEWABLE ENERGY TECHNOLOGIES

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

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

UNIT – II SOLAR ENERGY (9)
UNIT – III  WIND ENERGY  9

UNIT – IV  BIO-ENERGY  9

UNIT – V  OCEAN AND GEOTHERMAL ENERGY  9

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.

TOTAL: 45 PERIODS

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

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

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

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

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

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

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

REFERENCES
1. https://www.ideou.com/pages/design-thinking#process
MF3003 REVERSE ENGINEERING

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

UNIT – I ECONOMIC SUSTAINABILITY

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

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

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

UNIT – V TRENDS IN SUSTAINABLE OPERATIONS


COURSE OUTCOMES

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

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

TOTAL: 45 PERIODS

Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:

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

UNIT I DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES


UNIT II ENERGY SOURCES


UNIT III MOTORS AND DRIVES

Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT IV POWER CONVERTERS AND CONTROLLERS

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

UNIT V HYBRID AND ELECTRIC VEHICLES

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

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:

2. Lino Guzzella, " Vehicle Propulsion System” Springer Publications,2005
**OBJECTIVES:**

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

**UNIT I  STANDARD ATMOSPHERE**

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

**UNIT II  AERODYNAMICS**

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

**UNIT III  PERFORMANCE AND PROPULSION**

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

**UNIT IV  AIRCRAFT STABILITY AND STRUCTURAL THEORY**


**UNIT V  SPACE APPLICATIONS**

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

**OUTCOMES:**

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

**TEXT BOOKS:**


**REFERENCE:**

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) - Enterprise 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
OIE354 QUALITY ENGINEERING

COURSE OBJECTIVES

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

UNIT I INTRODUCTION


UNIT II CONTROL CHARTS

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

UNIT III SPECIAL CONTROL PROCEDURES

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

UNIT IV STATISTICAL PROCESS CONTROL

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

UNIT V ACCEPTANCE SAMPLING

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able to:

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

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.
OSF351  FIRE SAFETY ENGINEERING  L  T  P  C
3  0  0  3

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

UNIT I  INHERENT SAFETY CONCEPTS  9
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  9
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  9
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  9
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  9
Safe Access - Requirement for Safe Work Platforms- Stairways - Gangways and Ramps-Fall
Prevention & Fall Protection - Safety Belts - Safety nets - Fall Arrestors- Working on Fragile Roofs
- Work Permit Systems-Accident Case Studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES
On completion of the course the student will be able to
CO1:Understand the effect of fire on materials used for construction
CO2: Understand the method of test for non-combustibility and fire resistance; and will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.

CO3: To understand the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.

CO4: To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.

CO5: Describe the safety techniques and improve the analytical and intelligence to take the right decision at right time.

TEXT BOOKS

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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

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

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

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

TOTAL: 45 PERIODS

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

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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

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

TEXT BOOKS

REFERENCES

Mapping of COs with POs and PSOs

| COs/POs & PSOs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
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| CO4            | 3 | 2 | 1 | 3 | 2 |   |   |   |   |    |   |   | 2 | 3 | 2 |
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1 – Slight, 2 – Moderate, 3 – Substantial

ORA351 FOUNDATION OF ROBOTICS

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

UNIT – I FUNDAMENTALS OF ROBOT

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

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

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

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

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

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

UNIT III  BASICS OF AERODYNAMICS
9

UNIT IV  BASICS OF AIRCRAFT STRUCTURES
9

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

TOTAL : 45 PERIODS

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

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

UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION

UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL

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

UNIT IV SENSING TECHNIQUES

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

TOTAL:45 PERIODS

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

TEXTBOOKS:

REFERENCES:

CO-PO MAPPING

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OAI351 URBAN AGRICULTURE

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-scene, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, waste utilization.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Demonstrate the principles behind crop production and various parameters that influences the crop growth on roof tops
2. Explain different methods of crop production on roof tops
3. Explain nutrient and pest management for crop production on roof tops
4. Illustrate crop water requirement and irrigation water management on roof tops
5. Explain the concept of waste management on roof tops

TEXT BOOKS:

REFERENCES:

CO-PO MAPPING

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OEN351    DRINKING WATER SUPPLY AND TREATMENT    L T P C

3 0 0 3

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

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

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

UNIT III    WATER TREATMENT
Objectives – Unit operations and processes – Principles, functions, and design of water treatment
plant units, aerators of flash mixers, Coagulation and flocculation — sand filters - Disinfection -
–Construction, Operation and Maintenance aspects.

UNIT IV    ADVANCED WATER TREATMENT
Membrane Systems - Iron and Manganese removal - Defluoridation - Construction and Operation
and Maintenance aspects

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

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

TEXTBOOKS :

REFERENCES :

CO’s- PO’s & PSO’s MAPPING

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

OEE352 ELECTRIC VEHICLE TECHNOLOGY

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

UNIT I ROTATING POWER CONVERTERS
UNIT II  STATIC POWER CONVERTERS  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
History of evolution of Electric Vehicles - Comparison of Electric Vehicles with Internal Combustion Engines - Architecture of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV) –
Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches,
Transmission and Brakes.

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:
   2020.
   Power Electronics and Motor Drives, CRC Press, 2011
3. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek “Analysis of Electric
   10th Impression 2021.
   Wiley, 2012
INTRODUCTION TO PLC PROGRAMMING

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

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

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

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

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

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

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5
1. Market survey of the recent PLCs and comparison of their features.
2. Summarize the PLC standards.
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software).
4. Market survey of Communication Network Used for PLC/SCADA.

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

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

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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OFD352 TRADITIONAL INDIAN FOODS

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

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

UNIT II TRADITIONAL METHODS OF FOOD PROCESSING

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

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

OFD353 INTRODUCTION TO FOOD PROCESSING L T P C
3 0 0 3

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

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

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

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

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

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

TOTAL: 45 PERIODS

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

TEXT BOOKS/REFERENCES:

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

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

UNIT III NANO COMPOSITES 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 10
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 9
Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots-Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.

TOTAL: 45 PERIODS

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

TEXT BOOKS

REFERENCES

Course articulation matrix

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198
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:

REFERENCE:
UNIT I  RESIN FINISHING  9

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

UNIT III  SOIL RELEASE AND ANTISTATIC FINISHES  9

UNIT IV  MECHANICAL FINISHES  9

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

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

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

OBJECTIVES:
- To enable the students to learn about basics of industrial engineering and different tools of industrial engineering and its application in apparel industry
UNIT I  INTRODUCTION
Scope of industrial engineering in apparel Industry, role of industrial engineers.
Productivity: Definition - Productivity, Productivity measures. Reduction of work content due to the product and process, Reduction of ineffective time due to the management, due to the worker. Causes for low productivity in apparel industry and measures for improvement.

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

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

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

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

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

TOTAL: 45 PERIODS

TEXTBOOKS:

REFERENCES

Course Articulation Matrix:

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

OTT353 BASICS OF TEXTILE MANUFACTURE

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

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

UNIT II REGENERATED AND SYNTHETIC FIBRES
Production sequence of regenerated and modified cellulosic fibres: viscose rayon, Acetate Rayon, high wet modulus and high tenacity fibres; synthetic fibres – chemical structure, fibre forming polymers, production principles.

UNIT III BASICS OF SPINNING
Spinning – principle of yarn formation, sequence of machines for yarn production with short staple fibres and blends, principles of opening and cleaning machines; yarn numbering - calculations
UNIT IV   BASICS OF WEAVING
Woven fabric – warp, weft, weaving, path of warp; looms – classification, handloom and its parts, powerloom, automatic looms, shuttleless looms, special type of looms; preparatory machines for weaving process and their objectives; basic weaving mechanism - primary, secondary and auxiliary mechanisms,

UNIT V   BASICS OF KNITTING AND NONWOVEN

TOTAL : 45 PERIODS

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

TEXTBOOKS

REFERENCES:
OPE351 INTRODUCTION TO PETROLEUM REFINING AND PETROCHEMICALS

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

UNIT I ORIGIN, FORMATION AND REFINING OF CRUDE OIL

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

UNIT III REFORMING AND HYDROTREATING

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

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

TOTAL: 45 PERIODS
OUTCOMES:
On the completion of the course students are expected to
CO1: Understand the classification, composition and testing methods of crude petroleum and its products. Learn the mechanism of refining process.
CO2: Understand the insights of primary treatment processes to produce the precursors.
CO3: Study the secondary treatment processes cracking, vis-breaking and coking to produce more petroleum products.
CO4: Appreciate the need of treatment techniques for the removal of sulphur and other impurities from petroleum products.
CO5: Understand the societal impact of petrochemicals and learn their manufacturing processes.
CO6: Learn the importance of optimization of process parameters for the high yield of petroleum products.

TEXT BOOKS

REFERENCES

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
OUTCOMES:

Upon completion of this course, the students can able to analyze the energy data of industries.

CO1: Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.

CO2: Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.

CO3: Skills on combustion thermodynamics and kinetics.

CO4: Apply calculation and design tube still heaters.

CO5: Studied different heat treatment furnace.

CO6: Practical and theoretical knowledge burner design.

TEXT BOOKS:


REFERENCES:


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

COURSE OBJECTIVES

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

UNIT I INTRODUCTION TO PLASTICS PROCESSING


UNIT II EXTRUSION

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

UNIT IV  COMPRESSION AND TRANSFER MOLDING
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

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
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 &

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
Impulse response - convolution integrals- Differential Equation- Fourier and Laplace
transforms in Analysis of CT systems - Systems connected in series / parallel.

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
Impulse response–Difference equations-Convolution sum- Discrete Fourier Transform and Z
Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series
and parallel.

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:
   Education, New Delhi, 2015.(Units I - V)

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 L T P C 3 0 0 3

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

UNIT I BASICS OF PRODUCT DEVELOPMENT 9

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

UNIT III DESIGN AND TESTING 9

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

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9
The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials – Introduction to Vertical Specific Product Development processes - Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical,
OUTCOMES:
Upon completion of the course, the students will be able to:
- Define, formulate, and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

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

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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CBM333 ASSISTIVE TECHNOLOGY

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

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

UNIT II HEMODIALYSERS
Physiology of kidney, Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.
UNIT III  HEARING AIDS
Anatomy of ear, Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

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

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

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.

TOTAL :45 PERIODS

TEXT BOOKS

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

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OMA352 OPERATIONS RESEARCH

OBJECTIVES:
This course will help the students to
• determine the optimum solution for Linear programming problems.
• study the Transportation and assignment models and various techniques to solve them.
• acquire the knowledge of optimality, formulation and computation of integer programming problems.
• acquire the knowledge of optimality, formulation and computation of dynamic programming problems.
• determine the optimum solution for non-linear programming problems.
UNIT I  LINEAR PROGRAMMING  9
Formulation of linear programming models – Graphical solution – Simplex method - Big M
Method – Two phase simplex method - Duality - Dual simplex method.

UNIT II  TRANSPORTATION AND ASSIGNMENT PROBLEMS  9
Matrix form of Transportation problems – Loops in T.P – Initial basic feasible solution –
Transportation algorithm – Assignment problem – Unbalanced assignment problems .

UNIT III  INTEGER PROGRAMMING  9
Introduction – All and mixed I.P.P – Gomory’s method – Cutting plane algorithm – Branch
and bound algorithm – Zero – one programming.

UNIT IV  DYNAMIC PROGRAMMING PROBLEMS  9
Recursive nature of computation – Forward and backward recursion – Resource Allocation
model – Cargo – loading model – Work – force size model - Investment model – Solution of
L.P.P by dynamic programming .

UNIT V  NON-LINEAR PROGRAMMING PROBLEMS  9
Lagrange multipliers – Equality constraints – Inequality constraints – Kuhn – Tucker Conditions
– Quadratic programming.

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 :
2. Richard Bronson & Govindasami Naadimuthu , " Operations Research " ( Schaum’s
Press, New Delhi , 2012.
4. J.P.Singh and N.P.Singh , " Operations Research , Ane Books Pvt.Ltd, New Delhi ,
2014.
OBJECTIVES:
To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To examine the key questions in the Theory of Numbers.
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

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

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

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

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

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

TOTAL: 45 PERIODS

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

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\textbf{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.

\textbf{UNIT I} \hspace{1cm} \textbf{MATRICES AND SYSTEM OF LINEAR EQUATIONS} \hspace{1cm} 9


\textbf{UNIT II} \hspace{1cm} \textbf{VECTOR SPACES} \hspace{1cm} 9

Vector spaces over Real and Complex fields - Subspace - Linear space - Linear independence and dependence - Basis and dimension.

\textbf{UNIT III} \hspace{1cm} \textbf{LINEAR TRANSFORMATION} \hspace{1cm} 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.

\textbf{UNIT IV} \hspace{1cm} \textbf{INNER PRODUCT SPACES} \hspace{1cm} 9

Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation.

\textbf{UNIT V} \hspace{1cm} \textbf{EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION} \hspace{1cm} 9


\textbf{TOTAL : 45 PERIODS}

\textbf{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.

\textbf{TEXT BOOKS}


\textbf{REFERENCES}

5. Strang G, Linear Algebra and its applications, Thomson (Brooks / Cole) New Delhi,
OBT352  BASICS OF MICROBIAL TECHNOLOGY  L T P C
3 0 0 3

COURSE OBJECTIVE:

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

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

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

UNIT III  PATHOGENIC MICROBES  9
Infectious Disease – Awareness, Causative agent, Prevention and control - Cholera, Dengu, Malaria, Diarrhea, Tuberculosis, Typhoid, Covid, HIV.

UNIT IV  BENEFICIAL MICROBES  9
Applications of microbes – Clinical microbiology, agricultural microbiology, Food Microbiology, Environmental Microbiology, Animal Microbiology, Marine Microbiology.

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

TOTAL: 45 PERIODS

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

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

UNIT III  AMINO ACIDS AND PROTEIN.  9

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

UNIT V  VITAMINS AND HORMONES  9

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

TOTAL: 45 PERIODS

TEXT BOOKS

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

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

UNIT II  CELL ORGANELLES  9
Molecular organisation, biogenesis and 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  9

UNIT IV  CELL CYCLE  9
Cell cycle- Cell division by mitosis and meiosis, Comparision of meosis and mitosis, regulation of cell cycle, cell lysis, Cytokinesis, Cell signaling, Cell communication, Cell adhesion and Cell junction, cell cycle checkpoints.

UNIT V  CENTRAL DOGMA  9

TOTAL: 45 PERIODS

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

TEXTBOOKS:

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

UNIT I
9

UNIT II
9

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

UNIT IV
9

UNIT V
9

OUTCOMES
By the end of the course, learners will be able to
- Write effective project reports.
- Use statistical tools with confidence.
- Explain the purpose and intension of the proposed project coherently and with clarity.
- Create writing texts to suit achieve the intended purpose.
- Master the art of writing winning proposals and projects.

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CO-PO & PSO MAPPING

AVG.

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

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

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

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

UNIT I OVERVIEW OF IWRM
9

UNIT II WATER USE SECTORS: IMPACTS AND SOLUTION
9
Water users: People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management.

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

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

UNIT V IMPLEMENTATION OF IWRM
9
Barriers to implementing IWRM - Policy and legal framework - Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.

TOTAL: 45 PERIODS

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

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

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

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

CO4 Illustrate the recent trends in water management.

CO5 Understand the implementation hitches and the institutional frameworks.

TEXT BOOKS

REFERENCES
OMA355    ADVANCED NUMERICAL METHODS    L T P C

3  0  0  3

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:
UNIT V  LINEAR SYSTEMS WITH RANDOM INPUTS

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

TOTAL: 45 PERIODS

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

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

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OMA357  QUEUEING AND RELIABILITY MODELLING  L T P C

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

UNIT I  RANDOM PROCESSES

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

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

UNIT IV  SYSTEM RELIABILITY  9

UNIT V  MAINTAINABILITY AND AVAILABILITY  9
Maintainability and Availability functions – Frequency of failures – Two Unit parallel system with repair – k out of m systems.

TOTAL: 45 PERIODS

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

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OBJECTIVES:

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

UNIT 1  INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT  
Functions of Production Management - Relationship between production and other functions – Production management and operations management, Characteristics of modern production and operation management, organisation of production function, recent trends in production /operations management - production as an organisational function, decision making in production Operations research

UNIT 2  PRODUCTION & OPERATION SYSTEMS  
Production Systems- principles – Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning-Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry

UNIT 3  PRODUCTION & OPERATIONS PLANNING  
Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of production process systems – Steps for production process- Production Planning Control Functions – Planning phase- Action phase- Control phase - Aggregate production planning

UNIT 4  PRODUCTION & OPERATIONS MANAGEMENT PROCESS  

UNIT 5  CONTROLLING PRODUCTION & OPERATIONS MANAGEMENT  

OUTCOMES:

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

REFERENCES
OMG355 MULTIVARIATE DATA ANALYSIS

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

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

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

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

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

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

TOTAL: 45 PERIODS

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

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

UNIT I INTRODUCTION

UNIT II VAT POLYMERIZATION AND MATERIAL EXTRUSION

UNIT III POWDER BED FUSION AND BINDER JETTING

UNIT IV MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

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

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

UNIT – I FUNDAMENTALS OF NPD

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

UNIT – III ESSENTIALS OF NPD

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

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

TOTAL :45 PERIODS

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

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

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

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OME355 INDUSTRIAL DESIGN & RAPID PROTOTYPING TECHNIQUES

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
Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human Factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Color theory - Design process flow,
wireframes, best practices in the industry - User engagement ethics - Design alternatives

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

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

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

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

TOTAL: 45 PERIODS

Course Outcomes
At the end of the course, learners will be able to:
- Create quick UI/UX prototypes for customer needs
- Develop web application to test product traction / product feature
- Develop 3D models for prototyping various product ideas
- Built prototypes using Tools and Techniques in a quick iterative methodology

Text Books

References

MF3010    MICRO AND PRECISION ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES:
At the end of this course the student should be able to
- Learn about the precision machine tools
- Learn about the macro and micro components.
- Understand handling and operating of the precision machine tools.
- Learn to work with miniature models of existing machine tools/robots and other instruments.
- Learn metrology for micro system

UNIT I    INTRODUCTION TO MICROSYSTEMS  9
Design, and material selection, micro-actuators: hydraulic, pneumatic, electrostatic/ magnetic etc. for medical to general purpose applications. Micro-sensors based on Thermal, mechanical, electrical properties; micro-sensors for measurement of pressure, flow, temperature, inertia, force, acceleration, torque, vibration, and monitoring of manufacturing systems.

UNIT II  FABRICATION PROCESSES FOR MICRO-SYSTEMS:  9
Additive, subtractive, forming process, microsystems-Micro-pumps, micro- turbines, micro engines, micro-robot, and miniature biomedical devices

UNIT III  INTRODUCTION TO PRECISION ENGINEERING  9
Machine tools, holding and handling devices, positioning fixtures for fabrication/ assembly of microsystems. Precision drives: inch worm motors, ultrasonic motors, stick- slip mechanism and other piezo-based devices.

UNIT IV  PRECISION MACHINING PROCESSES  9
Precision machining processes for macro components - Diamond turning, fixed and free abrasive processes, finishing processes.

UNIT V  METROLOGY FOR MICRO SYSTEMS  9
Metrology for micro systems - Surface integrity and its characterization.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon the completion of this course the students will be able to
- Select suitable precision machine tools and operate
- Apply the macro and micro components for fabrication of micro systems.
- Apply suitable machining process
- Able to work with miniature models of existing machine tools/robots and other instruments.
- Apply metrology for micro system

TEXT BOOKS:

REFERENCES:

OMF354  COST MANAGEMENT OF ENGINEERING PROJECTS  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.

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

AU3002  BATTERIES AND MANAGEMENT SYSTEM  L T P C  3 0 0 3

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

UNIT I  ADVANCED BATTERIES 9
Li-ion Batteries-different formats, chemistry, safe operating area, efficiency, aging. Characteristics- SOC, DOD, SOH. Balancing—Passive Balancing Vs Active Balancing. Other Batteries- NCM and NCA Batteries. NCR18650B specifications.

UNIT II BATTERY PACK
Battery Pack—design, sizing, calculations, flow chart, real and simulation Model. Peak power—definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging.

UNIT III BATTERY MODELLING
Battery Modelling Methods-Equivalent Circuit Models, Electrochemical Model, Neural Network Model. ECM Comparisons—Rint model, Thevenin model, PNGV model. State space Models—Introduction. Battery Modelling software/simulation frameworks

UNIT IV BATTERY STATE ESTIMATION

UNIT V BMS ARCHITECTURE AND REAL TIME COMPONENTS
Battery Management System—need, operation, classification. BMS ASIC—bq76PL536A-Q1 Battery Monitor IC—CC2662R-Q1 Wireless BMS MCU. Communication Modules—CAN Open-Flex Ray—CANGedge1 package. ARBIN Battery Tester. BMS Development with Modeling software and Model-Based Design.

TOTAL =45 PERIODS

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Acquire knowledge of different Li-ion Batteries performance.
2. Design a Battery Pack and make related calculations.
3. Demonstrate a Battery Model or Simulation.
5. Approach different BMS architectures during real world usage.

TEXT BOOKS

REFERENCE BOOKS
1. Developing Battery Management Systems with Simulink and Model-Based Design-whitepaper
2. Panasonic NCR18650B- DataSheet
3. bq76PL536A-Q1- IC DataSheet
4. CC2662R-Q1- IC DataSheet
COURSE OBJECTIVES:

- The objective of this course is to make the students to list common types of sensor and actuators used in automotive vehicles.

UNIT I  INTRODUCTION TO MEASUREMENTS AND SENSORS  9

- Sensors: Functions- Classifications- Main technical requirement and trends

UNIT II VARIABLE RESISTANCE AND INDUTANCE SENSORS  9

- Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors
- Inductive potentiometer- Variable reluctance transducers:- El pick up and LVDT

UNIT III VARIABLE AND OTHER SPECIAL SENSORS  9

- Variable air gap type, variable area type and variable permittivity type- capacitor microphone

UNIT IV AUTOMOTIVE ACTUATORS  9


UNIT V AUTOMATIC TEMPERATURE CONTROL ACTUATORS  9

- Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.

TOTAL =45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

1. List common types of sensor and actuators used in vehicles.
2. Design measuring equipment’s for the measurement of pressure force, temperature and flow.
3. Generate new ideas in designing the sensors and actuators for automotive application
4. Understand the operation of the sensors, actuators and electronic control.
5. Design temperature control actuators for vehicles.

TEXT BOOKS:


REFERENCES:

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
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.
INTRODUCTION TO MANAGEMENT AND ORGANISATION


OPERATIONS AND MARKETING MANAGEMENT


HUMAN RESOURCES MANAGEMENT

Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager:Manpower planning, Recruitment, Selection, TrainingandDevelopment, WageandSalaryAdministration, Promotion, Transfer, PerformanceAppraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating – Capability Maturity Model (CMM)Levels.

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).

STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES


Upon completion of the course, Students will be able to

CO1:PlananorganizationalstructureforagivencontextintheorganisationtocarryoutproductionoperationthroughWork-study.

CO2:Surveythemarkets,customersandcompetitionbetterandpricethegivenproductsappropriately

CO3:Ensurequalityforagivenproduct or service.

CO4:Plan, schedule and control projects through PERTandCPM.

CO5:Evaluate strategyforabusiness orserviceorganisation.

TEXTBOOKS:

3. ThomasN. Duering & John M.Ivancevich Management Principles and
OIM353 PRODUCTION PLANNING AND CONTROL

COURSE OBJECTIVES:
• To understand the concept of production planning and control act work study,
• To apply the concept of product planning,
• To analyze the production scheduling,
• To apply the Inventory Control concepts.
• To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION
Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design- Marketing aspect - Functional aspects- Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis- Economics of a new design.

UNIT II WORK STUDY
Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING
Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

UNIT IV PRODUCTION SCHEDULING

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC
Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic 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.

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).

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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 9

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 able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.
CO4: The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.
CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance.

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TEXT BOOKS

REFERENCES

OSF352 INDUSTRIAL HYGIENE L T P C 3 0 0 3

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


UNIT III: OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION


UNIT IV: OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT


UNIT V: INDUSTRIAL HAZARDS


TOTAL PERIODS: 45
COURSE OUTCOMES:
Students able to
CO1: Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems
CO2: Specify designs that avoid occupation related injuries
CO3: Define and apply the principles of work design, motion economy, and work environment design.
CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.
CO5: Acknowledge the impact of workplace design and environment on productivity

TEXT BOOKS:

REFERENCES:
2. Frank P Lees - Loss of prevention in Process Industries, Vol. 1 and 2,

CO’s- PO’s & PSO’s MAPPING

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OSF353 CHEMICAL PROCESS SAFETY

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
Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self-heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening.

UNIT III SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS
Design principles - Process design development - types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non-destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares - new concepts in safety design and operation - Pressure vessel testing standards - Inspection techniques for boilers and reaction vessels.

UNIT IV SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS
Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards - standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures - condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

UNIT V SAFETY AND ANALYSIS
Safety vs reliability - quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students able to
CO1 Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.
CO2 Develop thorough knowledge about safety in the operation of chemical plants.
CO3 Apply the principles of safety in the storage and handling of gases.
CO4 Identify the conditions that lead to reaction hazards and adopt measures to prevent them.
CO5 Develop thorough knowledge about

TEXT BOOK

REFERENCES:
#### OML352 ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS

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

1. Understanding the importance of various materials used in electrical, electronics and magnetic applications.
2. Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
3. Gaining knowledge on the selection of suitable materials for the given application.
4. Knowing the fundamental concepts in Semiconducting materials.
5. Getting equipped with the materials used in optical and optoelectronic applications.

**UNIT - I DIELECTRIC MATERIALS**
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics. Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous polarization, Curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

**UNIT - II MAGNETIC MATERIALS**
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis.

**UNIT - III SEMICONDUCTOR MATERIALS**
Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on specific superconducting materials; comments on fabrication and engineering applications.

**UNIT - IV MATERIALS FOR ELECTRICAL APPLICATIONS**
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetallic fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

**UNIT - V OPTICAL AND OPTOELECTRONIC MATERIALS**

**TOTAL: 45 PERIODS**

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

1. Understand various types of dielectric materials, their properties in various conditions.
2. Evaluate magnetic materials and their behavior.
3. Evaluate semiconductor materials and technologies.
4. Select suitable materials for electrical engineering applications.
5. Identify right material for optical and optoelectronic applications

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OML353 NANOMATERIALS AND APPLICATIONS L T P C 3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications
2. Gaining knowledge on dimensionality effects on different properties of nanomaterials
3. Getting acquainted with the different processing techniques employed for fabricating nanomaterials
4. Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
5. Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

UNIT I NANOMATERIALS 9
Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.

UNIT II THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS 9
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.
UNIT III  PROCESSING  9
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.

UNIT IV  STRUCTURAL CHARACTERISTICS  9
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis

UNIT V  APPLICATIONS  9
Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
1. Evaluate nanomaterials and understand the different types of nanomaterials
2. Recognise the effects of dimensionality of materials on the properties
3. Process different nanomaterials and use them in engineering applications
4. Use appropriate techniques for characterising nanomaterials
5. Identify and use different nanomaterials for applications in different engineering fields.

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COURSE OBJECTIVES:
1. To knowledge on fluid power principles and working of hydraulic pumps
2. To obtain the knowledge in hydraulic actuators and control components
3. To understand the basics in hydraulic circuits and systems
4. To obtain the knowledge in pneumatic and electro pneumatic systems
5. To apply the concepts to solve the trouble shooting

UNIT – I  FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS

UNIT – II  HYDRAULIC ACTUATORS AND CONTROL COMPONENTS

UNIT – III  HYDRAULIC CIRCUITS AND SYSTEMS
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT – IV  PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS

UNIT – V  TROUBLE SHOOTING AND APPLICATIONS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO 1: Analyze the methods in fluid power principles and working of hydraulic pumps
CO 2: Recognize the concepts in hydraulic actuators and control components
CO 3: Obtain the knowledge in basics of hydraulic circuits and systems
CO 4: Know about the basics concept in pneumatic and electro pneumatic systems
CO 5: Apply the concepts to solve the trouble shooting hydraulic and pneumatics

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TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

OMR353  
Sensors  

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COURSE OBJECTIVES:
1. To learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics.
2. To understand basic working principle, construction, Application and characteristics of displacement, speed and ranging sensors.
3. To understand and analyze the working principle, construction, application and characteristics of force, magnetic and heading sensors.
4. To learn and analyze the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors.
5. To familiarize students with different signal conditioning circuits design and data acquisition system.

UNIT – I  SENSOR CLASSIFICATION, CHARACTERISTICS AND SIGNAL TYPES  9

UNIT – II  DISPLACEMENT, PROXIMITY AND RANGING SENSORS  9

UNIT – III  FORCE, MAGNETIC AND HEADING SENSORS  9

UNIT – IV  OPTICAL, PRESSURE, TEMPERATURE AND OTHER SENSORS  9
UNIT – V SIGNAL CONDITIONING


TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:
CO1: Understand various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors. They can also analyze the sensor response.
CO2: Analyze and select suitable sensor for displacement, proximity and range measurement.
CO3: Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.
CO4: Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.
CO5: Select and design suitable signal conditioning circuit with proper compensation and linearizing element based on sensor output signal.

Mapping of COs with POs and PSOs

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TEXT BOOKS

REFERENCES

ORA352 CONCEPTS IN MOBILE ROBOTS

COURSE OBJECTIVES
1. To introduce mobile robotic technology and its types in detail.
2. To learn the kinematics of wheeled and legged robot.
3. To familiarize the intelligence into the mobile robots using various sensors.
4. To acquaint the localization strategies and mapping technique for mobile robot.
5. To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT – I INTRODUCTION TO MOBILE ROBOTICS

Introduction – Locomotion of the Robots – Key Issues on Locomotion – Legged Mobile Roots –
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

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Evaluate the appropriate mobile robots for the desired application.
CO2: Create the kinematics for given wheeled and legged robot.
CO3: Analyse the sensors for the intelligence of mobile robotics.
CO4: Create the localization strategies and mapping technique for mobile robot.
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.

TEXTBOOK

REFERENCES:

MV3501 MARINE PROPULSION

COOURSE OBJECTIVES:
1. To impart knowledge on basics of propulsion system and ship dynamic movements
2. To educate them on basic layout and propulsion equipment's
3. To impart basic knowledge on performance of the ship
4. To impart basic knowledge on Ship propeller and its types
5. To impart knowledge on ship rudder and its types
UNIT 1  BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS  

law of floatation - Basics principle of propulsion- Earlier methods of propulsion- ship propulsion machinery- boiler, Marine steam engine, diesel engine, ship power transmission system, ship dynamic structure, Marine propulsion equipment - shaft tunnel, Intermediate shaft and bearing, stern tube, stern tube sealing etc. degree of freedom, Modern propelling methods- water jet propulsion , screw propulsion.

UNIT 2  SHIPS MOVEMENTS AND SHIP STABILIZATION  

Thrust augmented devices, Ship hull, modern ship propulsion design, bow thruster – Advantages, various methods to stabilize the ship- passive and active stabilizer, fin stabilizer, bilge keel - stabilizing and securing ship in port- effect of tides on ship – effect of river water and sea water sailing vessel, Load line and load line of marking- draught markings.

UNIT 3  SHIPS SPEED AND ITS PERFORMANCE  
Ship propulsion factors, factors affecting ships speed, various velocities of ship, hull drag, effects of fouling on ships hull, ship wake, relation between powers, Fuel consumption of ship, cavitations - effects of cavitation's, ship turning radius.

UNIT 4  BASICS OF PROPELLER  

UNIT 5  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:

MAPPING OF COS AND POS:

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TOTAL: 45 PERIODS
OBJECTIVES:
At the end of the course, students are expected to acquire
1. Knowledge on basics of Hydrostatics
2. Familiarization on types of merchant ships
3. Knowledge on Shipbuilding Materials
4. Knowledge on marine propeller and rudder
5. Awareness on governing bodies in shipping industry

UNIT I  INTRODUCTION TO HYDROSTATICS  9

UNIT II  TYPES OF SHIP  10
General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers- Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gas carriers - Chemical tankers - Passenger ships

UNIT III  SHIPBUILDING MATERIALS  9
Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys, Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced Composites

UNIT IV  MARINE PROPELLER AND RUDDER  8
Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its effects on propeller

UNIT V  GOVERNING BODIES FOR SHIPPING INDUSTRY  9
Role of IMO (International Maritime Organization), SOLAS (International Convention for the Safety of Life at Sea), MARPOL (International Convention for the Prevention of Pollution from Ships ) , MLC (Maritime Labour Convention), STCW 2010 (International Convention on Standards of Training, Certification and Watch keeping for Seafarers), Classification societies Administration authorities

OUTCOMES:
Upon completion of this course, students would
1. Acquire Knowledge on floatation of ships
2. Acquire Knowledge on features of various ships
3. Acquire Knowledge of Shipbuilding Materials
4. Acquire Knowledge to identify the different types of marine propeller and rudder
5. Understand the Roles and responsibilities of governing bodies

TEXT BOOKS:
2. Dr.DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006

REFERENCES:
2. MARPOL Consolidated Edition , Bhandakar Publications, 2018

TOTAL: 45 PERIODS
OBJECTIVES:
At the end of the course, students are expected to
1. Understand the role of Marine machinery systems
2. Be familiar with Marine propulsion machinery system
3. Acquaint with Marine Auxiliary machinery system
4. Have acquired basics of Marine Auxiliary boiler system
5. Be aware of ship propellers and steering system

UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS 9
Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems

UNIT II MARINE PROPULSION MACHINERY SYSTEM 9
Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system

UNIT III MARINE AUXILIARY MACHINERY SYSTEM 9
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications

UNIT IV MARINE BOILER SYSTEM 9
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories

UNIT V SHIP PROPELLERS AND STEERING MECHANISM 9
Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, students should able to,
1. Distinguish the role of various marine machinery systems
2. Relate the components of marine propulsion machinery system
3. Explain the importance of marine auxiliary machinery system
4. Acquire knowledge of marine boiler system
5. Understand the importance of ship propellers and steering system

TEXT BOOKS:

REFERENCES:
1. Alan L.Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006
2. A.S.Tambwekar, "Naval Architecture and Ship Construction", The Institute of Marine Engineers (India), Mumbai, 2015
CRA332 DRONE TECHNOLOGIES  L  T  P  C
3  0  0  3

COURSE OBJECTIVES:
1. To understand the basics of drone concepts
2. To learn and understand the fundamentals of design, fabrication and programming of drone
3. To impart the knowledge of an flying and operation of drone
4. To know about the various applications of drone
5. To understand the safety risks and guidelines of fly safely

UNIT – I INTRODUCTION TO DRONE TECHNOLOGY 9
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

UNIT – II DRONE DESIGN, FABRICATION AND PROGRAMMING 9
Classifications of the UAV - Overview of the main drone parts - Technical characteristics of the parts - Function of the component parts - Assembling a drone - The energy sources - Level of autonomy- Drones configurations - The methods of programming drone- 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: Createthe programs for various drones

CO-PO MAPPING:

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<thead>
<tr>
<th>COs/Pos&amp;P SOs</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
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Average

Mapping of COs with POs and PSOs

Average

253
TEXT BOOKS

REFERENCES

OGI352 GEOGRAPHIC INFORMATION SYSTEM

OBJECTIVES:
To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.

UNIT I FUNDAMENTALS OF GIS

UNIT II SPATIAL DATA MODELS

UNIT III DATA INPUT AND TOPOLOGY

UNIT IV DATA QUALITY AND STANDARDS
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure

UNIT V DATA MANAGEMENT AND OUTPUT
Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS - distributed GIS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
• On completion of the course, the student is expected to
∞ CO1 Have basic idea about the fundamentals of GIS.
∞ CO2 Understand the types of data models.
∞ CO3 Get knowledge about data input and topology
∞ CO4 Gain knowledge on data quality and standards
∞ CO5 Understand data management functions and data output
TEXTBOOKS:

REFERENCES:

CO – PO – PSO MAPPING: GEOGRAPHIC INFORMATION SYSTEM

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<tr>
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<th>Course Outcome</th>
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<td>Conceptualization and evaluation of Design solutions</td>
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OAI352 AGRICULTURE ENTREPRENEURSHIP DEVELOPMENT L T P C

OBJECTIVES
- To introduce the importance of Agri-business management, its characteristics and principles
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.

UNIT I ENTREPRENEURIAL ENVIRONMENT IN INDIAN CONTEXT
Entrepreneur Development(ED): Concept of entrepreneur and entrepreneurship assessing overall business environment in Indian economy- Entrepreneurial and managerial characteristics- Entrepreneurship development programmers (EDP)-Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development-Globalization and the emerging business entrepreneurial environment.

UNIT II AGRIPRNEURSHIP IN GLOBAL ARENA: LEGAL PERSPECTIVE
Importance of agribusiness in Indian economy - International trade-WTO agreements- Provisions related to agreements in agricultural and food commodities - Agreements on Agriculture (AOA)- Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS).

UNIT III ENTREPRENEURSHIP MANAGEMENT: FINANCIAL PERSPECTIVE
Entrepreneurship - Essence of managerial Knowledge -Management functions- Planning-organizing-Directing-Motivation-ordering-leading-supervision- communication and control- Understanding Financial Aspects of Business - Importance of financial statements-liquidity ratios-leverage ratios, coverage ratios-turnover ratios-Profitability ratios. Agro-based industries-Project-Project cycle-Project appraisal and evaluation techniques- undiscounted measures-
UNIT IV  ENTREPRENEURIAL OPPORTUNITIES: ECONOMIC GROWTH PERSPECTIVE
Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country- Overview of Indian social, political system and their implications for decision making by individual entrepreneurs- Economic system and its implication for decision making by individual entrepreneurs.

UNIT V  ENTREPRENEURIAL PROMOTION MEASURES AND GOVERNMENT SUPPORT
Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis-Government schemes and incentives for promotions of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract framing (CF) and Joint Venture (JV), public-private partnerships (PPP) - overview of agricultural engineering industry, characteristics of Indian farm machinery industry.

COURSE OUTCOMES
1. Judge about agricultural finance, banking and cooperation
2. Evaluate basic concepts, principles and functions of financial management
3. Improve the skills on basic banking and insurance schemes available to customers
4. Analyze various financial data for efficient farm management
5. Identify the financial institutions

TEXT BOOKS

REFERENCES

CO-PO MAPPING

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
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<td>PSO1</td>
<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**
Concept of Species, Variation; Introduction to Major Plant Groups; Evolutionary relationships between Plant Groups; Nomenclature and History of plant taxonomy; Systems of Classification and their Application; Study of Plant Groups; Study of Identification Characters; Study of important families of Angiosperms; Plant Diversity Application.

**UNIT II INTRODUCTION TO ANIMAL DIVERSITY AND TAXONOMY**
Principles and Rules of Taxonomy; ICZN Rules, Animal Study Techniques; Concepts of Taxon, Categories, Holotype, Paratype, Topotype etc; Classification of Animal kingdom, Invertebrates, Vertebrates, Evolutionary relationships between Animal Groups.

**UNIT III MICROBIAL DIVERSITY**
Microbes and Earth History, Magnitude, Occurrence and Distribution. Concept of Species, Criteria for Classification, Outline Classification of Microorganisms (Bacteria, Viruses and Protozoa); Criteria for Classification and Identification of Fungi; Chemical and Biochemical Methods of Microbial Diversity Analysis

**UNIT IV MEGA DIVERSITY**
Biodiversity Hot-spots, Floristic and Faunal Regions in India and World; IUCN Red List; Factors affecting Diversity, Impact of Exotic Species and Human Disturbance on Diversity, Dispersal, Diversity-Stability Relationship; Socio- economic Issues of Biodiversity; Sustainable Utilization of Bioresources; National Movements and International Convention/Treaties on Biodiversity.

**UNIT V CONSERVATIONS OF BIODIVERSITY**
In-Situ Conservation- National parks, Wildlife sanctuaries, Biosphere reserves; Ex-situ conservation- Gene bank, Cryopreservation, Tissue culture bank; Long term captive breeding, Botanical gardens, Animal Translocation, Zoological Gardens; Concept of Keystone Species, Endangered Species, Threatened Species, Rare Species, Extinct Species

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**
4. Microbiology, Pearson Publisher, Gerard J. Tortora, Berdell R. Funke, Christine L.Case,
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

OBJECTIVES
- To impart knowledge on various representations of systems.
- To familiarize time response analysis of LTI systems and steady state error.
- To analyze the frequency responses and stability of the systems.
- To analyze the stability of linear systems in frequency domain and time domain.
- To develop linear models mainly state variable model and transfer function model.

UNIT I MATHEMATICAL MODELS OF PHYSICAL SYSTEMS
Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction–Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS & ROOTLOCUS TECHNIQUE

UNIT III FREQUENCY RESPONSE ANALYSIS
Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV STABILITY CONCEPTS & ANALYSIS

UNIT V STATE VARIABLE ANALYSIS
Concept of state – State Variable & State Model – State models for linear & continuous time systems–Solution of state & output equation–controllability & observability.
OUTCOMES:
Ability to
CO1: Design the basic mathematical model of physical System.
CO2: Analyze the time response analysis and techniques.
CO3: Analyze the transfer function from different plots.
CO4: Apply the stability concept in various criterion.
CO5: Assess the state models for linear and continuous Systems.

TEXTBOOKS

REFERENCES
2. Control System Dynamics" by Robert Clark, Cambridge University Press, 1996 USA.

<table>
<thead>
<tr>
<th>PO1</th>
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OEI354 INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS LT P C 3 0 0 3

COURSE OBJECTIVES:
1. To educate on design of signal conditioning circuits for various applications.
2. To Introduce signal transmission techniques and their design.
3. Study of components used in data acquisition systems interface techniques
4. To educate on the components used in distributed control systems
5. To introduce the communication buses used in automation industries.

UNIT I INTRODUCTION

UNIT II AUTOMATION COMPONENTS
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT III COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS
Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.
UNIT IV PROGRAMMABLE LOGIC CONTROLLERS
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT V DISTRIBUTED CONTROL SYSTEM
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5
1. Market survey of the recent PLCs and comparison of their features.
2. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)

COURSE OUTCOMES:
Students able to
CO1 Design a signal conditioning circuits for various application (L3).
CO2 Acquire a detail knowledge on data acquisition system interface and DCS system (L2).
CO3 Understand the basics and Importance of communication buses in applied automation Engineering (L2).
CO4 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block. (L3)
CO5 Able to develop a PLC logic for a specific application on real world problem. (L5)

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1. https://archive.nptel.ac.in/courses/108/105/108105062/
2. https://nptel.ac.in/courses/108105063

CO’s- PO’s & PSO’s MAPPING

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OBJECTIVES
The course aims to
- acquaint and equip the students with different techniques of measurement of engineering properties.
- make the students understand the nature of food constituents in the design of processing equipment

UNIT I
Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.

UNIT II
Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foammat dryers

UNIT III
Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger’s, Kick’s and Bond’s equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbler mills, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping)

UNIT IV
Mixing: theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for low- or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids.

UNIT V
Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine, Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment: plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids, Membrane separation: General considerations, materials for membrane construction, ultra-filtration, microfiltration, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, pervaporation and osmotic dehydration.

COURSE OUTCOMES:
At the end of the course the students will be able to
CO1 understand the importance of food polymers
CO2 understand the effect of various methods of processing on the structure and texture of food materials
CO3 understand the interaction of food constituents with respect to thermal, electrical properties to develop new technologies for processing and preservation.

TEXTBOOKS:
OBJECTIVES:
• To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
• To help become skilled in systems for food safety surveillance
• To be aware of the regulatory and statutory bodies in India and the world
• To ensure processed food meets global standards

UNIT I
Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labelling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection, ISO 22000 – Importance and Implementation

UNIT II
Food quality: Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities.

UNIT III
Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system. Food inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system to monitor food safety, risk communication

UNIT IV
Indian and global regulations: FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)

UNIT V
Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.

COURSE OUTCOMES:
CO1 Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments
CO2 Awareness on regulatory and statutory bodies in India and the world

REFERENCES:
1. Handbook of food toxicology by S. S. Deshpande, 2002
2. The food safety information handbook by Cynthia A. Robert, 2009
4. Microbiological safety of Food by Hobbs BC, 1973
# Energy Technology

### Unit I: Introduction

Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources.

### Unit II: Conventional Energy

Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

### Unit III: Non-Conventional Energy

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 Graviian 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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<td>CO1 Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.</td>
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<td>CO2 Students will excel as professionals in the various fields of energy engineering</td>
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<td>CO3 Compare different renewable energy technologies and choose the most appropriate based on local conditions.</td>
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<td>CO4 Explain the technological basis for harnessing renewable energy sources.</td>
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<td>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.</td>
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OVERALL CO

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

OCH354 SURFACE SCIENCE

OBJECTIVE:

- To enable the students to analyze properties of a surfaces and correlate them to structure, chemistry, and physics and surface modification technique.

UNIT I SURFACE STRUCTURE AND EXPERIMENTAL PROBES

Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, absorbate structure, Band and Vibrational structure, Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy.

UNIT II ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT SURFACES

Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods.
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:

OTT354  BASICS OF DYEING AND PRINTING  L T P C
3 0 0 3

OBJECTIVE:
- To enable the students to learn about the basics of Pretreatment, dyeing, printing and machinery in textile processing.

UNIT I  INTRODUCTION  9
Impurities present in different fibres, Inspection of grey goods and lot preparation. Shearing.

UNIT II  PRE TREATMENT  9

UNIT III  DYEING  9

UNIT IV  PRINTING  9
Definition of printing – Difference between printing and dyeing- Classification thickeners – Requirements to be good thickener, printing paste Preparation - different styles of printing.

UNIT V  MACHINERIES  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:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
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<td>Regenerated and synthetic fibres</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
COURSE OBJECTIVES

- 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:


OTT355  GARMENT MANUFACTURING TECHNOLOGY  L T P C  3 0 0 3

OBJECTIVE:

- To enable the students to understand the basics of pattern making, cutting and sewing.
- To expose the students to various problems & remedies during garment manufacturing
UNIT I  PATTERN MAKING, MARKER PLANNING, CUTTING  9
Anthropometry, specification sheet, pattern making – principles, basic pattern set drafting,
grading, marker planning, spreading & cutting

UNIT II  TYPES OF SEAMS, STITCHES AND FUNCTIONS OF NEEDLES  9
Different types of seams and stitches; single needle lock stitch machine – mechanism and
accessories; needle – functions, special needles, needlepoint

UNIT III  COMPONENTS AND TRIMS USED IN GARMENT  9
Sewing thread-construction, material, thread size, packages, accessories – labels, linings,
interlinings, wadding, lace, braid, elastic, hook and loop fastening, shoulder pads, eyelets and
laces, zip fasteners, buttons

UNIT IV  GARMENT INSPECTION AND DIMENSIONAL CHANGES  9
Raw material, in process and final inspection; needle cutting; sewability of fabrics; strength
properties of apparel; dimensional changes in apparel due to laundering, dry-cleaning,
steaming and pressing.

UNIT V  GARMENT PRESSING, PACKING AND CARE LABELING  9
Garment pressing – categories and equipment, packing; care 268abelling 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 abelling

TEXT BOOKS:
2. Gerry Cooklin, “Introduction to Clothing Manufacture” Blackwell Science Ltd., 1995. 64

REFERENCES:
5. Pradip V.Mehta, “An Introduction to Quality Control for the Apparel Industry”, J.S.N.
OBJECTIVES:
- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen's Compensation and other laws) enacted for the protection of employees health at work settings.
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards.

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

UNIT II  OCCUPATIONAL HEALTH AND HYGIENE

UNIT III  WORKPLACE SAFETY AND SAFETY SYSTEMS

UNIT IV  HAZARDS AND RISK MANAGEMENT

UNIT V  ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT

TOTAL: 45 PERIODS

OUTCOMES:
After completion of this course, the student is expected to be able to:
- Describe, with example, the common work-related diseases and accidents in occupational setting.
- Name essential members of the Occupational Health team.
- What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee.

OBJECTIVES:
- To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.

UNIT I  FLUID MECHANICS CONCEPTS
Fluid definition and classification of fluids, types of fluids, Rheological behaviour of fluids & Newton’s Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium. Barometric equation and pressure measurement(problems),Basic equations of fluid flow - Continuity equation, Euler’s equation and Bernoulli equation; Types of flow - laminar and turbulent.

UNIT II FLOW MEASUREMENTS & MECHANICAL OPERATIONS

UNIT III CONDUCTIVE & CONVECTIVE HEAT TRANSFER
Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).

UNIT IV BASICS OF MASS TRANSFER

UNIT V MASS TRANSFER OPERATIONS
Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction). Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method. Drying- drying operations, batch and continuous drying. Conceptual numerical.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the student will be able to:
- State and describe the nature and properties of the fluids.
- Study the different flow measuring instruments, the principles of various size reductions, conveying equipment’s, sedimentation and mixing tanks.
- Comprehend the laws governing the heat and mass transfer operations to solve the problems.
- Design the heat transfer equipment suitable for specific requirement.

TEXTBOOK(S)
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008

REFERENCE BOOKS
2. Unit Operations of Chemical Engineering, Vol I & II Chattopadhyaya Khanna Publishers, Delhi-6 1996
COURSE OBJECTIVES

- Understand the advantages, disadvantages and general classification of plastic materials
- To know the manufacturing, sources, and applications of engineering thermoplastics
- Understand the basics as well as the advanced applications of various plastic materials in the industry
- To understand the preparation methods of thermosetting materials
- Select suitable specialty plastics for different end applications

UNIT I INTRODUCTION TO PLASTIC MATERIALS

Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermosetting behavior, amorphous polymers, crystalline polymers and cross-linked structures. General purpose thermoplastics/Commodity plastics: manufacture, structure, properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene, polyvinyl chloride-compounding, formulation, polypropylene (PP)

UNIT II ENGINEERING THERMOPLASTICS AND APPLICATIONS

Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides, PMMA, polyphenylene oxide, thermoplastic polyurethane (PU)

UNIT III THERMOSETTING PLASTICS

Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.

UNIT IV MISCELLANEOUS PLASTICS FOR END APPLICATIONS

Miscellaneous plastics - Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbazole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers- their synthesis, properties and applications

UNIT V PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS

Sources, raw materials, methods of manufacturing, properties and applications of biobased polymers- poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications

TOTAL HOURS: 45

COURSE OUTCOMES

- To study the importance, advantages and classification of plastic materials
- Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics
- To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins
- Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU
- To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

REFERENCES

5. Olagoke Olabisi, Kolapo Adewale (Eds.), Handbook of Thermoplastics 2nd
OPT353  PROPERTIES AND TESTING OF PLASTICS  L T P C  3 0 0 3

COURSE OBJECTIVES

- To understand the relevance of standards and specifications as well as the specimen preparation for polymer testing.
- To study the mechanical properties and testing of polymer materials and their structural property relationships.
- To understand the thermal properties of polymers and their testing methods.
- To gain knowledge on the electrical and optical properties of polymers and their testing methods.
- To study about the environmental effects and prevent polymer degradation.

UNIT I  INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS  9

UNIT II  MECHANICAL PROPERTIES  9
Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact strength, resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic fatigue, ageing properties. Basic concepts of stress and strain, short term tests: Viscoelastic behavior (simple models: Kelvin model for creep and stress relaxation, Maxwell-Voigt model, strain recovery and dynamic response), Effect of structure and composition on mechanical properties, Behavior of reinforced polymers.

UNIT III  THERMAL RHEOLOGICAL PROPERTIES  9
Thermal properties: Transition temperatures, specific heat, thermal conductivity, co-efficient of thermal expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness temperature, thermal stability and flammability. Product testing: Plastic films, sheeting, pipes, laminates, foams, containers, cables and tubes.

UNIT IV  ELECTRICAL AND OPTICAL PROPERTIES  9
Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and power factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric co-efficient, dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive index, haze, gloss, clarity, birefringence.

UNIT V  ENVIRONMENTAL AND CHEMICAL RESISTANCE  9

TOTAL: 45 PERIODS

COURSE OUTCOMES

- Understand the relevance of standards and specifications.
- Summarize the various test methods for evaluating the mechanical properties of the polymers.
- To know the thermal, electrical & optical properties of polymers.
- Identify various techniques used for characterizing polymers.
- Distinguish the processability tests used for thermoplastics, thermosets and elastomers.
REFERENCES

OEC353 VLSI DESIGN

OBJECTIVES:
- Understand the fundamentals of IC technology components and their characteristics.
- Understand combinational logic circuits and design principles.
- Understand sequential logic circuits and clocking strategies.
- Understand Interconnects and Memory Architecture.
- Understand the design of arithmetic building blocks.

UNIT I MOS TRANSISTOR PRINCIPLES
MOS logic families (NMOS and CMOS), Ideal and Non Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor DC transfer Characteristics ,small signal analysis of MOSFET.

UNIT II COMBINATIONAL LOGIC CIRCUITS

UNIT III SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES

UNIT IV INTERCONNECT, MEMORY ARCHITECTURE
Interconnect Parameters – Capacitance, Resistance, and Inductance, Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks.

UNIT V DESIGN OF ARITHMETIC BUILDING BLOCKS
Arithmetic Building Blocks: Data Paths, Adders-Ripple Carry Adder, Carry-Bypass Adder, Carry Select Adder, Carry-Look Ahead Adder, Multipliers, Barrel Shifter, power and speed tradeoffs.

TOTAL: 45 PERIODS

OUTCOMES:
Upon successful completion of the course the student will be able to
CO1: Understand the working principle and characteristics of MOSFET
CO2: Design Combinational Logic Circuits
CO3: Design Sequential Logic Circuits and Clocking systems
CO4: Understand Memory architecture and interconnects
CO5: Design of arithmetic building blocks.

TEXTBOOKS
REFERENCES

CBM370 WEARABLE DEVICES

OBJECTIVES:
The student should be made to:
- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS

UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES
Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS

UNIT IV SMART TEXTILE

UNIT V APPLICATIONS OF WEARABLE SYSTEMS
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

TOTAL PERIODS:45
OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Describe the concepts of wearable system.
CO2: Explain the energy harvestings in wearable device.
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile
CO5: Compare the various wearable devices in healthcare system

TEXT BOOKS

REFERENCES

CO’s- PO’s & PSO’s MAPPING

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CBM356 MEDICAL INFORMATICS L T P C 3 0 0 3

Preamble:
1. To study the applications of information technology in health care management.
2. This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

UNIT I INTRODUCTION TO MEDICAL INFORMATICS 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.

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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TOTAL : 45 PERIODS

UNIT I  BIOLOGICAL TREATMENT PROCESS  

UNIT II  WASTE BIOMASS AND ITS VALUE ADDITION  
Types of waste biomass – Solid waste management - Nature of biomass feedstock – Biobased economy/process – Value addition of waste biomass – Biotransformation of biomass – Biotransformation of marine processing wastes – Direct extraction of biochemicals from biomass – Plant biomass for industrial application

UNIT III  BIOCONVERSION OF WASTES TO ENERGY  
Perspective of biofuels from wastes - Bioethanol production – Biohydrogen Production – dark and photofermentative process - Biobutanol production – Biogas and Biomethane production -
Single stage anaerobic digestion, Two stage anaerobic digestion - Biodiesel production - Enzymatic hydrolysis technologies

UNIT IV CHEMICALS AND ENZYME PRODUCTION FROM WASTES 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

UNIT I INTRODUCTION 3 0 0 3
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 dolescent obesity – Weight control and BMI
UNIT V  RESPIRATORY DISEASES  9
Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

OBT357  BIOTECHNOLOGY IN HEALTH CARE  L T P C  3 0 0 3

COURSE OBJECTIVES
The aim of this course is to
1. Create higher standard of knowledge on healthcare system and services
2. Prioritize advanced technologies for the diagnosis and treatment of various diseases

UNIT I  PUBLIC HEALTH  9

UNIT II  CLINICAL DISEASES  9
Communicable diseases: Chickenpox / Shingles, COVID-19, Tuberculosis, Hepatitis B, Hepatitis C, HIV / AIDS, Influenza, Swine flu. Non Communicable diseases: Diabetes mellitus, atherosclerosis, fatty liver, Obesity, Cancer

UNIT III  VACCINOLOGY  9
History of Vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems. Instruments related to monitoring of temperature, sterilization, environment.

UNIT IV  OUTPATIENT & IN PATIENT SERVICES  9
Radiotherapy, Nuclear medicine, surgical units, OT Medical units, G & Obs. units Pediatric, neonatal units, Critical care units, Physical medicine & Rehabilitation, Neurology, Gastroenterology, Endoscopy, Pulmonology, Cardiology.

UNIT V  BASICS OF IMAGING MODALITIES  9

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE BOOKS
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  9
Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization - Time Value of money - Risk and return concepts.

UNIT II  SOURCES OF FINANCE  9
Long term sources of Finance - Equity Shares - Debentures - Preferred Stock - Features - Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc

UNIT III  INVESTMENT DECISIONS:  9

UNIT IV  FINANCING AND DIVIDEND DECISION  9

UNIT V  WORKING CAPITAL DECISION  9

TOTAL : 45 PERIODS

TEXT BOOKS
3. Prasanna Chandra, Financial Management,

REFERENCES
2. Prasanna Chandra, Financial Management,

OBJECTIVES:
1. Describe the investment environment in which investment decisions are taken.
2. Explain how to Value bonds and equities
3. Explain the various approaches to value securities
4. Describe how to create efficient portfolios through diversification
5. Discuss the mechanism of investor protection in India.

UNIT I  THE INVESTMENT ENVIRONMENT  9
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 9
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and rating.

UNIT III APPROACHES TO EQUITY ANALYSIS 9
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 9
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India

UNIT V INVESTOR PROTECTION 9
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors’ awareness and activism.

TOTAL : 45 PERIODS

REFERENCES

CMG333 BANKING, FINANCIAL SERVICES AND INSURANCE LT P C 3 0 0 3

OBJECTIVES
- Understand the Banking system in India
- Grasp how banks raise their sources and how they deploy it
- Understand the development in banking technology
- Understand the financial services in India
- Understand the insurance Industry in India

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM 9
Overview of Banking system – Structure – Functions – Banking system in India - Key Regulations in Indian Banking sector – RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT II MANAGING BANK FUNDS/ PRODUCTS 9

UNIT III DEVELOPMENT IN BANKING TECHNOLOGY 9

UNIT IV FINANCIAL SERVICES 9
UNIT V  INSURANCE  9

REFERENCES :

TOTAL : 45 PERIODS

CMG334  INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS  LT P C  3 0 0 3
UNIT I  INTRODUCTION TO BLOCKCHAIN  9
Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.

UNIT II  INTRODUCTION TO CRYPTOCURRENCY  9

UNIT III  ETHEREUM  9
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  9

UNIT V  EMERGING TRENDS  9

REFERENCE
2. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018

TOTAL : 45 PERIODS
UNIT I  CURRENCY EXCHANGE AND PAYMENT

UNIT II  DIGITAL FINANCE AND ALTERNATIVE FINANCE
A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity,. Introduction to the concept of Initial Coin Offering

UNIT III  INSURETECH
InsurTech Introduction , Business model disruption AI/ML in InsurTech • IoT and InsurTech ,Risk Modeling ,Fraud Detection Processing claims and Underwriting Innovations in Insurance Services

UNIT IV  PEER TO PEER LENDING
P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies , Concept of Crowdfunding Crowdfunding Architecture and Technology ,P2P and Crowdfunding unicorns and business models , SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations

UNIT V  REGULATORY ISSUES

REFERENCE
5. IIBF, Digital Banking, Taxmann Publication, 2016

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

UNIT II PAYMENT INDUSTRY 9
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 9

UNIT IV FINTECH AROUND THE GLOBE 9

UNIT V FUTURE OF FINTECH 9
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.

TOTAL : 45 PERIODS

REFERENCES
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
6. Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018

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 Entrepreneruship to Economic Development.

UNIT II BUSINESS OWNERSHIP & ENVIRONMENT


UNIT III FUNDAMENTALS OF TECHNOPRENEURSHIP

Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characterisitics of a technopreneur - Impacts of Technopreneurship on Society – Economy-Job Opportuinites 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 ENTREPRENERUSHIP


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 evnironment
CO 3 Understand the Job opportunites in Industries relating to Technopreneurship
CO 4 Learn about applications of tehnopreneurship and successful technopreneurs
CO 5 Acquaint with the recent and emerging trends in entrepreneruship

Text Books:

2) Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning,

References :

5) JumpStart: A Technoprenuership Fable, Dennis Posadas, (Singapore: Pearson Prentice Hall, 2009
6) Basics of Technoprenuership: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP
7) 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-Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- Creative Personality and Motivation.

UNIT II CREATIVE INTELLIGENCE
Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training--Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities-Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III INNOVATION

UNIT IV INNOVATION AND ENTREPRENEURSHIP

Unit V INNOVATIVE BUSINESS MODELS

OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of creativity for developing Entrepreneurship
CO 2 Understand the importance of creative intelligence for business growth
CO 3 Understand the advances through Innovation in Industries
CO 4 Learn about applications of innovation in building successful ventures
CO 5 Acquaint with developing innovative business models to run the business efficiently and effectively

Suggested Readings:
Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand
Strategic Innovation: Building and Sustaining Innovative Organizations- Course Era, Raj Echambadi.

CMG340 PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS 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  9

COURSE OUTCOMES:
After completion of this course, the students will be able to:
CO 1 Have the awareness of marketing management process
CO 2 Understand the marketing environment
CO 3 Acquaint about product and pricing strategies
CO 4 Knowledge of promotion and distribution in marketing management.
CO 5 Comprehend the contemporary marketing scenarios and offer solutions to marketing issues.

REFERENCES:
OBJECTIVES:
1. To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
2. To create an awareness of the roles, functions and functioning of human resource department.
3. To understand the methods and techniques followed by Human Resource Management practitioners.

UNIT I INTRODUCTION TO HRM

UNIT II HUMAN RESOURCE PLANNING
HR Planning - Definition - Factors - Tools - Methods and Techniques - Job analysis - Job rotation - Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends

UNIT III RECRUITMENT AND SELECTION
Sources of recruitment - Internal Vs. External - Domestic Vs. Global Sources - eRecruitment - Selection Process - Selection techniques - eSelection - Interview Types - Employee Engagement.

UNIT IV TRAINING AND EMPLOYEE DEVELOPMENT

UNIT V CONTROLLING HUMAN RESOURCES

OUTCOMES:
Upon completion of this course the learners will be able:
CO 1 To understand the Evolution of HRM and Challenges faced by HR Managers
CO 2 To learn about the HR Planning Methods and practices.
CO 3 To acquaint about the Recruitment and Selection Techniques followed in Industries.
CO 4 To known about the methods of Training and Employee Development.
CO 5 To comprehend the techniques of controlling human resources in organisations.

REFERENCES
COURSE OBJECTIVES

- To develop the basics of business venture financing.
- To impart the knowledge essential for entrepreneurs for financing new ventures.
- To acquaint the learners with the sources of debt and equity financing.
- To empower the learners towards fund raising for new ventures effectively.

UNIT I - ESSENTIALS OF NEW BUSINESS VENTURE


UNIT II - INTRODUCTION TO VENTURE FINANCING


UNIT III - SOURCES OF DEBT FINANCING


UNIT IV - SOURCES OF EQUITY FINANCING

Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.

UNIT V - METHODS OF FUND RAISING FOR NEW VENTURES


OUTCOMES:
Upon completion of this course, the students should be able to:
CO 1  Learn the basics of starting a new business venture.
CO 2  Understand the basics of venture financing.
CO 3  Understand the sources of debt financing.
CO 4  Understand the sources of equity financing.
CO 5  Acquaint with the methods of fund raising for new business ventures.

REFERENCES:

1) Principles of Corporate Finance by Brealey and Myers et al.,12TH ed, McGraw Hill Education (India) Private Limited, 2018

VERTICAL 3: PUBLIC ADMINISTRATION

CMG343 PRINCIPLES OF PUBLIC ADMINISTRATION

UNIT-I
1. Meaning, Nature and Scope of Public Administration
2. Importance of Public Administration
3. Evolution of Public Administration

(9)

UNIT-II
1. New Public Administration
2. New Public Management
3. Public and Private Administration

(9)

UNIT-III
1. Relationships with Political Science, History and Sociology
2. Classical Approach
3. Scientific Management Approach

(9)

UNIT-IV
1. Bureaucratic Approach: Max Weber
2. Human Relations Approach : Elton Mayo
3. Ecological Approach : Riggs

(9)

UNIT-V
1. Leadership: Leadership - Styles - Approaches
2. Communication: Communication Types - Process - Barriers

(9)

TOTAL: 45 PERIODS

REFERENCES:
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.

CMG344 CONSTITUTION OF INDIA

UNIT-I
1. Constitutional Development Since 1909 to 1947
3. Constituent Assembly

(9)

UNIT-II
1. Fundamental Rights
2. Fundamental Duties
3. Directive Principles of State Policy

(9)

UNIT-III
1. President
2. Parliament
3. Supreme Court

(9)
UNIT-IV
1. Governor
2. State Legislature
3. High Court

UNIT-V
1. Secularism
2. Social Justice
3. Minority Safeguards

REFERENCES:
4. Agarwal, R.C: Indian Political System; S.Chand & Co., New Delhi

CMG345 PUBLIC PERSONNEL ADMINISTRATION

UNIT-I
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

UNIT-II
1. Generalist Vs Specialist
2. Civil Servants’ Relationship with Political Executive
3. Integrity in Administration.

UNIT-III
1. Recruitment: Direct Recruitment and Recruitment from Within
2. Training: Kinds of Training
3. Promotion

UNIT-IV
1. All India Services
2. Service Conditions
3. State Public Service Commission

UNIT-V
1. Employer Employee Relations
2. Wage and Salary Administration
3. Allowances and Benefits

REFERENCES:
1. Stahl, Glean O: Public Personnel Administration
4. Dwivedi, O.P and Jain, R.B: India’s Administrative state.
7. Davar, R.S: Personnel Management & Industrial Relations

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 Willson, C.I. Barnard . Peter Drucker

REFERENCES:
1. Crozior M : The Bureaucratic phenomenon (Chand)
3. Presthus. R : The Organizational Society (MAC)
5. Keith Davis : Organization Theory (MAC)

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

REFERENCES:
1. S.R. Maheswari : Indian Administration
2. Khera. S.S : Administration in India
3. Ramesh K. Arora : Indian Public Administration
4. T.N. Chaturvedi : State administration in India
5. Basu, D.D : Introduction to the Constitution of India

TOTAL: 45 PERIODS
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
To understand and solve business problems
To apply statistical techniques to data sets, and correctly interpret the results.
To develop skill-set that is in demand in both the research and business environments
To enable the students to apply the statistical techniques in a work setting.

REFERENCES:

CMG350                 DATAMINING FOR BUSINESS INTELLIGENCE                   L T P C
                                                                                     3 0 0 3

OBJECTIVES :
➢ To know how to derive meaning form huge volume of data and information.
➢ To understand how knowledge discovering process is used in business decision making.

UNIT I     INTRODUCTION 9
Data mining, Text mining, Web mining, Data ware house.

UNIT II    DATA MINING PROCESS 9
Datamining process – KDD, CRISP-DM, SEMMA
Prediction performance measures

UNIT III   PREDICTION TECHNIQUES 9
Data visualization, Time series – ARIMA, Winter Holts,

UNIT IV    CLASSIFICATION AND CLUSTERING TECHNIQUES 9
Classification, Association, Clustering.

UNIT V     MACHINE LEARNING AND AI 9
Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization

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. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
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:

4. Dipak Kumar Bhattacharyya, HR Analytics ,Understanding Theories and
CMG352 MARKETING AND SOCIAL MEDIA WEB ANALYTICS

OBJECTIVE:
➢ To showcase the opportunities that exist today to leverage the power of the web and social media

UNIT I - MARKETING ANALYTICS
Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT II - COMMUNITY BUILDING AND MANAGEMENT
History and Evolution of Social Media - Understanding Science of Social Media – Goals for using Social Media - Social Media Audience and Influencers - Digital PR - Promoting Social Media Pages - Linking Social Media Accounts - The Viral Impact of Social Media.

UNIT III - SOCIAL MEDIA POLICIES AND MEASUREMENTS
Social Media Policies - Etiquette, Privacy - ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV - WEB ANALYTICS
Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT V - SEARCH ANALYTICS
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

TOTAL: 45 PERIODS

OUTCOME:
➢ The Learners will understand social media, web and social media analytics and their potential impact.

REFERENCES:
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress 2004
OBJECTIVE:
- To treat the subject in depth by emphasizing on the advanced quantitative models and methods in operations and supply chain management and its practical aspects and the latest developments in the field.

UNIT I - INTRODUCTION
Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains.

UNIT II - WAREHOUSING DECISIONS
P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.

UNIT III - INVENTORY MANAGEMENT
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV - TRANSPORTATION NETWORK MODELS

UNIT V - MCDM MODELS
Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic an Techniques, the analytical network process (ANP), TOPSIS.

OUTCOME:
- To enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.

REFERENCES:
UNIT III - PORTFOLIO ANALYSIS  
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.

UNIT IV - TECHNICAL ANALYSIS  

UNIT V - CREDIT RISK ANALYSIS  
Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.

TOTAL: 45 PERIODS

OUTCOME
➢ The learners should be able to perform financial analysis for decision making using excel, Python and R.

REFERENCES:

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

CES331 SUSTAINABLE INFRASTRUCTURE DEVELOPMENT

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
Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable

UNIT IV SUSTAINABLE CONSTRUCTION MATERIALS


UNIT V SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS


TOTAL: 45 PERIODS

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

CO1 Understand the environment sustainability goals at global and Indian scenario.

CO2 Understand risks in development of projects and suggest mitigation measures.

CO3 Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.

CO4 Explain Life Cycle Analysis and life cycle cost of construction materials.

CO5 Explain the new technologies for maintenance of infrastructure projects.

REFERENCES:
5. New Building Materials and Construction World magazine
7. Munier N, "Introduction to Sustainability", Springer2005
CO’s- PO’s & PSO’s MAPPING

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CES332 SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT  L T P C 3 0 0 3

OBJECTIVES:
- To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.

UNIT I  AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS  9
Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT II  SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT  9
Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT III  WATER MANAGEMENT  9
Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT IV  ENERGY AND WASTE MANAGEMENT  9
Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V  EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS  9
Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS

OUTCOME
- On completion of the course, the student is expected to be able to
  CO1 Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture
  CO2 Discuss the sustainable ways in managing soil health, nutrients, pests and diseases
  CO3 Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources
  CO4 Develop energy and waste management plans for promoting sustainable agriculture in...
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
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

TOTAL : 45 PERIODS

OUTCOMES
- Students will gain familiarity with Biomaterials and they will understand their importance.
- Students will get an overview of different biopolymers and their properties
- Students gain knowledge on some of the important Bioceramics and Biocomposite materials
- Students gain knowledge on metals as biomaterials
- Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

REFERENCES
6. VasifHasirci, NesrinHasirci "Fundamentals of Biomaterials" Springer, 2018

CES334 MATERIALS FOR ENERGY SUSTAINABILITY L T P C 3 0 0 3
OBJECTIVES
- To familiarize the students about the challenges and demands of energy sustainability
- To provide fundamental knowledge about electrochemical devices and the materials used.
- To introduce the students to various types of fuel cell
- To enable students to appreciate novel materials and their usage in photovoltaic application
- To introduce students to the basic principles of various types Supercapacitors and the materials used.
UNIT I  SUSTAINABLE ENERGY SOURCES
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 polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.  

TOTAL : 45 PERIODS

OUTCOMES
• Students will acquire knowledge about energy sustainability.
• Students understand the principles of different electrochemical devices.
• Students learn about the working of fuel cells and their application.
• Students will learn about various Photovoltaic applications and the materials used.
• The students gain knowledge on different types of supercapacitors and the performance of various materials

REFERENCES
5. Materials for Supercapacitor applications; B.Viswanathan, M.Aulice Scibioh

CES335  GREEN TECHNOLOGY  L T P C  3 0 0 3

COURSE OBJECTIVE:
- To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.
- To provide green engineering solutions to energy demand, reduced energy footprint.

UNIT I  PRINCIPLES OF GREEN CHEMISTRY
Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.

UNIT II  POLLUTION TYPES
Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT III  GREEN REAGENTS AND GREEN SYNTHESIS
Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions

UNIT IV  DESIGNING GREEN PROCESSES
Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention

UNIT V  GREEN NANOTECHNOLOGY
Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

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 L T P C 3 0 0 3

OBJECTIVES:
- to understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.

UNIT I ENVIRONMENTAL MONITORING AND STANDARDS 9

UNIT II MONITORING OF ENVIRONMENTAL PARAMETERS 9

UNIT III ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING 9
Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods -Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT IV ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISK ASSESSMENT 9

UNIT V AUTOMATED DATA ACQUISITION AND PROCESSING 9
Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks - Sensors and transducers- classification of transducers-data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

TOTAL: 45 PERIODS

COURSE OUTCOMES
After completion of this course, the students will know

CO1 Basic concepts of environmental standards and monitoring.
CO2 the ambient air quality and water quality standards;
CO3 the various instrumental methods and their principles for environmental monitoring
CO4 The significance of environmental standards in monitoring quality and sustainability of the environment.
CO5 the various ways of raising environmental awareness among the people.
CO6 Know the standard research methods that are used worldwide for monitoring the environment.
TEXTBOOKS
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and solid wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc

REFERENCES
1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.

Course Articulation Matrix

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CES337 INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT L T P C 3 0 0 3

COURSE OBJECTIVES:
1. To create awareness on the energy scenario of India with respect to world
2. To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation
3. Familiarisation on the concept of sustainable development and its benefits
4. Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development
5. Acquainting with energy policies and energy planning for sustainable development

UNIT I ENERGY SCENARIO
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 L T P C

COURSE OBJECTIVES:

1. To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
2. To create awareness on energy audit and its impacts
3. To acquaint the techniques adopted for performance evaluation of thermal utilities
4. To familiarise on the procedures adopted for performance evaluation of electrical utilities
5. To learn the concept of sustainable development and the implication of energy usage

UNIT I  ENERGY AND ENVIRONMENT Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT II  ENERGY AUDITING Need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

UNIT III  ENERGY EFFICIENCY IN THERMAL UTILITIES Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression
UNIT IV  ENERGY CONSERVATION IN ELECTRICAL UTILITIES

Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

UNIT V  SUSTAINABLE DEVELOPMENT


TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to
1. Understand the prevailing energy scenario
2. Familiarise on energy audits and its relevance
3. Apply the concept of energy audit on thermal utilities
4. Employ relevant techniques for energy improvement in electrical utilities
5. Understand Sustainable development and its impact on human resource development

REFERENCES: