B.E. AUTOMOBILE ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

I. Excel in their professional career in automobile industry
II. Display research contribution with highest professional and ethical standards.
III. Apply the mathematical, scientific and engineering knowledge acquired in automobile engineering in growth of the industry.
IV. Demonstrate professionalism and team work in their career
V. Adapt to contemporary, technological and industrial trends by involving in life-long learning.

PROGRAM OUTCOMES (POs)

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<td>Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.</td>
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<td>Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.</td>
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<td>Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.</td>
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<td>Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.</td>
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<td>Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.</td>
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<td>The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.</td>
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<td>Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.</td>
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<td>Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.</td>
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<td>Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.</td>
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<td>Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.</td>
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<td>Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.</td>
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<td>Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.</td>
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PROGRAM SPECIFIC OUTCOMES (PSOs)

1. The knowledge of humanities, basic sciences and management principles in the automobile industry
2. The knowledge of engineering sciences in field of automobile engineering for the development of sustainable society
3. The attitude of lifelong learning and ethical practices in their profession to assess societal, health, safety, legal and cultural issues

PEO's – PO's & PSO's MAPPING:

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

#### SEMESTER I

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#### PRACTICAL

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| 8.      | BS3171      | Physics and Chemistry Laboratory            | BSC | 0    0    4       | 4                      | 2       |
| 9.      | GE3172      | English Laboratory                          | EEC | 0    0    2       | 2                      | 1       |

**TOTAL**: 16 1 10 27 22

*Skill Based Course

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#### PRACTICAL

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| 9.      | BE3271      | Basic Electrical and Electronics Engine 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

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

§ Skill Based Course
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* NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
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* Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC-I)

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*Open Elective – I shall be chosen from the emerging technologies.
* Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC-II)
# NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA
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#Two weeks Summer Internship carries one credit and it will be done during VI semester summer vacation and same will be evaluated in VII semester.

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

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

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

### SEMESTER VIII / VII*

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<thead>
<tr>
<th>S. No.</th>
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<th>Category</th>
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<th>Total Contact Periods</th>
<th>Credits</th>
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*If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.

**TOTAL: 165 CREDITS**
## ELECTIVE – MANAGEMENT COURSES

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<tr>
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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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<thead>
<tr>
<th>VERTICAL 1</th>
<th>VERTICAL 2</th>
<th>VERTICAL 3</th>
<th>VERTICAL 4</th>
<th>VERTICAL 5</th>
<th>VERTICAL 6</th>
<th>VERTICAL 7</th>
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<tr>
<td>ELECTRIC VEHICLES</td>
<td>COMPUTATIONAL DESIGN</td>
<td>VEHICLE RESEARCH AND VALIDATION</td>
<td>SPECIAL PURPOSE VEHICLES</td>
<td>PRODUCT AND PROCESS DEVELOPMENT</td>
<td>DIVERSIFIED COURSES GROUP 1</td>
<td>DIVERSIFIED COURSES GROUP 2</td>
</tr>
<tr>
<td>Batteries and Management system</td>
<td>Integrated Computational Materials Engineering</td>
<td>Noise, Vibration and Harshness</td>
<td>Defence Vehicles</td>
<td>Ergonomics in Automotive Design</td>
<td>Transport Management</td>
<td>Fundamentals of Nanoscience</td>
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<tr>
<td>Automotive Power Electronics</td>
<td>Computational and Visualization Theory</td>
<td>Alternative Fuels and Energy Systems</td>
<td>Marine Vehicles</td>
<td>Additive Manufacturing</td>
<td>Two and Three Wheelers</td>
<td>Road Vehicle Aerodynamics</td>
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<tr>
<td>Automotive Functional Safety</td>
<td>Computer Integrated Manufacturing in Automotive Sector</td>
<td>Automotive Instrumentation</td>
<td>Space vehicles</td>
<td>Finite Element Analysis</td>
<td>Entrepreneurship Development</td>
<td>Lean Six Sigma</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 1: ELECTRIC VEHICLES

<table>
<thead>
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<th>Sl. No.</th>
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## VERTICAL 2: COMPUTATIONAL DESIGN

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## VERTICAL 4: SPECIAL PURPOSE VEHICLES

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## VERTICAL 5 : PRODUCT AND PROCESS DEVELOPMENT

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### VERTICAL 6: DIVERSIFIED COURSES GROUP 1

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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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<tr>
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</table>

Total: 165
ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

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

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

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

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

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

<table>
<thead>
<tr>
<th>Vertical I</th>
<th>Vertical II</th>
<th>Vertical III</th>
<th>Vertical IV</th>
<th>Vertical V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fintech and Block Chain</td>
<td>Entrepreneurship</td>
<td>Public Administration</td>
<td>Business Data Analytics</td>
<td>Environment and Sustainability</td>
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<tr>
<td>Financial Management</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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<tr>
<td>Fundamentals of Investment</td>
<td>Team Building and Leadership</td>
<td>Constitution of India</td>
<td>Data mining for Business</td>
<td>Sustainable Agriculture and</td>
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<tr>
<td></td>
<td>Management for Business</td>
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<td>Intelligence</td>
<td>Environmental Management</td>
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<tr>
<td>Banking, Financial Services and</td>
<td>Creativity and Innovation in</td>
<td>Public Personnel Administration</td>
<td>Human Resource Analytics</td>
<td>Sustainable Bio Materials</td>
</tr>
<tr>
<td>Insurance</td>
<td>Entrepreneurship</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Introduction to Blockchain and its</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>Applications</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Fintech Personal Finance and</td>
<td>Human Resource Management for</td>
<td>Indian Administrative System</td>
<td>Operation and Supply Chain</td>
<td>Green Technology</td>
</tr>
<tr>
<td>Payments</td>
<td>Entrepreneurs</td>
<td></td>
<td>Analytics</td>
<td></td>
</tr>
<tr>
<td>Introduction to Fintech</td>
<td>Financing New Business Ventures</td>
<td>Public Policy Administration</td>
<td>Financial Analytics</td>
<td>Environmental Quality Monitoring and Analysis</td>
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<td>Integrated Energy Planning for</td>
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<td>Sustainable Development</td>
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<td>Energy Efficiency for Sustainable</td>
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<td>Development</td>
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</table>
(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 BLOCKCHAIN

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
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<tr>
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<td>CMG331</td>
<td>Financial Management</td>
<td>PEC</td>
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<td>2</td>
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<td>PEC</td>
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<td>3</td>
<td>CMG333</td>
<td>Banking, Financial Services and Insurance</td>
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<td>4</td>
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<td>Introduction to Blockchain and its Applications</td>
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<td>5</td>
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<td>Fintech Personal Finance and Payments</td>
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<tr>
<td>6</td>
<td>CMG336</td>
<td>Introduction to Fintech</td>
<td>PEC</td>
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### VERTICAL 2: ENTREPRENEURSHIP

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
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<tbody>
<tr>
<td>1</td>
<td>CMG337</td>
<td>Foundations of Entrepreneurship</td>
<td>PEC</td>
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<td>2</td>
<td>CMG338</td>
<td>Team Building and Leadership Management for Business</td>
<td>PEC</td>
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<td>3</td>
<td>CMG339</td>
<td>Creativity and Innovation in Entrepreneurship</td>
<td>PEC</td>
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<tr>
<td>4</td>
<td>CMG340</td>
<td>Principles of Marketing Management for Business</td>
<td>PEC</td>
<td>3 0 0</td>
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<td>5</td>
<td>CMG341</td>
<td>Human Resource Management for Entrepreneurs</td>
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<td>6</td>
<td>CMG342</td>
<td>Financing New Business Ventures</td>
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### VERTICAL 3: PUBLIC ADMINISTRATION

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<tbody>
<tr>
<td>1.</td>
<td>CMG343</td>
<td>Principles of Public Administration</td>
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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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<th>COURSE CODE</th>
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<tr>
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<td>CMG350</td>
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<td>3.</td>
<td>CMG351</td>
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<td>4.</td>
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<td>Marketing and Social Media Web Analytics</td>
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<td>5.</td>
<td>CMG353</td>
<td>Operation and Supply Chain Analytics</td>
<td>PEC</td>
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<td>Financial Analytics</td>
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### VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

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<th>COURSE TITLE</th>
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<tr>
<td>1.</td>
<td>CES331</td>
<td>Sustainable infrastructure Development</td>
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<td>2.</td>
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<td>3.</td>
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<td>Sustainable Bio Materials</td>
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<tr>
<td>4.</td>
<td>CES334</td>
<td>Materials for Energy Sustainability</td>
<td>PEC</td>
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<td>5.</td>
<td>CES335</td>
<td>Green Technology</td>
<td>PEC</td>
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<td>8.</td>
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<td>Energy Efficiency for Sustainable Development</td>
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IP3151  INDUCTION PROGRAMME

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

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

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

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

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

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

(i) Physical Activity

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

(ii) Creative Arts

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

(iii) Universal Human Values

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

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

(iv) Literary Activity

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

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

(vi) Lectures by Eminent People

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

(vii) Visits to Local Area

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

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

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

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

References:
Guide to Induction program from AICTE

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HS3152 PROFESSIONAL ENGLISH - I

OBJECTIVES:

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

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

UNIT 1 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: Why/ 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.

TOTAL : 45 PERIODS

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

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AVg. 1.6 2.2 1.8 2.2 1.5 3 3 3 1.6 3 3 3 - - -

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

**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.

**REFERENCES:**

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

**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

UNIT - IV INTEGRAL CALCULUS
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

TOTAL: 60 PERIODS

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

- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools in solving various application problems.
- Able to use differential calculus ideas on several variable functions.
- Apply different methods of integration in solving practical problems.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.

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

REFERENCES:
PH3151  ENGINEERING PHYSICS  L  T  P  C  
3  0  0  3

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

UNIT I  MECHANICS

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

UNIT III  OSCILLATIONS, OPTICS AND LASERS

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

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

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

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

**REFERENCES:**

**CO’s-PO’s & PSO’s MAPPING**

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

**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**

Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour,

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

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

TOTAL: 45 PERIODS

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

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

TEXT BOOKS:
Company (P) Ltd, New Delhi, 2018.

REFERENCES:

CO-PO & PSO MAPPING

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

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

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9
Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.
UNIT III  CONTROL FLOW, FUNCTIONS, STRINGS
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

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

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

TOTAL : 45 PERIODS

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

TEXT BOOKS:

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

COs- PO’s & PSO’s MAPPING

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1 - low, 2 - medium, 3 - high, '-' - no correlation
TEXT-CUM-REFERENCE BOOKS

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)
GE3152 HERITAGE OF TAMILS

UNIT I LANGUAGE AND LITERATURE

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE
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
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

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

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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. தமிழ் நாடுகள் - கல்விகள் பார்வையில் - கைதிக. பிரசுரம் (தமிழ் புத்தகங்கள் பார்வையில் கைதிகள் குறிப்பிட்டு).
2. கருவறைகள் தமிழ் - பள்ளிகளும் புத்தகங்களும். (தமிழ் புத்தகங்கள்).
3. சீரை - தமிழ் திறந்த பொழுதுபோக்குகள் கைதிகளை தமிழில் குறிப்பிட்டு (தமிழ் புத்தகங்கள் கைதிகளை குறிப்பிட்டு).
4. தமிழ் நொக்கம் - அரசு கைதிகளுக்கு குறிப்பிட்டு (தமிழ் புத்தகங்கள் கைதிகளை குறிப்பிட்டு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

GE3171 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

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

EXPERIMENTS:
Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.
1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS
COURSE OUTCOMES:
On completion of the course, students will be able to:
CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Implement programs in Python using conditionals and loops for solving problems.
CO4: Deploy functions to decompose a Python program.
CO5: Process compound data using Python data structures.
CO6: Utilize Python packages in developing software applications.

TEXT BOOKS:

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

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BS3171  PHYSICS AND CHEMISTRY LABORATORY

PHYSICS LABORATORY: (Any Seven Experiments)

COURSE OBJECTIVES:
• To learn the proper use of various kinds of physics laboratory equipment.
• To learn how data can be collected, presented and interpreted in a clear and concise manner.
• To learn problem solving skills related to physics principles and interpretation of experimental data.
• To determine error in experimental measurements and techniques used to minimize such error.
• To make the student as an active participant in each part of all lab exercises.
1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser - Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre - Determination of Numerical Aperture and acceptance angle
    b) Compact disc - Determination of width of the groove using laser.
8. Acoustic grating - Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

TOTAL: 30 PERIODS

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

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Note: the average value of this course to be used for program articulation matrix.
CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

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

1. Preparation of 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

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

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1-low, 2-medium, 3-high, "-"- no correlation
OBJECTIVES:
- To improve the communicative competence of learners
- To help learners use language effectively in academic/work contexts
- To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
- To build on students’ English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- To use language efficiently in expressing their opinions via various media.

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

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

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

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

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

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

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

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.

HS3252  PROFESSIONAL ENGLISH - II  L T P C

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

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

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

UNIT IV  REPORTING OF EVENTS AND RESEARCH  6

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

**TOTAL:** 30 PERIODS
OUTCOMES:
At the end of the course, learners will be able
- To compare and contrast products and ideas in technical texts.
- To identify and report cause and effects in events, industrial processes through technical texts
- To analyse problems in order to arrive at feasible solutions and communicate them in the written format.
- To present their ideas and opinions in a planned and logical manner
- To draft effective resumes in the context of job search.

CO-PO & PSO MAPPING

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

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

REFERENCE BOOKS:

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

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

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

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

UNIT III  SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS  9+3

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

UNIT V  NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS  9+3

COURSE OUTCOMES:
Upon successful completion of the course, students will be able to:
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture.
- Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.
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PH3251 MATERIALS SCIENCE

COURSE OBJECTIVES:
- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instil knowledge on physics of semiconductors, determination of charge carriers and device applications
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

UNIT I CRYSTALLOGRAPHY
UNIT II  ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS  9

UNIT III  SEMICONDUCTORS AND TRANSPORT PHYSICS  9

UNIT IV  OPTICAL PROPERTIES OF MATERIALS  9

UNIT V  NANOELECTRONIC DEVICES  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the students should be able to
- Know basics of crystallography and its importance for varied materials properties
- Gain knowledge on the electrical and magnetic properties of materials and their applications
- Understand clearly of semiconductor physics and functioning of semiconductor devices
- Understand the optical properties of materials and working principles of various optical devices
- Appreciate the importance of functional nanoelectronic devices.

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.

BE3251 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE OBJECTIVES:
- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics
- To introduce the functional elements and working of measuring instruments

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

UNIT II ELECTRICAL MACHINES

UNIT III ANALOG ELECTRONICS

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

UNIT V MEASUREMENTS AND INSTRUMENTATION

TOTAL: 45 PERIODS
COURSE OUTCOMES:
After completing this course, the students will be able to
1. Compute the electric circuit parameters for simple problems
2. Explain the working principle and applications of electrical machines
3. Analyze the characteristics of analog electronic devices
4. Explain the basic concepts of digital electronics
5. Explain the operating principles of measuring instruments

TEXT BOOKS:

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**CO/PO & PSO Average**

| CO/PO & PSO Average | 1.8 | 1  | 1  | 2  | 1  |

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

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

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

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

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

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

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

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

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

REFERENCES:

Publication of Bureau of Indian Standards:

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

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Low (1) ; Medium (2) ; High (3)
TEXT-CUM-REFERENCE BOOKS

1. The Classical Period - Tamil Society - 3rd Century BC - 2nd Century BC (Dr. S. Venkatraman, Published by: Jorvik Press)
2. Tamil Actress - 3rd Century BC - 2nd Century BC (Dr. S. Venkatraman, Published by: Jorvik Press)
3. Tamil Language and Literature - 3rd Century BC - 2nd Century BC (Dr. S. Venkatraman, Published by: Jorvik Press)
4. Bharatagiri - A Bhakti Movement - 3rd Century BC - 2nd Century BC (Dr. S. Venkatraman, Published by: Jorvik Press)
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:
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)

GE3252 TAMILS AND TECHNOLOGY

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

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

UNIT III
MANUFACTURING TECHNOLOGY

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

UNIT V
SCIENTIFIC TAMIL & TAMIL COMPUTING

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. தமிழக வரலொறு – மக்களும் பண் பொடும் - தவளியீடு (தவளியீடு பொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முமனவர் இல - சுந்தரம் (விகடன் பிரசுரம்).
3. கீழடி – மவமக நதிக்கமரயில் எங்கொல நகரநொகரிகம் (தொல்லியல் துமற தவளியீடு).
4. தபொருமந – ஆற்றங்கமர நொகரிகம். (தொல்லியல் துமற தவளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
## NCC CREDIT COURSE LEVEL 1*

### NX3252  
(NAVAL WING) NCC CREDIT COURSE LEVEL - I  

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### NCC GENERAL  

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### NATIONAL INTEGRATION AND AWARENESS  

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### PERSONALITY DEVELOPMENT  

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### LEADERSHIP  

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### SOCIAL SERVICE AND COMMUNITY DEVELOPMENT  

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

**NX3253**

(AIR FORCE WING) NCC CREDIT COURSE LEVEL – I

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

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

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES

PLUMBING WORK:

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

WOOD WORK:

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

Wood Work Study:

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

PART II ELECTRICAL ENGINEERING PRACTICES

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

PART III

MECHANICAL ENGINEERING PRACTICES

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

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:
1. Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
2. Wire various electrical joints in common household electrical wire work.
3. Weld various joints in steel plates using arc welding work; Machine various simple processeslike turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
4. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.
### COURSE OBJECTIVES:
- To train the students in conducting load tests on electrical machines
- To gain practical experience in characterizing electronic devices
- To train the students to use DSO for measurements.

### LIST OF EXPERIMENTS
1. Verification of ohms and Kirchhoff’s Laws.
2. Load test on DC Shunt Motor.
3. Load test on Self Excited DC Generator
4. Load test on Single phase Transformer
5. Load Test on Induction Motor
6. Characteristics of PN and Zener Diodes
7. Characteristics of BJT, SCR and MOSFET
8. Half wave and Full Wave rectifiers
9. Study of Logic Gates
10. Implementation of Binary Adder and Subtractor
11. Study of DSO

**TOTAL: 60 PERIODS**

### COURSE OUTCOMES:
After completing this course, the students will be able to:
1. Use experimental methods to verify the Ohm’s and Kirchhoff’s Laws.
2. Analyze experimentally the load characteristics of electrical machines
3. Analyze the characteristics of basic electronic devices
4. Use DSO to measure the various parameters

### Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial
OBJECTIVES

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

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

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

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

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

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

TOTAL: 60 PERIODS

LEARNING OUTCOMES

At the end of the course, learners will be able

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

CO-PO & PSO MAPPING

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- 1-low, 2-medium, 3-high, "-" no correlation.
- Note: The average value of this course to be used for program articulation matrix.
Assessment Pattern
- One online / app based assessment to test speaking and writing skills
- Proficiency certification is given on successful completion of speaking and writing.

MA3351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS
L T P C
3 1 0 4

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

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3
Formation of partial differential equations – Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types- Lagrange’s linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 9+3
Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval’s identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3
Classification of PDE – Method of separation of variables - Fourier series solutions of one-dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Cartesian coordinates only).

UNIT IV FOURIER TRANSFORMS 9+3

UNIT V Z-TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

TOTAL: 60 PERIODS

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

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ME3393 MANUFACTURING PROCESSES

COURSE OBJECTIVES:

1. To illustrate the working principles of various metal casting processes.
2. To learn and apply the working principles of various metal joining processes.
3. To analyse the working principles of bulk deformation of metals.
4. To learn the working principles of sheet metal forming process.
5. To study and practice the working principles of plastics molding.

UNIT I METAL CASTING PROCESSES

UNIT II METAL JOINING PROCESSES
UNIT III BULK DEFORMATION PROCESSES

UNIT IV SHEET METAL PROCESSES

UNIT V MANUFACTURE OF PLASTIC COMPONENTS

TOTAL :45 PERIODS

OUTCOMES:
At the end of the course the students would be able to
1. Explain the principle of different metal casting processes.
2. Describe the various metal joining processes.
3. Illustrate the different bulk deformation processes.
4. Apply the various sheet metal forming process.
5. Apply suitable molding technique for manufacturing of plastics components.

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Low (1) ; Medium (2) ; High (3)
COURSE OBJECTIVES:
The objective of this course is to prepare the students with the knowledge of basic principles of thermodynamics via real world engineering examples in order to apply, analyse and evaluate air standard cycles, Steam power cycles and Refrigeration and Air conditioning cycles.

UNIT I BASIC THERMODYNAMICS

UNIT II AIR STANDARD CYCLES AND COMPRESSORS
Cycle, Carnot cycle, Otto, Diesel, Dual combustion and Brayton cycles; Calculation of Air standard efficiency (simple problems). Mean effective pressure (Definition only). Compressors, Classifications of compressors, Reciprocating compressor- Rotary, Axial and Vane compressors (descriptive).

UNIT III STEAM PROPERTIES AND CYCLE
Formation of steam and its thermodynamic properties, T-s and h-s diagrams. Properties of steam, Dryness fraction, Quality of steam by steam tables and Mollier chart – simple Rankine cycle, Efficiency, Steam Nozzles, Types of nozzles, Friction in nozzles (descriptive)

UNIT IV REFRIGERATION AND AIR-CONDITIONING
Construction and working principles of refrigeration, Vapour compression system - Vapour absorption types, comparison – Definition of Co-efficient of performance (COP), Properties of refrigerants – Basic Principle, Summer, winter and Year round Air conditioning.

UNIT V INTRODUCTION TO HEAT TRANSFER

COURSE OUTCOMES:
Upon completion of this course, the students will be able to,
1. Demonstrate the understanding of the nature of the thermodynamic processes for pure substances of ideal gases
2. Interpret First Law of Thermodynamics and its application to systems and control volumes
3. Solve any flow specific problem in an engineering approach based on basic concepts and logic sequences.
4. Compare and contrast between various types of refrigeration cycles
5. Understand the basics and modes of heat transfer

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ME3351 ENGINEERING MECHANICS

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

UNIT I  STATIC OF PARTICLES

UNIT II  EQUILIBRIUM OF RIGID BODIES

UNIT III  DISTRIBUTED FORCES
Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.
UNIT IV       FRICTION
The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.

UNIT V       DYNAMICS OF PARTICLES

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

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Low (1); Medium (2); High (3)
COURSE OBJECTIVES: 
The objective of this course is to prepare the students to learn the basics of fluid statics and dynamics, and solve numerical related to equations of fluid motion, fluid flow in pipes, dimensional analysis, model studies and hydraulic machinery.

UNIT I BASIC CONCEPTS  9
Classification of fluids and their properties – Measurement of pressure and viscosity – Fluid statics and force on submerged bodies – Stability of floating bodies.

UNIT II EQUATIONS OF FLUID FLOW  9
Kinematics – Motion of a fluid particle – Fluid deformation – Navier Stokes equation and Euler’s equation – Basic laws of fluid motion in integral form and differential form - Linear momentum equation.

UNIT III INCOMPRESSIBLE INVISCID AND VISCOUS FLOWS  9

UNIT IV DIMENSIONAL ANALYSIS AND MODEL STUDIES  9
Dimensional analysis – non-dimensional numbers - The Buckingham-Pi theorem – Significant dimensionless groups – Flow similarity and model studies.

UNIT V HYDRAULIC MACHINERY FOR VEHICLE APPLICATIONS  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to,
1. Apply the basic concepts of fluids statics and dynamics
2. Summarize the concepts of flow governing equations
3. Generate solutions to complex pipe flow problems
4. Interpret the results of dimensional analysis
5. Understand the applications of fluid machinery in automotives

TEXT BOOK:

REFERENCES:
COURSE OBJECTIVES:
The objective of this course is to prepare the students with the knowledge on basics of constructional and working principles of automotive SI and CI engines along with their sub systems, thermochemistry of fuel-air mixtures, combustion process, performance and emission characteristics of IC engines.

UNIT I ENGINE FUNDAMENTALS

UNIT II INDUCTION AND IGNITION SYSTEM
Carburettors – mixture requirements - working principles, different circuits – Requirements and objective of injection system – types of injection - Jerk and distributor type pumps, Unit injector, common rail direct injection - Electronic fuel injection – GDI, Injection timing, Injection lag. Types of injection nozzle, Nozzle tests. Spray characteristics. Split and Multiple injection. Mechanical and pneumatic governors. Ignition system- battery coil, magneto coil and Electronic ignition system

UNIT III COMBUSTION OF FUELS

UNIT IV ENGINE COOLING, LUBRICATING AND EXHAUST SYSTEM

UNIT V ENGINE TESTING AND MEASUREMENTS
Engine testing and measuring equipment- Indicated and brake MEP, operating variables that affect engine performance, efficiency and emission – Automotive and stationary engine testing and related standards – use of transient dynamometer for engine testing. Engine power- measurement of indicated power-brake power- frictional power- efficiencies – Heat balance – Methods to improve engine performance.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to,
1. Identify various components of SI and CI engines
2. Explain the functions of IC engine sub-systems like Ignition, cooling and lubrication
3. Understand the actual engine working principle and its thermochemistry of fuel-air mixtures
4. Describe the basic knowledge on SI and CI engine combustion and its related parameters
5. Apply their knowledge in analyzing the engine performance and pollution characteristics.

TEXT BOOKS:

REFERENCES:
1. Heinz Hesiler, Advanced engine technology, Butterworth Heinmann publications
2. Heldt, P.M., High Speed Combustion Engines, Oxford IBH Publishing Co., Calcutta,

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AU3311 MECHANICAL SCIENCES LABORATORY

COURSE OBJECTIVES:
The objective of this course is to prepare the students to conduct experiments in order to understand the various physical characterization, mechanical properties and testing methods of materials, performance of fluid flow measuring devices and fluid machinery.

LIST OF EXPERIMENTS
1. Tension Test
2. Torsion Test
3. Testing of springs
4. Impact test i) Izod, ii) Charpy
5. Hardness test i) Vickers, ii) Brinell, iii) Rockwell, iv) Shore
6. Deflection of Beams
7. Mass Moment of inertia of connecting rods
8. Determination of the Coefficient of discharge of given Orifice meter.
10. Calculation of the rate of flow using Rota meter.
11. Determination of friction factor for a given set of pipes.
12. Experiments and drawing the characteristic curves of centrifugal pump.
13. Experiments and drawing the characteristic curves of reciprocating pump.
14. Experiments and drawing the characteristic curves of Gear pump.
15. Experiments and drawing the characteristic curves of Pelton wheel / Francis turbine/ Kaplan turbine.

TOTAL: 60 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students will be able to,
1. Conduct experiments to understand the physical characterization of materials.
2. Identify the various experimental testing methods for mechanical properties of materials.
3. Evaluate the basics of fluid flow characteristics.
4. Measure experimentally the Performance characteristics of pumps.
5. Determine experimentally the Performance characteristics of turbines.

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ME3382 MANUFACTURING TECHNOLOGY LABORATORY

COURSE OBJECTIVES:
1. To Selecting appropriate tools, equipment’s and machines to complete a given job.
2. To Performing various welding process using GMAW and fabricating gears using gear making machines.
3. To Performing various machining process such as rolling, drawing, turning, shaping, drilling, milling and analysing the defects in the cast and machined components.

LIST OF EXPERIMENTS
1. Fabricating simple structural shapes using Gas Metal Arc Welding machine.
2. Preparing green sand moulds with cast patterns.
3. Taper Turning and Eccentric Turning on circular parts using lathe machine.
4. Knurling, external and internal thread cutting on circular parts using lathe machine.
5. Shaping – Square and Hexagonal Heads on circular parts using shaper machine.
8. Cutting spur and helical gear using milling machine.
13. Cutting force calculation using dynamometer in milling machine
14. Cutting force calculation using dynamometer in lathe machine

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

1. Demonstrate the safety precautions exercised in the mechanical workshop and join two metals using GMAW.
2. The students able to make the work piece as per given shape and size using machining process such as rolling, drawing, turning, shaping, drilling and milling.
3. The students become make the gears using gear making machines and analyze the defects in the cast and machined components

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

10 Hours

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

MS EXCEL:

10 Hours

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

MS POWERPOINT:

10 Hours

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

TOTAL: 30 PERIODS
OUTCOMES:
On successful completion the students will be able to
- Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
- Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
- Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

AU3401 FUELS AND LUBRICANTS L T P C 3 0 0 3

COURSE OBJECTIVES:
The objective of this course is to prepare the students to understand the role, properties and testing of various fuels and lubricants in the design and operation of IC engines

UNIT I REFINERY OF FUELS AND LUBRICANTS 9
Introduction to Structure of petroleum, refining Process-Distillation, cracking processes, Catalytic reforming, alkylation, isomerisation and polymerization, finishing process- blending, products of refining process. Manufacture of lubricating oil base stocks, manufacture of finished automotive lubricants.

UNIT II THEORY OF LUBRICATION 9
Engine friction: introduction, total engine friction, effect of engine variables on friction, hydrodynamic lubrication, elastic hydrodynamic lubrication, boundary lubrication, bearing lubrication, functions of the lubrication system, introduction to design of a lubricating system

UNIT III LUBRICANTS 9
Specific requirements for automotive lubricants, oxidation deterioration and degradation of lubricants, additives and additive mechanism, synthetic lubricants, classification of lubricating oils, properties of lubricating oils, tests on lubricants. Grease, classification, properties, test used in grease- lubricants for gearbox, brake, differential and steering systems

UNIT IV PROPERTIES AND TESTING OF FUELS 9
Properties and testing of fuels- density, calorific value, cetane and octane number, flash point, fire point, distillation, vapour pressure, spontaneous ignition temperature, viscosity, cloud and pour point, flammability, ignitability, diesel index, API gravity, aniline point, carbon residue, copper strip corrosion. Test on used lubricants. Biofuel-properties and testing.

UNIT V TESTING INSTRUMENTS 9
Working principles and types – viscometers, calorimeters, flash and fire point apparatus, cloud and pour point apparatus, distillation apparatus, penetrometer, carbon residue apparatus, CFR engine, vapour pressure testing equipment, copper strip equipment, Aniline point apparatus -Ash content testing equipment - specifications of fuels. ASTM and SAE standards - FTIR- GCMS analysers

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
- Identify the fuels and lubricants for automotive applications
- Understand the properties of fuels and lubricants and its testing equipment
- Evaluate the properties of fuels and lubricants
- Select suitable fuel and lubricant testing equipment
- Analyse the behaviour of fuels and lubricants

TOTAL: 45 PERIODS
COURSE OBJECTIVES:
The objective of this course is to prepare the students to understand the basics of various vehicle frames, front axles, steering, suspension and braking systems used in automobile.

UNIT I INTRODUCTION, FRAME, STEERING SYSTEM
Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, Testing of frames, Types of Front Axles and Stub Axles, Front Wheel Geometry, Condition for True Rolling Motion of Wheels during Steering, Ackerman’s and Davis Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over–Steer and Under–Steer, Reversible and Irreversible Steering, EPAS.

UNIT II PROPELLER SHAFT AND FINAL DRIVE

UNIT III AXLES AND TYRES
Construction and Design of Drive Axles, Types of Loads acting on drive axles, Full – Floating, Three–Quarter Floating and Semi–Floating Axles, Axle Housings and Types – Lift axle, Dead axle, Types and Constructional Details of Different Types of Wheels and Rims, Different Types of Tyres and their constructional details.
UNIT IV  SUSPENSION SYSTEM  9

UNIT V  BRAKING SYSTEM  9

COURSE OUTCOMES:
At the end of this course, the student will be able to
1. Identify the different types of frame and chassis used in Automotive.
2. Classify the different types of drivelines and drives used in Automotive.
3. Acquire knowledge about different types of front axle and rear axles used in motor vehicles.
4. Examine the working principle of conventional and independent suspension systems.
5. Apply knowledge on working principles of brake and its subsystems.

TEXT BOOKS:
1. Kirpal Singh, Automobile Engineering, Standard Publisher, New Delhi , 2017

REFERENCES:

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COURSE OBJECTIVES:
The objective of this course is to prepare the students with the knowledge on the body construction details of light, heavy and commercial vehicles, along with the vehicle aerodynamics and body materials.

UNIT I CAR BODY DETAILS 9

UNIT II BUS BODY DETAILS 9
Types of bus body: based on capacity, distance travelled and based on construction. – Bus body lay out, floor height, engine location, entrance and exit location. Types of metal sections used – Regulations – Constructional details: Conventional and integral.

UNIT III COMMERCIAL VEHICLE DETAILS 8
Types of commercial vehicle bodies - Light commercial vehicle body. Construction details of Flat platform body, Tipper body and Tanker body – Dimensions of driver’s seat in relation to controls – Driver’s cab design.

UNIT IV VEHICLE AERODYNAMICS 9
Objectives, Vehicle drag and types. Various types of forces and moments. Effects of forces and moments. Side wind effects on forces and moments. Various body optimization techniques for minimum drag. Wind tunnels – Principle of operation, Types. Wind tunnel testing such as: Flow visualization techniques, Airflow management test – measurement of various forces and moments by using wind tunnel balance.

UNIT V BODY MATERIALS, TRIM, MECHANISMS AND BODY REPAIR 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the student will be able to
1. Understand the different aspects of car body
2. Differentiate the bus and commercial vehicle bodies.
3. Describe the role of various aerodynamic forces and moments, measuring instruments in vehicle body design.
4. Identify the materials used in body building,
5. Select hand tools for body repairs and maintenance.

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Applying the principle concepts behind stress, strain and deformation of solids for various engineering applications.
2. Analyzing the transverse loading on beams and stresses in beam for various engineering applications.
3. Understanding the torsion principles on shafts and springs for various engineering applications.
4. Acquiring knowledge on the deflection of beams for various engineering applications.
5. Interpreting the thin and thick shells and principal stresses in beam for various engineering applications.

UNIT I  STRESS, STRAIN AND DEFORMATION OF SOLIDS  9

UNIT II  TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM  9

UNIT III  TORSION  9
Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts – Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, – Closed and Open Coiled helical springs – springs in series and parallel, carriage springs.

UNIT IV  DEFLECTION OF BEAMS  9
Slope, Deflection and Radius of Curvature – Methods of Determination of Slope and Deflection- Double Integration method – Macaulay’s method – Area moment Theorems for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell’s reciprocal theorems.
UNIT V THICK & THIN SHELLS & PRINCIPAL STRESSES

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the principle concepts behind stress, strain and deformation of solids for various engineering applications.
2. Analyze the transverse loading on beams and stresses in beam for various engineering applications.
3. Solve problems based on the torsion principles involved in shafts and springs for various engineering applications.
4. Interpret the results of the deflection of beams.
5. Analyze the thin and thick shells and principal stresses in beam for various engineering applications

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COURSE OBJECTIVES:
The objective of this course is to prepare the students to gain knowledge in the construction and principle of mechanical transmission components, hydrodynamic devices, hydrostatic devices, automatic transmission system, Electric drive used in road vehicles.

UNIT I  
CLUTCH  
9
Requirement of transmission system, Types of transmission system, Requirement of Clutches – Functions - Types of clutches, construction and operation of Single plate, multi plate and Diaphragm spring clutches. Centrifugal clutch, Electronic clutch.

UNIT II  
GEAR BOX  
9
Purpose of gear box. Construction and working principle of sliding, constant and synchromesh gear boxes, Automatic manual transmission. Introduction to epicycle gear trains, Numerical examples on performance of automobile such as Resistance to motion, Tractive effort, Engine speed & power and acceleration. Determination of gear ratios for different vehicle applications.

UNIT III  
HYDRODYNAMIC TRANSMISSION  
9

UNIT IV  
HYDROSTATIC DRIVE  
9

UNIT V  
AUTOMATIC TRANSMISSION AND ELECTRIC DRIVE  
9

TOTAL= 45 PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to:
1. Understand the construction and working of various types of clutches
2. Determine the gear ratio for different vehicle applications
3. Describe the types and principle of hydrodynamic transmission
4. Compare Hydrostatic and hydrodynamics drives
5. Identify the differences among various automatic transmissions.

TEXT BOOKS:

REFERENCES:
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  9

UNIT II  ENVIRONMENTAL POLLUTION  9

UNIT III  RENEWABLE SOURCES OF ENERGY  9
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  9
Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols- Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.
UNIT V  
SUSTAINABILITY PRACTICES


TOTAL: 30 PERIODS

OUTCOMES:
At the end of the course the students would be able to
1. Understand the nature and its impacts on human life.
2. The students have the knowledge and awareness of Environmental Pollution.
3. Understanding of the energy sources and scientific concepts/principles behind them
4. Understand the concepts of the Sustainability and Management
5. Understand the Sustainability Practices and socio economical changes

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NX3451 (ARMY WING) NCC Credit Course Level - II

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TOTAL: 45 PERIODS

NCC Credit Course Level 2*
NX3452 (NAVAL WING) NCC Credit Course Level - II

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

**NX3453** *(AIR FORCE WING) NCC Credit Course Level - II*  
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AU3411 VEHICLE COMPONENTS LABORATORY L T P C 0 0 4 2

COURSE OBJECTIVES:
The objective of this course is to prepare the students to acquire skill in identify, dismantling and assembling the parts of an IC engine and its subcomponents like Clutch, Front/Rear axle, steering system, gear boxes and suspension systems.

LIST OF EXPERIMENTS
1. Dismantling, Measurement and Assembling of 1000CC engine
2. Dismantling, Measurement and Assembling of Bus engine
3. Dismantling, Measurement and Assembling of V8 engine
4. Dismantling, Measurement and Assembling of CRDI engine
5. Dismantling, Measurement and Assembling of MPFI engine
7. Dismantling, calculation of gear ratio and Assembling of Constant and Sliding mesh gear boxes
8. Dismantling and Assembling of Transfer case.
11. Study of different chassis layouts.
12. Study of different braking systems.
13. Study of Steering system
14. Study of Suspension system

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to:
1. Dismantle and Assemble the automobile chassis and Engine components
2. Identify & differentiate components of SI & CI engines
3. Understand working of braking, steering, clutch, transmission, Suspension systems.
4. Develop skills in Dismantling and assembling of chassis components.
5. Correct minor repairs and trouble shoots the breakdowns

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AU3412 FUELS AND LUBRICANTS LABORATORY L T P C 0 0 4 2

COURSE OBJECTIVE:
The objective of this course is to prepare the students to attain practical skills during the properties testing procedure for automotive fuels and Lubricants.

LIST OF EXPERIMENTS:
1. Determination of viscosity of lubricating oil by Redwood Viscometer.
2. Determination of viscosity of lubricating oil by Saybolt Viscometer
3. Determination of Flash and Fire points of given sample of fuel and lubricants
4. Determination of Cloud and pour point of given oil.
5. Conduct of ASME distillation test of fuels (gasoline / diesel).
7. Determination of Calorific value of liquid fuel by using bomb calorimeter.
8. Conduct of Penetration test for the given sample.
9. Determination of Density test of different fuels

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to:
Develop skills and understand various testing methods adopted to assess quality of fuels and lubricants like
1. Viscosity
2. Importance of flash, fire point
3. Cloud and pour point
4. Calorific value
5. Density

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AU3501 MECHANICS OF MACHINES

COURSE OBJECTIVES:
The objective of this course is to prepare the students to acquire knowledge and skills to analyze various types of kinematic mechanisms, cams and gears, effect of friction in power transmission, vibration and balancing.

UNIT I MECHANISMS

UNIT II FRICTION
Types of friction – friction in screw and nut – screw jack – pivot, collar and thrust bearings – plate and cone clutch – belt (Flat and V) and rope drives – creep in belts – open and crossed belt drives – Ratio of tensions – Effect of centrifugal and initial tensions – condition for maximum power transmission.

UNIT III GEARS AND CAMS

UNIT IV VIBRATION

UNIT V BALANCING
Static and dynamic balancing – single and several masses in different planes – primary and secondary balancing of reciprocating masses – Balancing of single and multi-cylinder engines – Governors and Gyroscopic effects.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course, students will be able to:
1. Apply the concepts of kinematics and dynamics of machinery in design and analysis of engineering problems.
2. Demonstrate the ability to synthesize and analysis mechanisms
3. Design and analyze cam and their motion.
4. Select the gears and gear trains for their applications.
5. Examine the concept of free, forced and damped vibrations.

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AU3502 AUTOMOTIVE ELECTRICAL AND ELECTRONICS L T P C

COURSE OBJECTIVES:
The objective of this course is to prepare the students to become familiar with the basic concepts and applications of different sensor and actuators used for electronic control, different communication protocols and networking in vehicles

UNIT I INTRODUCTION AND AUTOMOTIVE BATTERIES 9
Introduction - Overview of vehicle electrical systems- Electrical circuits - Electrical power supply in conventional vehicle- Dimensioning of wires- Circuit diagrams and symbols - Electromagnetic Compatibility and interference suppression. Batteries – Battery design – Method of operation – Lead acid battery construction – Battery ratings and testing- Maintenance -free batteries – Battery– Substitute, versions, special cases
UNIT II STARTING AND CHARGING SYSTEM

Alternators – Generation of electrical energy in vehicle- physical principles- Alternator and voltage regulations versions – power losses – characteristics curve- Alternator operation in the vehicle- Alternator circuitry. Starter Motors – Development and Starting requirements in the IC engines starter motor design – Starter motor design variations – starter motor control and power circuits

UNIT III IGNITION, LIGHTING AND AUXILLARY SYSTEM


UNIT IV AUTOMOTIVE ELECTRONICS AND SENSORS AND ACTUATORS


UNIT V VEHICLE NETWORKING

Data transfer between automotive Electronics systems - Basic principles of networking- Network topology- Network organization- OSI reference model- Control mechanisms - communication protocols in embedded systems- - Vehicle Communication Protocols – Cross-system functions - Requirements for bus systems- Classification of bus systems- Applications in the vehicle -Coupling of networks- Examples of networked Vehicles - Bus system- CAN, LIN, Flexray – MOST etc.

TOTAL:45 PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to:
1. Define the glossary related to vehicle electrical and electronic system
2. Explain the need for starter batteries, starter motor and alternator in the vehicle.
3. Differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols
4. List common types of sensor and actuators used in vehicles.
5. Understand networking in vehicles.

TEXT BOOK:

REFERENCES:
The objective of this course is to prepare the students to trouble shoot the connectivity and program various electrical and electronics circuits used in automobiles.

LIST OF EXPERIMENTS:

Electrical System

1. Study of Vehicle lighting system.
2. Study of an Ignition system.
3. Study of Layout of an Automotive Electrical System.
4. Study of Voltage regulator, solenoids, Horn and wiper mechanism.

Electronic System

1. Visualization of Engine Sensor Signals and fault Diagnosis using OBD Kit.
2. Interface of Seven segment display.
3. Interfacing of ADC for a sensor and Interfacing of DAC for an actuator.
4. Interface circuit like amplifier, filter, Multiplexer and De Multiplexer.
5. Basic microprocessor programming like arithmetic and Logic operation, code conversion, waveform generation, look up table etc.
7. Study of Virtual Instrumentation and Communication Protocols (CAN, LIN, MOST etc.)

COURSE OUTCOMES:

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

1. Understand the working principle of Electrical circuits in automobile.
2. Evaluate the working principle of Battery, and starter motor.
3. Describe the working principle of auxiliary systems used in automobiles.
4. Explain the use of sensors in an automobile.
5. Develop a programming knowledge on Microprocessor.

TOTAL: 60 PERIODS
SEMESTER VI

AU3601 AUTOMOTIVE POLLUTION AND CONTROL L T P C
3 0 0 3

COURSE OBJECTIVES:
The objective of this course is to prepare the students to have knowledge on the harmful effects of major pollutants of IC engines, emission standards, various pollution measurement devices and control techniques

UNIT I EMISSION FROM AUTOMOBILES 9

UNIT II EMISSION FROM SPARK IGNITION ENGINE AND ITS CONTROL 9
Emission formation in SI Engines- Carbon monoxide- Unburned hydrocarbon, NOx, Smoke — Effects of design and operating variables on emission formation – controlling of pollutants - Catalytic converters — Charcoal Canister — Positive Crank case ventilation system, Secondary air injection, thermal reactor, Laser Assisted Combustion.

UNIT III EMISSION FROM COMPRESSION IGNITION ENGINE AND ITS CONTROL 9
Formation of White, Blue, and Black Smokes, NOx, soot, sulphur particulate and Intermediate Compounds – Physical and Chemical delay — Significance Effect of Operating variables on Emission formation — Fumigation, EGR, HCCI, Particulate Traps, SCR — Cetane number Effect.

UNIT IV NOISE POLLUTION FROM AUTOMOBILES 9

UNIT V TEST PROCEDURES AND EMISSION MEASUREMENTS 9
Constant Volume Sampling I and 3 (CVSI & CVS3) Systems- Sampling Procedures — Chassis dyno - Seven mode and thirteen mode cycles for Emission Sampling — Sampling problems — world harmonized driving cycles - Emission analysers —NDIR, FID, Chemiluminescent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters. Particle counter

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Differentiate the various emissions formed in IC engines
2. Analyze the effects of pollution on human health and environment
3. Design the control techniques for minimizing emissions
4. Categorize the emission norms
5. Identify suitable methods to reduce the noise emissions.
TEXT BOOKS:

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<td>Modes of Entry to Army, CAPF, Police</td>
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TOTAL: 45 PERIODS

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

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

**SHIP MODELLING**
SM  Ship Modelling Capsule  3

**TOTAL**: **45 PERIODS**

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**NCC Credit Course Level 3**

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**PERSONALITY DEVELOPMENT**
PD 3  Group Discussion: Team Work  2
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

**AIRMANSIP**
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

**TOTAL**: **45 PERIODS**
COURSE OBJECTIVES:
The objective of this course is to prepare the students to become familiar with the use of various
modelling software for modelling and visualizing various engine components

LIST OF ENGINE DESIGN EXPERIMENTS
1. Design and modelling of piston, piston pin and piston rings.
2. Design and modelling of connecting rod assembly.
4. Design and modelling of flywheel
5. Design and modelling of cam and camshaft.

LIST OF CHASSIS DESIGN EXPERIMENTS
1. Design and modelling of frame
2. Design and modelling of clutch assembly.
3. Design and modelling of sliding mesh gearbox
5. Design and modelling of front and rear axle assembly

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Visualize the automotive components with the help of modelling software.
2. Modify design instantly if required at the initial design stage itself
3. Demonstrate the knowledge on designing components to withstand the loads and
deformations.
4. Synthesize, analyse and document the design of the various components
5. Apply engineering techniques for developing vehicle components with industry standards

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COURSE OBJECTIVES:
The objective of this course is to prepare the students to acquire practical knowledge in automotive
emission measurement and methods of testing engines.

LIST OF EXPERIMENTS:
1. Study of Engine Dynamometers.
2. Study of IC engine Pressure measurement systems for combustion analysis.
3. Performance study on petrol engine.
4. Performance study on diesel engine.
5. Determination of Frictional power on multi cylinder petrol/diesel engines.
7. Measurement of HC, CO, CO$_2$, O$_2$ and NOx using exhaust gas analyzer.
8. Diesel smoke measurement.

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**
At the end of this course, students will be able to
1. Identify the various emission measuring instruments
2. Describe the various engine testing instruments
3. Understand the procedure to measure the emission
4. Conduct testing for engine performance, combustion and emission characteristics
5. Recall the available emission norms

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**SEMESTER VII**

**AU3701 ENGINE AND CHASSIS COMPONENTS DESIGN**

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**COURSE OBJECTIVES:**
The objective of this course is to prepare the students for understanding the design concept and principles involved in various engine components like cylinder, piston, connecting rod, crankshaft, flywheel, axle, suspension and steering systems.

**UNIT I**
**INTRODUCTION**
Engineering materials - Introduction endurance limit, notch sensitivity. Tolerances, types of tolerances and fits, design considerations for interference fits, surface finish, surface roughness, Rankine’s formula - Tetmajer’s formula - Johnson formula - design of pushrods.

**UNIT II**
**DESIGN OF CYLINDER, PISTON AND CONNECTING ROD**
Choice of material for cylinder and piston, design of cylinder, piston, and piston pin, piston rings, piston failures, lubrication of piston assembly. Material for connecting rod, determining minimum length of connecting rod, small end design, shank design, design of big end cap bolts.

**UNIT III**
**DESIGN OF CRANKSHAFT AND FLYWHEEL**
Balancing of I.C. engines, significance of firing order. Material for crankshaft, design of crankshaft under bending and twisting, balancing weight calculations, development of short and long crank arms. Front and rear-end details. Determination of the mass of a flywheel for a given co-efficient of speed fluctuation. Engine flywheel - stresses on the rim of the flywheels. Design of hubs and arms of the flywheel, turning moment diagram.

**UNIT IV**
**DESIGN OF VEHICLE FRAME, SUSPENSION AND STEERING SYSTEMS**
Study of loads-moments and stresses on frame members. Design of frame for passenger and commercial vehicle - Design of leaf Springs-Coil springs and torsion bar springs. Determination of optimum dimensions and proportions for steering linkages, ensuring minimum error in steering.

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Understand the choice of material for various vehicle components
2. Design various vehicle components.
3. Apply the concept of limits, fits and tolerance during the design of engine and chassis components
4. Analyse the different types of loads acting in various engine components
5. Describe the requirement of surface finish of vehicle components

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

UNIT I DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES

UNIT II ENERGY SOURCES

UNIT III MOTORS AND DRIVES
Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

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

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

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

TOTAL: 45 PERIODS

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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  6
Reading Text: Excerpts from John Stuart Mills’ On Liberty

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

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

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

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

TOTAL: 30 PERIODS

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

AU3711 VEHICLE MAINTENANCE AND TESTING LABORATORY L T P C 0 0 4 2

COURSE OBJECTIVES:
The objective of this course is to educate the students on the aspects of maintenance of vehicle and subsystems.

LIST OF EXPERIMENTS:
1. Study on layout of automotive service station.
2. Tightening and adjustment of wheel bearing.
3. Adjustment of pedal play in clutch, brake, hand brake lever and steering wheel orientation.
4. Wheel alignment in four wheelers.
5. Minor and major tune up of gasoline and diesel engines.
6. Calibration of Fuel injection pump
7. Fault diagnosis and service of Electrical system like battery, starting system, charging system, lighting system.
8. Removal and fitting of tyre.
9. Engine fault diagnosis using scan tool
10. Fault diagnosis of brake system – Air bleeding from hydraulic brakes.
11. Performance test on two wheeler chassis dynamometer.

TOTAL: 60 PERIODS

COURSE OUTCOME:
At the end of this course, students will be able to
1. Describe the layout of an automotive service station
2. Demonstrate the skills on the adjustment of clutch, brake, hand brake lever and steering wheel orientation
3. Calibrate Fuel injection pump
4. Trouble shoot the fault in electrical systems
5. Align wheel for four wheelers

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Course objective
The objective of this course is to prepare the students to get exposure to industry environment and to take up on-site assignment as trainees or interns.

The students are expected with two weeks of work at industry site and supervised by an expert at the industry.
At the end of Industrial internship, the candidate shall submit a certificate from the organization where he/she has undergone training and a brief report. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a three member Departmental Committee constituted by the Head of the Institution. The certificates (issued by the organization) submitted by the students shall be attached to the mark list sent by the Head of the Institution to the Controller of Examinations.

COURSE OUTCOMES
At the end of the course, students will be able to:
1. Understand the industrial practices and work environment as an individual, member or leader in diverse teams and in multidisciplinary settings
2. Communicate effectively on complex engineering activities with the engineering community and with society at large
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. Develop the ability to engage in research and to involve in life-long learning
5. Comprehend contemporary issues

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COURSE OBJECTIVE:
The objective of this course is to help the students to develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same, and to train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

COURSE OUTCOME:

At the end of this course, students will be able to
1. Take up any challenging practical problems and find solution by formulating proper methodology.

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COURSE OBJECTIVE:
The objective of this course is to provide the students with the knowledge on the design, operation and control of electric two and three wheelers

UNIT I  DESIGN CONCEPTS FOR ELECTRIC TWO AND THREE WHEELER  9

UNIT II  BATTERIES FOR EV  9

UNIT III  FUNDAMENTAL PRINCIPLES OF ELECTRIC MOTORS  9

UNIT IV  POWER ELECTRONICS INTERFACE  9
Power electronics interface – basic devices and components-Convertors and invertors-Traction motors-Battery modules and pack-Sizing of battery pack-Mechanical and thermal design of battery pack-Motor Control- Different type of Motor Control- Working principle of Motor Control-Testing and Troubleshooting.

UNIT V  ECONOMICS, REGULATIONS AND POLICY  9

TOTAL: 45 PERIODS

REFERENCES:

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Understand the design concepts for electric two and three wheeler
2. Familiarize the battery system
3. Know the types, principles and applications of electric motors
4. Recognize the importance of power electronics in electric automotives
5. Analyse the economics and policies related to E vehicles
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AU3002 BATTERIES AND MANAGEMENT SYSTEM L T P C

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

UNIT II BATTERY PACK 9

UNIT III BATTERY MODELLING 9

UNIT IV BATTERY STATE ESTIMATION 9

UNIT V BMS ARCHITECTURE AND REAL TIME COMPONENTS 9
- Battery Management System: need, operation, classification. BMS ASIC: bq76PL536A-Q1 Battery Monitor IC: CC2662R-Q1 Wireless BMS MCU. Communication Modules: CAN Open-Flex Ray-CANedge1 package. ARBIN Battery Tester. BMS Development with Modeling software and Model-Based Design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Acquire knowledge of different Li-ion Batteries performance.
2. Design a Battery Pack and make related calculations.
3. Demonstrate a Battery Model or Simulation.
5. Approach different BMS architectures during real world usage.
TEXT BOOKS

REFERENCE BOOKS
1. Developing Battery Management Systems with Simulink and Model-Based Design-whitepaper
2. Panasonic NCR18650B- Data Sheet
3. bq76PL536A-Q1- IC Data Sheet
4. CC2662R-Q1- IC Data Sheet

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AU3003 TRACTION MOTORS

COURSE OBJECTIVES:
The objective of this course is to make the students understand various systems of track electrification, power supply system and mechanics of electric train, and identify a suitable drive for electric traction.

UNIT I TRACTION SYSTEMS
Electric drives – Advantages & disadvantages – System of track electrification – d.c., 1-Phase low frequency, 3-Phase low frequency and composite systems, Problems of 1-phase traction system – Current unbalance, Voltage unbalance, Production of harmonics, Induction effects, Booster transformer – Rail connected booster transformer. Comparison between ac. and d.c. systems.

UNIT II TRACTION MECHANICS
Types of services, Speed – time curves – Construction of quadrilateral and trapezoidal speed time curves, Average & schedule speeds. Tractive effort – Speed characteristic, Power of traction motor, specific energy consumption – Factors affecting specific energy consumption, Coefficient of adhesion, slip – Factors affecting slip, magnetically suspended trains

UNIT III POWER SUPPLY ARRANGEMENTS
High voltage supply, Constituents of supply system – Substations, Feeding post, Feeding & sectioning arrangements, Remote control center, Design considerations of substations, Over head equipment – principle of design of OHE, Polygonal OHE – Different types of constructions, Basic sag & tension calculations, Dropper design, Current collection gear for OHE.

UNIT IV TRACTION MOTORS
UNIT V  
SEMI CONDUCTOR CONVERTER CONTROLLED DRIVES


TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Understand Traction systems and its mechanics
2. Identify the power supply equipment for traction systems
3. Analyze various types of motors used in traction
4. Differentiate AC and DC traction drives

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COURSE OBJECTIVES:
The objective of this course is to make the students to understand the working and characteristics of Power Semiconductor Devices.

UNIT I  
AUTOMOTIVE POWER SEMICONDUCTOR DEVICES

Power Electronic Circuits - Types, design of equipment’s, RMS waveforms, peripheral effects. Power Transistors- types, operation. Diodes- types, operation and characteristics. BJT and MOSFETs- Steady state, switching characteristics. Power MOSFETs and IGBTs-importance, operations. SPICEMODELS-Diode, BJT and MOSFETs Simulation concepts.

UNIT II  
AUTOMOTIVE POWER ELECTRONIC CONVERTERS

UNIT III  RECTIFIERS AND INVERTERS 9
Inverters-Inverter circuit design. SPICE MODEL- Rectifiers and Invertors simulation concepts.

UNIT IV  AC AND DC DRIVES 9
DC Drives-performance equations, single-phase and three phasehalf-wave, full, dual converter and
semiconductor drives.AC Drives-Three-phase Induction Motor, various controls, DSP based Vector
Control. Modeling Capabilities- Field-Oriented Control Modeling of Induction Motor Drives.

UNIT V  RECENT TRENDS AND CASE STUDIES IN POWER ELECTRONICS 9
Wide bandgap (WBG) semiconductors-Silicon power Transistors-design overview-Gallium Nitride
Transistors-SiC Vs GaN in powerswitching applications-HEV/EVOn board chargers-
Wiboticaautonomous wireless charging systems-Boeing 787 Electrical Power System-Case studies.
Simulation Packages overview- SPICE, EMTP and PSIM.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Apply the knowledge in selecting Power Semiconductor Devices for applications.
2. Demonstrate the operation and characteristics of the DC-DC Converters.
3. Analyze the operation of Rectifiers and Inverters.
4. Explain the operation of AC and DC Drives.
5. Identify different simulation packages.

TEXT BOOKS:
1. Rashid M.H., "Power Electronics Circuits- Devices and Applications", Pearson Education,
2. Haitham Abu-Rub, Mariusz Malinowski and Kamal Al-Haddad "Power Electronics for
Renewable Energy Systems, Transportation and Industrial Applications", John Wiley and
sons, 2014.

REFERENCE BOOKS:
New Delhi, 2012.
4. Gallium Nitride (GaN) Power ICs: Turning Academic Dreams into an Industry Reality- white
paper.
5. Driving the future of HEV/EV with high-voltage solutions- white paper, Texas instruments.

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COURSE OBJECTIVES:
The objective of this course is to make the students to Know about the fail-safe, fault-tolerant, and fail-operational automotive systems.

UNIT I INTRODUCTION
Definition of System and Functional safety, Lifecycle of safe product, Safety terminologies, System engineering – from Faults to Hazards, Reliability.

UNIT II AUTOMOTIVE FUNCTIONAL SAFETY STANDARD

UNIT III FUNCTIONAL SAFETY ASSESSMENT METHODS

UNIT IV FUNCTIONAL SAFETY DESIGN
Safety function, Safety pitfalls, Residual faults, Fault prevention design, Fault tolerant design, Modelling methods in Technical Safety concept, Safety plan, Safe SW development, Role of product safety engineer.

UNIT V FUNCTIONAL SAFETY VERIFICATION
HW & SW integration checks, Safety-Related systems design assessments, Verification of functional safety, Test results integration in safety case, Introduction to Automotive SPICE – SW maturity model, introduction to SW stacks (AUTOSAR, RTOS, etc) & V-model.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Choose the safety standards according to application in automotive industry
2. Explain the automotive functional safety product lifecycle
3. Choose a functional item on a vehicle level, construct hazard assessment and risk analysis, and select an ASIL level for the item.
4. Analyse and select appropriate work products while understanding the ISO26262 lifecycle
5. Determine the requirements of functional safety at the system, hardware, and software design phases
6. Solve Functional problems in automobile design, development, and in-use phases

TEXT BOOKS:
1. ISO26262 - Road vehicles — Functional safety

REFERENCES:
COURSE OBJECTIVES:
The objective of this course is to provide the students with the basic concepts of various types of Fuel cells, so as to equip the students with knowledge required for the design of component of Fuel cells.

UNIT I  FUEL CELL PERFORMANCE

UNIT II  ALKALINE (AFC) AND SOLID OXIDE FUEL CELLS

UNIT III  DIRECT METHANOL AND PROTON EXCHANGE MEMBRANE FUEL CELLS
Catalyst and Non catalyst aspects- Methanol cross over- Catalyst aspects and scale up-Engineering aspects - Scientific aspects and challenges - Milestones in technology development- Approaches and challenges to high temperature operations.

UNIT IV  FUEL PROCESSING AND HYDROGEN STORAGE
Processing hydrogen from alcohols- producing hydrogen from hydrocarbons- Hydrogen from other sources- Gas clean up- Hydrogen storage- Methods of Hydrogen storage- Hydrogen as Engine storage

UNIT V  FUEL CELL SYSTEMS
Introduction to fuel cell power conditioning systems- Various options- Fuel cell systems fuelled by Natural gas (PEFC, PAFC, MCFC systems)- Coal fuelled fuel cell system-Combined fuel cell and Gas turbine system- Hybrid fuel cell systems- Electric vehicles

TOTAL :45 PERIODS
COURSE OUTCOMES:
At the end of this course, students will be able to
1. Describe the working principles of Fuel cells and its component.
2. Estimate the performance parameters of Fuel cells
3. Develop clear understanding about functioning and types of Fuel cells
4. Evaluate the cost of generation and economics of Fuel cells
5. Assess environmental impact of Fuel cells

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AU3007 AUTONOMOUS AND CONNECTED VEHICLES L T P C 3 0 0 3

COURSE OBJECTIVE:
The objective of this course is to make the students to enumerate the requirements, levels, hardware and software in autonomous vehicles.

UNIT I INTRODUCTION TO AUTONOMOUS VEHICLE TECHNOLOGY 9

UNIT II PATH PLANNING AND DECISION MAKING 9
Principles of decision making and path planning for autonomous vehicles-Decision making approaches-Approximation-Heuristic-Graph based-Point guidance. Verification and validation of decision making and path planning- Application examples of task allocation and path planning algorithms.

UNIT III SENSORS, PERCEPTION AND VISUALISATION 9
Introduction to sensors, perception and visualisation for autonomous vehicles-Sensor integration architectures and multiple sensor fusion-AI algorithms for sensing and imaging-neural networks.

UNIT IV NETWORKING AND CONNECTED VEHICLES 9
Current and future vehicle networking technologies- CAN, LIN, MOST and Flex-ray. The use of modern validation and verification methods- software-in-the-loop, and hardware-in-the-loop...
techniques. The role of Functional Safety and ISO26262 within the overall control system. Inter-
dependency between software engineering and control system-advanced test methods for the
validation of safety-critical systems. Connected vehicle control (CACC), vehicle-to-vehicle
[V2V], vehicle-to-infrastructure [V2I], and Vehicle to “Cloud” [V2C]. Applications such as intelligent
traffic signals, collaborative adaptive cruise and vehicle platooning.

UNIT V HUMAN FACTORS AND ETHICAL DECISION MAKING

Introduction to Human Factors-Human Performance: Perception and Attention-Situation Awareness
and Error-Human Reliability: Driver Workload and Fatigue-Emotion and Motivation in Design-Trust
in Autonomous Vehicles and Assistive Technology-Designing ADAS Systems-Driveless Vehicles
and Ethical Dilemmas: Human Factors and Decision Making Software-Application of Human Factors
in Autonomous Vehicles. International and national regulatory frameworks for CAV and their safe
operation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Estimate vehicle state based on available data.
2. Describe various computer vision features and techniques.
3. Develop motion plan for the vehicle based on the environment, behaviour and interaction
   of objects.
4. Describe the applications of AI in autonomous and connected vehicles.

REFERENCES:
1. Autonomous Driving: How the Driverless Revolution will Change the World, by Andreas
2. Autonomous Vehicles: Technologies, Regulations, and Societal Impacts, George
   Dimitrakopoulos, Aggelos Tsakanikas, Elias Panagiotopoulos, Paperback ISBN:
3. Driverless: Intelligent Cars and the Road Ahead (MIT Press) 1St Edition, by Hod Lipson , Melba

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COURSE OBJECTIVES:
The objective of this course is to make the students to list common types of sensor and actuators used in automotive vehicles.

UNIT I INTRODUCTION TO MEASUREMENTS AND SENSORS

UNIT II VARIABLE RESISTANCE AND INDUTANCE SENSORS
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezo resistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT.

UNIT III VARIABLE AND OTHER SPECIAL SENSORS
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.

UNIT IV AUTOMOTIVE ACTUATORS

UNIT V AUTOMATIC TEMPERATURE CONTROL ACTUATORS
Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. List common types of sensor and actuators used in vehicles.
2. Design measuring equipment’s for the measurement of pressure force, temperature and flow.
3. Generate new ideas in designing the sensors and actuators for automotive application
4. Understand the operation of these sensors, actuators and electronic control.
5. Design temperature control actuators for vehicles.

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VERTICAL 2 : Computational Design

AU3009 COMPUTER AIDED DESIGN AND MANUFACTURING

COURSE OBJECTIVE:
The objective of this course is to provide the students with the knowledge in computer aided design and manufacturing (CAD/CAM) techniques, product specification, CAD/CAM integration, CNC programming using manual method, generation of CNC codes using CAM software.

UNIT I COMPUTER AIDED DESIGN (CAD) 9
Overview of 2D drawings, work area customization, constraints and parameters, sketching tools, geometrical modifications, converting 2D drawings to 3D models, modeling features and tools, dimensioning and annotations, materials and appearances, file import/export.

UNIT II COMPUTER AIDED MANUFACTURING (CAM) 9
Overview of machining processes, work setup, cutting tool selection, calculation of feeds and speeds, CAM cycles, cutting planes selection, toolpath setup, post-processing of G-codes, file import/export.

UNIT III CAD AND CAM INTEGRATION 9

UNIT IV FUNDAMENTAL OF CNC AND PART PROGRAMMING 9
UNIT V ADDITIVE MANUFACTURING


TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Creation of part drawings and 3D models using CAD techniques.
2. Create the CAM Toolpath for specific given operations
3. Ability to develop a product from conceptualization to reality and to make collaboration between product design and manufacturing.
4. Apply NC & CNC programming concepts to develop part programme for Lathe & Milling Machines
5. Illustrate understanding of various cost effective alternatives for manufacturing products.

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COURSE OBJECTIVES:
The objective of this course is to make the students understand the role of computational techniques in solving problems in materials engineering and to impart them with the knowledge of various kind of multiscale modelling techniques used in materials engineering.

UNIT I  BASICS OF COMPUTATIONAL MATERIALS SCIENCE  9
Atomistic theory of matter, Statistical mechanics of materials (equilibrium and non-equilibrium systems and ensembles, Stochastic processes and stochastic modeling), Coarse graining methods, Continuum models of materials and microstructures.

UNIT II  MULTISCALE SIMULATION METHODS  9
Molecular Dynamics, equilibrium and kinetic Monte Carlo simulation, mesoscopic methods such as Dislocation Dynamics and the Phase Field method, and continuum-level modeling of materials behavior in Finite Element simulations.

UNIT III  NUMERICAL METHODS FOR ATOMISTIC MODELING I  9
General theory of atomistic simulations, Advanced methods for the generation of atomistic samples, MD integration algorithms for different thermodynamic ensembles (NVE,NVT,NPT), Energy minimization algorithms and structure optimization, Introduction to Density Functional Theory, Determination of defect properties, Atomic interaction potentials, including EAM, BOP and Tight-Binding Methods, Advanced analysis and visualization methods for atomistic samples.

UNIT IV  NUMERICAL METHODS FOR ATOMISTIC MODELING II  9
Monte Carlo and kinetic Monte Carlo methods, Modeling thermally activated events: transition state theory, nudged elastic band calculations, hyperdynamics Generalized Continuum Models of Microstructure: Cosserat continua, Micromorphic continua, Nonlocal and gradient-dependent models, Stochastic models of heterogeneous microstructure.

UNIT V  DISLOCATION THEORY AND SIMULATION  9
Foundations of dislocation theory (stress and strain fields, dislocation energetics and interactions), Dislocation-based modeling of plastic deformation processes, Discrete and continuous simulation approaches.

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Upon successful completion of the course, the students will be able to
2. Identify the simulation techniques for solving a particular problem in material science
3. Perform basic atomistic and microstructure level simulations
4. Apply finite element method for solving stress-strain, heat and mass transfer problems in material science
5. Study and model the role of dislocations and other material defects

TEXT BOOKS:

REFERENCES:
1. Introduction to Computational Materials Science: Fundamentals to Applications, Richard LeSar, Cambridge University Press.
2. Computational Materials Science: An Introduction, June Gunn Lee, CRC press
3. Computational Materials Science: From Ab Initio to Monte Carlo Methods, Kaoru Ohno, Keivan Esfarjani, and Yoshiyuki Kawazoe, Springer
4. Density Functional Theory: A Practical Introduction by David Sholl and Janice A. Steckel, Wiley

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AU3011 COMPUTATIONAL THEORY ON SOLID MECHANICS L T P C 3 0 0 3

OBJECTIVES
The objective of this course is to make the students understand the principles of mechanics of rigid and deformable bodies in Engineering to learn nonlinear problems in solid mechanics and finite element method.

UNIT I STIFFNESS METHOD 9
Types of skeletal structures, internal forces and deformations. Introduction and applications of stiffness member approach to analyze beams, Trusses, plane frames and grids.

UNIT II STIFFNESS METHOD (SPECIAL TOPICS) 9
Various secondary effects like deformation of support, prestrain & temperature. Symmetry/Anti-symmetry, Oblique, supports Elastic supports, Axial- flexural interaction. Analysis of Composite structures having combination of different type of members.

UNIT III NONLINEAR PROBLEMS IN SOLID MECHANICS 6
Material and geometric nonlinearities, Solution techniques for nonlinear equations: Newton-Raphson method.

UNIT IV FINITE ELEMENT METHOD 12
Theory of Stresses: State of stress and strain at a point in two and three dimensions, stress and strain invariants, Hook’s law, Plane stress and plain strain problems. Equations of equilibrium, boundary conditions, compatibility conditions. Introduction and Application of FEM to One dimensional (bar & beam) problems & two dimensional problems using Constant strain triangles.

UNIT V ENERGY METHODS 9
Principle of Stationary Potential Energy, Castigliano’s Theorem of Deflection, Castigliano’s Theorem on Deflection for Linear Load-Deflection, Strain Energy for Axial Loading, Strain
Energies for Beams, Strain Energy for Torsion, Fictitious Load Method, Statistically Indeterminate Structures.

**COURSE OUTCOMES:**
At the end of the course, the student will be able to
1. Apply equilibrium and compatibility equations to determine response of statically determinate and indeterminate structures.
2. Determine placements and internal forces of statically indeterminate structures by matrix methods.
3. Understand the concept of energy methods for solving problems.
4. Identify solution techniques for non linear equations
5. Apply the theory of stress in 2 and 3 dimensions

**TEXT BOOKS:**
1. Bhavikatti; Finite Element Analysis, New Age International Publishers
2. Gere & Weaver; Matrix Analysis of framed structures, CBS Publications

**REFERENCES:**
1. Desai & Abel; Finite Element Method, Tata Mcgraw hill
2. Meghre & Deshmukh; Matrix Analysis of Structures, Charotar Publication
3. A First Course in the Finite Element Method – D. L. Logan
4. Elements of Matrix and Stability Analysis of Structures by Manicka Selvam
5. Advanced Mechanics of Solids by L.S Srinath, Mcgraw Hill.

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**AU3012**  COMPUTATIONAL AND VISUALIZATION THEORY  
**L T P C**  3 0 0 3  

**COURSE OBJECTIVES:**
The objective of this course is to provide the students a comprehensive insight into theory of computation by understanding grammar, languages and other elements of modern language design to develop capabilities to design and develop formulations for computing models

**UNIT I  AUTOMATA THEORY**  
Defining Automaton, Finite Automaton, Transitions and Its properties, Acceptability by Finite Automaton, Nondeterministic Finite State Machines, DFA and NDFA equivalence, Mealy and Moore Machines, Minimizing Automata.
UNIT II REGULAR GRAMMAR & CONTEXT FREE LANGUAGES AND PUSHDOWN AUTOMATA

Regular Grammar, Regular Expressions, Finite automata and Regular Expressions, Pumping Lemma and its Applications, Closure Properties, Regular Sets and Regular Grammar

Context Free Languages: Context-free Languages, Derivation Tree, Ambiguity of Grammar, CFG simplification, Normal Forms, Pumping Lemma for CFG

Pushdown Automata: Definitions, Acceptance by PDA, PDA and CFG

UNIT III TURING MACHINES & UNDECIDABILITY

Turing Machine Definition, Representations, Acceptability by Turing Machines, Designing and Description of Turing Machines, Turing Machine Construction, Variants of Turing Machine,


UNIT IV FOUNDATIONS FOR DATA VISUALIZATION

Introduction to Visualization – Visualization stages – Experimental Semiotics based on Perception – Gibson’s Affordance theory – A Model of Perceptual Processing – Costs and Benefits of Visualization – Types of Data.

UNIT V MULTIDIMENSIONAL VISUALIZATION


TOTAL: 45 PERIODS

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

1. Understand Grammar and Languages
2. Learn about Automata theory and its application in Language Design
3. Learn about Turing Machines and Pushdown Automata
4. Describe the stages of visualization
5. Understand Information and Scientific visualization techniques

TEXT BOOKS:

REFERENCES:
1. Theory of Computation, Kavi Mahesh, Wiley India
2. Elements of the Theory of Computation, Lewis, Papadimitriou, PHI
3. Introduction to Languages and the Theory of Computation, John E Martin, McGraw-Hill Education
4. Introduction to Theory of Computation, Michel Sipser, Thomson
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AU3013 COMPUTER INTEGRATED MANUFACTURING IN AUTOMOTIVE L T P C
SECTOR 3 0 0 3

COURSE OBJECTIVE:
The objective of this course is to make the students understand computer-integrated manufacturing (CIM) and its impact on productivity, product cost, and quality and to understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT I INTRODUCTION

UNIT II PRODUCTION PLANNING & CONTROL AND COMPUTERISED PROCESS PLANNING

UNIT III CELLULAR MANUFACTURING

UNIT IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)
UNIT V  INDUSTRIAL ROBOTICS


TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
2. Comprehend the basic elements of an automated system
3. Apply computers for process planning
4. Analyze cellular manufacturing
5. Understand Robot part programming

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AU3014  COMPUTATIONAL AERODYNAMICS

COURSE OBJECTIVES:
The objective of this course is to provide the students with knowledge in the aspects of numerical discretization techniques such as finite volume and finite difference methods to show their impact on computational aerodynamics.
UNIT I INTRODUCTION TO COMPUTATIONAL AERODYNAMICS

Need of computational fluid dynamics, philosophy of CFD, CFD as a research tool as a design tool, applications in various branches of engineering, models of fluid flow finite control volume, infinitesimal fluid element, substantial derivative physical meaning of divergence of velocity, derivation of continuity, momentum and energy equations, physical boundary conditions significance of conservation and non-conservation forms and their implication on CFD applications strong and weak conservation forms shock capturing and shock fitting approaches.

UNIT II MATHEMATICAL BEHAVIOR OF PARTIAL DIFFERENTIAL EQUATIONS AND THEIR IMPACT ON COMPUTATIONAL AERODYNAMICS

Classification of quasi-linear partial differential equations by Cramer’s rule and Eigen value method, general behaviour of different classes of partial differential equations and their importance in understanding physical and CFD aspects of aerodynamic problems at different Mach numbers involving hyperbolic, parabolic and elliptic equations: domain of dependence and range of influence for hyperbolic equations, well-posed problems.

UNIT III BASIC ASPECTS OF DISCRETIZATION


UNIT IV CFD TECHNIQUES

Lax-Wendroff technique, MacCormack’s technique, Crank Nicholson technique, Relaxation technique, aspects of numerical dissipation and dispersion. Alternating-Direction-Implicit (ADI) Technique, pressure correction technique: application to incompressible viscous flow, need for staggered grid. Philosophy of pressure correction method, pressure correction formula. Numerical procedures: SIMPLE, SIMPLER, SIMPLEC and PISO algorithms, boundary conditions for the pressure correction method.

UNIT V FINITE VOLUME METHODS

Basis of finite volume method, conditions on the finite volume selections, cell-centered and cell vertex approaches. Definition of finite volume discretization, general formulation of a numerical scheme, two dimensional finite volume method with example.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Summarize the concepts of computational fluid dynamics and its applications in industries as a tool for fluid analysis.
2. Choose the type of flow from the finite control volume and infinitesimal small fluid element for the fluid flow analysis.
3. Select the quasi linear partial differential equation for estimating the behavior in computational fluid dynamics.
5. Apply the grid generation and transformation techniques in implementation of finite difference and finite volume methods in solving complex fluid and aerodynamic problems.

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AU3015 CFD AND HEAT TRANSFER

COURSE OBJECTIVES:
The objective of this course is to enable the students to understand the various discretization methods, solution procedures and turbulence modeling to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9

UNIT II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9

UNIT III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9
Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT IV FUNDAMENTALS OF HEAT TRANSFER 9
Conduction in parallel, radial and composite wall – Basics of Convective heat transfer – Fundamentals of Radiative heat transfer – Flow through heat exchangers

UNIT V PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Derive the governing equations and boundary conditions for Fluid dynamics
2. Analyze Finite difference and Finite volume method for Diffusion
3. Investigate Finite volume method for Convective diffusion
4. Apply the concepts of heat transfer in three modes to real problems
5. Simulate the performance of heat exchangers

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AU3016 DIGITAL MANUFACTURING OF AUTOMOBILES L T P C
3 0 0 3

COURSE OBJECTIVE:
The objective of this course is to provide the students with the fundamental theoretical and practical knowledge to understand the digital manufacturing concept, a range of technologies that are capable of joining materials to make objects from 3D model data, usually layer upon layer, in a quick and easy process.

UNIT I CONCEPTION AND DEVELOPMENT OF PRODUCTS

UNIT II COMPUTER AIDED DESIGN (CAD)
3D modeling. Parametric design. Assembly modeling. Render the appearance of a product. CAD and additive manufacturing.

UNIT III COMPUTER AIDED ENGINEERING (CAE)
Finite Element Analysis (FEA) to validate functional performance: general stages of the process, solid and FEA models, materials definition, loading (loads, displacements constraints...), post-processing, results and verifications. Topology optimization.
UNIT IV REVERSE ENGINEERING
General methodology: point clouds, meshes (.stl), NURBS surface models and parametric CAD models. Digitizing methods and main technologies: applications and selection of reverse engineering systems. Hardware and software involved. Reverse engineering.

UNIT V INDUSTRIAL INTERNET OF THINGS (IIoT)

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Develop product ideas into viable products
2. Apply fundamental engineering design principles and procedures
3. Design, analysis and optimization of parts using CAD/CAM/CAE technologies;
4. Implement reverse engineering processes.
5. Understand IIOT in Manufacturing Sectors

TEXT BOOKS:

REFERENCES
5. Sabina Jeschke, Christian Brecher Houbing Song, Danda B. Rawat Editors Industrial Internet of Things Cyber Manufacturing Systems

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COURSE OBJECTIVES:
The objective of this course is to provide the students with the knowledge on properties of engineering materials so as to enable them to select and apply for automotive applications.

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

UNIT II BASIS OF MATERIAL SELECTION

UNIT III MATERIALS FOR ENGINES AND TRANSMISSION SYSTEMS
Materials selection for IC engines: Piston, piston rings, cylinder, Engine block, Connecting rod, Crank shaft, Fly wheels, Gear box, Gears, Splines, Clutches.

UNIT IV MATERIALS FOR AUTOMOTIVE STRUCTURES
Materials selection for bearings, leaf springs, chassis & frames, Bumper, shock absorbers, wind screens, panels, brake shoes, Disc, wheels, differentials, damping and antifriction fluids, Tires and tubes.

UNIT V ELECTRONIC MATERIALS FOR AUTOMOTIVE APPLICATIONS

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Develop knowledge on different class of materials and their applications
2. Understand the Selection criteria for various components and importance.
3. Comprehend different materials used for automotive engines and transmission.
4. Select proper material for Automobile applications
5. Analyze different materials used for sensors in a vehicle

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AU3018 NOISE, VIBRATION AND HARSHNESS L T P C
3 0 0 3

COURSEOBJECTIVES:
The objective of this course is to make the students understand the various types of vibration and noise along with their measurement and control techniques.

UNIT I FUNDAMENTALS OF ACOUSTICS AND NOISE, VIBRATION
9

UNIT II EFFECTS OF NOISE, BLAST, VIBRATION, AND SHOCK ON PEOPLE
9

UNIT III ENGINE NOISE AND VIBRATION—SOURCES, PREDICTION, AND CONTROL
9

UNIT IV TRANSPORTATION NOISE AND VIBRATION SOURCES-PREDICTION AND CONTROL
9

UNIT V NOISE AND VIBRATION TRANSDUCERS, ANALYSIS EQUIPMENT, SIGNAL PROCESSING, AND MEASURING TECHNIQUES
9
General Introduction to Noise and Vibration Transducers, Measuring Equipment, Measurements, Signal Acquisition, and Processing, Acoustical Transducer Principles and Types of Microphones,

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Classify the types of vibrations.
2. Identify the sources of noise in IC engines.
3. Understand the effect of vibrations and noises.
4. Control vibration and noise with suitable techniques.
5. Apply engineering techniques and tools for NVH measurements.

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AU3019 COMBUSTION THERMODYNAMICS AND HEAT TRANSFER L T P C 3 0 0 3

COURSE OBJECTIVES:
The objective of this course is to make the students to understand the kinetics of combustion and engine heat transfer.

UNIT I THERMODYNAMICS OF COMBUSTION 9
UNIT II CHEMICAL KINETICS OF COMBUSTION
Combustion kinetics, rate of reaction, equation of Arrhenius, activation energy, Chemical thermodynamic model for Normal Combustion.

UNIT III FLAMES

UNIT IV HEAT TRANSFER IN IC ENGINES

UNIT V INSTRUMENTATION
Pressure sensors-piezoelectric pickup- crank angle encoder-thermocouples. Hot wire anemometer- laser Doppler anemometry and velocimetry for flow and combustion analysis in IC engines. In- cylinder pressure measurement and Rate of heat release calculation.

TOTAL: 45 PERIODS

COURSEOUTCOMES:
At the end of the course, the student will be able to
1. Understand the principle of combustion in thermodynamics.
2. Identify the kinetics behind the chemical reaction of combustion of fuels.
3. Distinguish the flame types inside a combustion chamber.
4. Apply the principle of conduction, convection and radiation in IC engines.
5. Describe the various measuring sensors related to combustion analysis

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COURSE OBJECTIVES:
The objective of this course is to make the students to acquire knowledge on availability of possible alternate fuels and their properties to use as fuel in CI and SI engines.

UNIT I ALCOHOL FUELS

UNIT II VEGETABLE OILS

UNIT III HYDROGEN AND LPG

UNIT IV BIOGAS AND NATURAL GAS
Production methods of Biogas and Natural gas- Properties.Scrubbingof CO2 and H2S from Biogas. Modification required to use in SI and CI Engines – Performance-combustion -emission characteristics of Biogas and Natural gas in SI and CI engines.

UNIT V ELECTRIC, HYBRID AND FUEL CELL VEHICLES

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Acquire knowledge on possible alternate fuels and their properties to use as fuel in CI and SI engines.
2. Develop knowledge in all the possible ways of using alcohols as a fuel in IC engines.
3. List the challenges and difficulties in using alternative fuel in internal combustion engines.
4. Identify the uses of hydrogen as fuel in IC engines as an alternative for fossil fuels.
5. Understand the usefulness of natural acquiring gases towards IC engines.

TEXT BOOK:

REFERENCES:
COURSE OBJECTIVES:
The objective of this course is to provide the students with the theoretical and applicative knowledge in automobile test instrumentation for measuring force, torque, pressure, temperature, fluid flow, velocity and rotational speed.

UNIT I MECHANICAL MEASUREMENT
Introduction to measurements – Construction, principle, working of Instruments for measuring force, torque, pressure, temperature, fluid flow, velocity, rotational speed.

UNIT II VIBRATION AND BODY TEST
Vibration measurement instrument – accelerometer and signal conditioning. Dynamic simulation sled testing, methodology, vehicle acceleration measurement and documentation. Dolly roll over test, dolly role over fixture, photographic / video coverage. Vehicle roof strength test – Door system crush test – wind tunnel tests.

UNIT III CRASH AND BRAKE TEST
Crash tests – standards – road hazard impact test for wheel and tyre assemblies, test procedures, failure and performance criteria. Bumpers - types of tests, pendulum test, fixed collision barrier test, procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test, performance requirements.

UNIT IV ENGINE EXPERIMENTAL TECHNIQUES
I.S Code for Engine testing – Instruments for performance testing of engine, Instrumentation for measuring noise, vibration in cylinder, different types of engine tests are performed within the industry.

UNIT V VEHICLE EXPERIMENTAL TECHNIQUES
Laboratory tests- test tracks - Endurance Tests - Dynamic cornering fatigue, dynamic radial fatigue tests – procedure, bending moment and radial load calculations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Demonstrate the understanding of engine testing procedures.
2. Develop a measurement strategy for temperature, pressure, mass flow, velocity.
3. Understand sensors and instrumentation, and to analyse and interpret test data.
4. Design new instrumentation that would help in keeping the environment sustainable.
5. Identify industrial engine tests

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AU3022  TESTING AND MEASUREMENT SYSTEMS  L T P C  3 0 0 3

COURSE OBJECTIVES:
The objective of this course is to provide the students an understanding on different degree of accuracy obtained from different types of instruments and uncertainties in measurements.

UNIT I  MEASUREMENT SYSTEMS  9
Introduction to Measurement systems-static and dynamic measurement –closed and open loop system - Requirements and characteristics – Analysis of experimental detail. Error analysis-calibration of instruments

UNIT II  TRANSDUCERS, MODIFIERS AND TERMINATING DEVICE  9
Transducers for Automotive Applications – Amplifiers- filters –data Acquisition- Indicators, Printers and displays – Signal analyzer

UNIT III  MEASUREMENT SYSTEMS  9
UNIT IV  ENGINE EXPERIMENTAL TECHNIQUES  9

UNIT V  VEHICLE EXPERIMENTAL TECHNIQUES  9

TOTAL:45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Demonstrate their knowledge about different measurement method and devices used in industries.
2. Design measuring equipment’s for the measurement of pressure force, temperature and flow.
3. Generate new ideas in designing measuring instruments for automotive application.
4. Develop new system that would help in keeping the environment sustainable.
5. Interpret measurement data, to estimate measurement uncertainties.

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PROGRESS THROUGH KNOWLEDGE
COURSE OBJECTIVES:
The objective of this course is to provide the students a preliminary idea regarding some of the practices and standards followed in automobile industry for their testing and homologation.

UNIT I INTRODUCTION 9
Need of vehicle testing and homologation, Vehicle testing organizations, Hierarchy of testing: Individual component approval, System level approval and Whole vehicle approval. Type Approval & Conformity of Production tests, Approval for Safety systems (Active & Passive).

UNIT II ENGINE, FUEL SYSTEMS AND EMISSIONS TESTING 9
Laboratory testing of basic engine parameters: Measurement of BHP, IHP, Engine testing on dynamometers, different types of dynamometers hydraulic, eddy current etc., engine analyzers- for petrol and diesel engines, FIP calibrating and testing. Emission test for CO, HC, NOx, CO2, PM, etc. using exhaust gas analyzers, Spectroscopic methods, NDIR (Non Dispersive Infrared), FID (Flame Ionization Detector), chemiluminescent analyzers, Gas Chromatograph, Smoke meters. Emission testing on chassis dynamometers, Driving Cycles- USA, Japan, Euro and India. Test procedures – European driving cycles, Modified Indian Driving Cycle, SHED (Sealed Housing for Evaporative Determination) Test on chassis dynamometers.

UNIT III NOISE VIBRATION AND HARSHNESS TESTING 9
Standard noise measurement methods, Noise inside and outside the vehicle, sources of vehicle noise - intake and exhaust noise, combustion noise, mechanical noise, noise from auxiliaries, wind noises, transmission noises, brake squeal, structure noise and noise control methods. Pass by Noise testing method.

UNIT IV VEHICLE PERFORMANCE TESTING 9
Methods for evaluating vehicle performance - energy consumption in conventional automobiles, performance, and emission and fuel economy, Operation of full load and part load conditions. Gradability test, Turning circle diameter test, Steering Impact test, Steering effort test. Road and track testing: Maximum speed and acceleration, brake testing, lane changing, handling and ride characteristics. Track testing on Multi Friction Braking Track, High Speed Track, Wet skid pad, Test slopes, External noise test track, Accelerated fatigue track, Water wade, Salt-water wade, and Gravel road and off road track, Dry handling circuit, Comfort track.

UNIT V AUTOMOBILE TESTING STANDARDS 9

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Recall the need of vehicle testing and homologation.
2. Apply fundamental knowledge to measure the emissions and calculate the vehicle performance with reference to standard reference conditions.
3. Identify the testing procedures of evaluating the vehicle performance, road test and track test.
4. Understand standard procedures for vehicle certification and approval as per rules and regulations.
5. Interpret and understand various automotive testing standards.

REFERENCES:
4. Dr. N.K.Giri- Automotive technology – Khanna publishers, 2009
6. ISO Standards, ICS: 43.020, 43.040, 43.100
7. Indian emission Standards.

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AU3024 IC ENGINE PROCESS MODELING L T P C 3 0 0 3

COURSE OBJECTIVES:
The objective of this course is to provide the students with knowledge on simulation of IC engine considering the stoichiometric ratio and adiabatic flame temperature.

UNIT I INTRODUCTION TO SIMULATION

UNIT II STOICIOMETRY AND ADIABATIC FLAME TEMPERATURE
Reactive processes, Heat of reaction, measurement of URP, measurement of HRP. Introduction -combustion equation for hydrocarbon fuels. Calculation of minimum air, excess air and stoichiometric air required for combustion. Introduction, complete combustion in C-H-N-O systems, constant volume adiabatic combustion, constant pressure adiabatic combustion, calculation of adiabatic flame temperature, isentropic changes of state.
UNIT III  SI ENGINE SIMULATION

SI Engine simulation with air as working medium, deviation between actual and ideal cycle. Fuel air cycle analysis - Temperature drop due to fuel vaporization, full throttle operation, work output and efficiency calculation, part-throttle operation, engine performance at part throttle, super charged operation. SI Engines simulation with progressive combustion. Models for mass burnt fraction.

UNIT IV  SI ENGINE SIMULATION WITH GAS EXCHANGE PROCESS

Introduction, gas exchange process, Heat transfer process, friction calculations, compression of simulated values, validation of the computer code, engine performance simulation, pressure crank angle diagram, brake power, brake thermal efficiency, effect of speed on performance.

UNIT V  CI ENGINE SIMULATION


TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Acquire knowledge on simulation of IC engine components.
2. Apply the principle of the stoichiometric ratio and adiabatic flame temperature.
3. Develop a simulation model for SI and CI engine.
4. Understand the concept of gas exchange process in SI engine.
5. Perform parametric studies on simulated engine performance.

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:
The objective of this course is to provide the students with knowledge on various agricultural vehicles like Farm Machinery and Tractor.

UNIT I TRACTORS

UNIT II FARM MACHINERY DESIGN
Research and development procedure; Basic design principals of farm machines, implements and tools. Design of various components for performance, strength, and wear. Selection of materials of construction. Design of power transmission of elements, bearings, controls and safety devices. Application of design in primary tillage implements, secondary tillage implements, seed drill, planter, harvesting and threshing machine and its components. Reliability criteria in design.

UNIT III TRACTOR DESIGN PRINCIPLES

UNIT IV FARM MACHINERY DYNAMICS, NOISE AND VIBRATION
Tractor chassis mechanics, hitching systems, 3-point hitch linkage design, hydraulic control of tractors, Determination of CG and moment of inertia, Dynamic stability and tractive ability of tractor, Tire selection. Ergonomics in tractor system design, noise and vibration effects, Design of operators’ seat and suspension, work-place area and controls, Strain gauges and instruments for the measurement of tractor engine power, torque, fuel consumption, draft and drawbar power, Precision agriculture, sensors, GPS, GIS, Variable rate applications.

UNIT V PRECISION FARMING MACHINERY TECHNIQUES

COURSE OUTCOMES:
At the end of the course, the student will be able to
- Understand the fundamentals of Agricultural Vehicles.
- List the tools and techniques used in Agricultural vehicles.
- Explain the design of the farm machinery.
- Identify the implementation and challenges in precision farming machinery techniques.
- Evaluate continuous improvement methods.

TOTAL = 45 PERIODS
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AU3026
DEFENCE VEHICLES
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COURSE OBJECTIVES:
The objective of this course is to provide the students with knowledge of defence and combat Vehicles.

UNIT I COMBAT VEHICLE ENGINEERING
Engineering principles to the design of combat systems with emphasis on detection, tracking, and identification systems, Vehicle Configuration, Man Machine Interface, Sensor technologies (radars, ESM, active and passive sonar, infrared, electro-optical, and magnetic/electric/gravity field sensors). Selection and design for military vehicles.

UNIT II AEROSPACE PROPULSION

UNIT III NAVAL TECHNOLOGY
Introduction of naval combat systems, Integration of naval combat systems, Detection, engagement, and control elements interact with each other and on how to combine them into an efficient and survivable combat system, System-oriented approach to integrating the principles of Naval Architecture and Marine Engineering in the design of ship subsystems.

UNIT IV COMMUNICATION SYSTEMS AND SENSORS
Introduction to RADAR, Radar parameters/definitions, radar equations, Radar cross section (RCS) & Theory of detection, Clutter. Atmospheric propagation, Surveillance and Tracking Radar, Radar
Designs. Free space optical communication, Fiber optics communication, Wireless/cellular communications.

**UNIT V**

**HIGH ENERGY MATERIALS TECHNOLOGY**

9

Understanding of high energy materials from theoretical and practical standpoints, to formulate the bases for evaluating competitive and alternative high energy material systems, High energy materials physics and chemistry. Molecular energetic of the high energy materials molecule including molecular orbital and valence bonding and resonance stabilization

**TOTAL : 45 PERIODS**

**OUTCOMES:**
At the end of the course, the student will be able to
1. Understand the fundamentals of combat vehicle engineering.
2. Indentify the tools and techniques used in naval technology.
3. Describe the communication systems and sensors.
4. Aalayze high energy materials technology.
5. Apply the principles of basis thermodynamics & fluid Dynamic in defence vehicle

**REFERENCES / SUGGESTED BOOKS:**
4. “Rocket Propulsion Elements”, by George Paul Sutton and Oscar Biblarz. Publisher: John Wiley & Sons
9. “Shock Waves Science and Technology Library, Detonation Dynamics- Vol. 6,” by Zhang F. Publisher : Springer

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COURSE OBJECTIVE:
The objective of this course is to provide the students with knowledge on the various features of the constructional vehicles and their systems.

UNIT I  INTRODUCTION AND EQUIPMENT COST  9
Selection of equipment for earth work - earth moving operations - types of earthwork equipment-tractors, motor graders, scrapers, front end waders, earth movers

UNIT II  DOZERS AND SCRAPERS  9
Dozers types- crawler bulldozer, wheel bulldozer, mini bulldozer, straight blades (s-blade),universal blade (u-blade), s-u (semi-u) blade, angle blade.scrapers types- single-engine wheeled, dual-engine wheeled, elevating, and pull-type scrapers.

UNIT III  EARTH MOVING CONSTRUCTIONAL MACHINES-TRUCKS AND HAULING EQUIPMENT.  9
Dumpers - safety features, safe warning system for dumper , design aspects on dumper body,articulated dumpers, loaders - single bucket, multi bucket and rotary types - bulldozers,kine\[...\]kinematics for loader and bulldozers with operational linkages, excavators, backhoe loaders,scrapers, motor graders, power shawl, bush cutters, bush cutters, stumpers, rippers--transporters

UNIT IV  VEHICLE SYSTEMS & ADVANCE FEATURES.  9
Brake system and actuation – disc caliper brakes. Body hoist and bucket operational hydraulics.hydro-pneumatic suspension cylinders. power steering system. articulated steering assembly -power and capacity of earth moving machines.

UNIT V  OFF-THE-ROAD TIRES AND TRACKS  9
Types of off-the-road tires, transport for earthmoving machines, work for slow moving earthmoving machines, and load and carry for transporting- digging. off-highway tires have sixcategories of service compactor, earthmover, grader, loader, log-skidder and mining and logging.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. List the various earth moving operations
2. Identify the types of dozers
3. Understand the construction, working and applications of various earth moving operations
4. Analyze the types and use of off road tires
5. Appreciate the concept of hydraulics and pneumatics
TEXT BOOKS
3. Nakra C.P., "Farm machines and equipments" Dhanparai Publishing company Pvt. Ltd.

REFERENCES:
1. Bart H Vanderveen,; Tanks and Transport Vehicles Frederic Warne and Co Ltd.London..

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AU3028 MARINE VEHICLES

COURSE OBJECTIVES:
The objective of this course is to provide the students with a basic knowledge about various types, design and development of marine vehicles.

UNIT I    MARINE VEHICLES
Types – general – by function – commercial marine vehicles- passenger ship, cargo ships, oil and chemical tankers , cattle carriers, harbor crafts, off shore platform, container ships, reefers and gas carriers,

UNIT II   REMOTELY OPERABLE VEHICLE (ROV), UMS SHIPS

UNIT III  MANNED AND UN MANNED SUBMERSIBLE
UNIT IV  MOTION OF SHIPS & FLOATING SYSTEMS  9
Ship motions – co-ordinate systems, 6 dof, uncoupled and coupled equation of motion; hydrodynamic coefficients; wave excitation – summary of wave theory, dispersion relation, wavepressure, velocity, acceleration; encounter frequency; motion damping effects, magnification and tuning factors. Ship responses in regular waves. Ship controllability fundamentals – the control loop, motion stability, linear equations of motion, stability indices; Stability and control in the horizontal and vertical planes

UNIT V  MARINE POWER PLANT  9
Marine Diesel Engines – Low speed and medium speed engines – Auxiliary engines – Marine Nuclear power installation - Principles of operation of Atomic Reactors – Different types of Reactors – Use of Nuclear reactors in sea going vessels Marine Turbines – Steam turbine Classification based on impulse and reaction principles – Flow thro’ blade passages ,Marine gas turbines – Practical cycles and shaft arrangements - Power turbine – Applications

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Identify various marine vehicles based on their function
2. Understand the concept of remote and under water operated vehicles
3. Differentiate manned and un manned submarines
4. Analyze the motion of floating systems
5. Describe the requirement of marine power plant
6. Students will be able understand the types of marine vehicles
7. Students should get a preliminary knowledge in marine vehicle design, construction and its components

TEXT BOOKS:
1. Jonathan M. Ross, human factors for naval marine vehicle design and operation
3. R. Frank Busby, Manned Submersibles, Office of the oceanographer of the Navy, 1976

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COURSE OBJECTIVES:
The objective of this course is to provide the students to understand the basic space vehicles, manufacturing techniques and to provide the concepts of propulsion, dynamics & controls.

UNIT I UNDERSTANDING FLIGHT – LIGHTER-THAN-AIR & HEAVIER-THAN-AIR

UNIT II MATERIALS, MODELS AND MANUFACTURING TECHNIQUES

UNIT III PROPULSION, DYNAMICS & CONTROLS

UNIT IV STRUCTURAL DESIGN & PERFORMANCE OPTIMIZATION

UNIT V FUTURE DIRECTIONS & RESEARCH AREAS IN SPACE VEHICLES
Reusable vehicles, Space debris reduction, Green propellants, Space robotics, Inter-planetary travel vehicles

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Understand the concept of flight design
2. Apply Materials, Models and Manufacturing techniques for space applications
3. Examine the Propulsion, Dynamics & Controls devices
4. Optimize the design and performance of Jet Propulsion systems.
5. Identify research areas in Space Propulsion.

TEXT BOOKS:
5. Flight without formulae – A.C.Kermode
6. Stick and Rudder: An Explanation of the Art of Flying: Wolfgang Langewiesche
7. Ignition!: An informal history of liquid rocket propellants: John Drury Clark
8. Skyriders - The story of human space flight: P.Sasikumar&B.Arvind
REFERENCES:
1. Aircraft Design: A Conceptual Approach by Daniel P. Raymer
5. Aircraft Structures for Engineering Students (Paperback)

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COURSE OBJECTIVES:
1. To understand the basics of drone concepts
2. To learn and understand the fundamentals of design, fabrication and programming of drone
3. To impart the knowledge of flying and operation of drone
4. To know about the various applications of drone
5. To understand the safety risks and guidelines of fly safely

UNIT I INTRODUCTION TO DRONE TECHNOLOGY
Drone Concept - Vocabulary Terminology - History of drone - Types of current generation of drones based on their method of propulsion - Drone technology impact on the businesses - Drone business through entrepreneurship - Opportunities/applications for entrepreneurship and employability

UNIT II DRONE DESIGN, FABRICATION AND PROGRAMMING
Classifications of the UAV - Overview of the main drone parts - Technical characteristics of the parts - Function of the component parts - Assembling a drone - The energy sources - Level of autonomy - Drones configurations - The methods of programming drone - Download program - Install program on computer - Running Programs - Multi rotor stabilization - Flight modes - Wi-Fi connection.

UNIT III DRONE FLYING AND OPERATION
Concept of operation for drone - Flight modes - Operate a small drone in a controlled environment - Drone controls - Flight operations - management tool - Sensors - Onboard storage capacity - Removable storage devices - Linked mobile devices and applications
UNIT IV DRONE COMMERCIAL APPLICATIONS

Choosing a drone based on the application - Drones in the insurance sector - Drones in delivering mail, parcels and other cargo - Drones in agriculture - Drones in inspection of transmission lines and power distribution - Drones in filming and panoramic picturing

UNIT V FUTURE DRONES AND SAFETY

The safety risks - Guidelines to fly safely - Specific aviation regulation and standardization - Drone license - Miniaturization of drones - Increasing autonomy of drones - The use of drones in swarms

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Know about a various type of drone technology, drone fabrication and programming.
CO2: Execute the suitable operating procedures for functioning a drone
CO3: Select appropriate sensors and actuators for Drones
CO4: Develop a drone mechanism for specific applications
CO5: Create the programs for various drones

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TEXT BOOKS


REFERENCES

COURSE OBJECTIVES
The objective of this course is to educate the students regarding the Product Design Phases of an automobile and to familiarize them with the procedures of Design Phases.

UNIT I PRODUCT PLANNING AND CONCEPT PHASE

UNIT II SYSTEM LEVEL DESIGN

UNIT III PROTOTYPING AND VALIDATION

UNIT IV DATA RELEASE FOR MANUFACTURING

UNIT V PILOT PRODUCTION AND RAMP-UP
Manufacturing Tooling readiness – Pilot Production – CFT Sign-off for SOP – Start of Production – Production Ramp-up

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Acquire the knowledge of Automotive Product design techniques.
2. Design and develop a new vehicle model.
3. Understand the importance of various design phases.
4. Identify the product design procedure
5. Apply the principles for pilot production

TEXT BOOKS:

REFERENCES:
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COURES OBJECTIVES:
The objective of this course is to educate the students regarding the importance of ergonomics of an automobile and its impact on driver fatigue.

UNIT I  FUNDAMENTALS OF ERGONOMICS
Introduction- principles – applications- Dimension Determination, Anthropometry – Need, Data collection methodology, Different postural considerations -Recent developments in ergonomics and styling.

UNIT II  ERGONOMICS FOR SEATING
seating dimensions- interior ergonomics- seat comfort - suspension seats - split frame seating - back pain reducers- driver & pillion seating arrangement dash board instruments - electronic displays - commercial vehicle cabin ergonomics-mechanical package layout - goods vehicle layout.

UNIT III  ERGONOMICS FOR VISIBILITY
Regulations- driver’s visibility- tests for visibility- methods of improving visibility and space- Dash board equipments and arrangement., mirror and cockpit design.

UNIT IV  ERGONOMICS FOR FRAMES AND BODY
Types of frame, construction, loads, design consideration, materials, ergonomics & comfort, Positioning of operational controls, Types of three wheeler bodies, layout, RTO regulations, aerodynamic, aesthetic & ergonomics considerations for body work.

UNIT V  VEHICLE ERGONOMICS:
Passenger Compartment, Floor Pan, Vehicle interior ergonomics, ergonomics system design, Technical requirements, Force Analysis, Seating and position – ECE Regulations, Human Factors, Navigation systems, pedal positioning Crash tests, forces in rollover, head on impact.

TOTAL: 45 PERIODS

COURSES OUTCOMES:
At the end of the course, the student will be able to
1. Possess the knowledge of various ergonomic techniques.
2. Design and develop a new styling in a given vehicle model.
3. Understand the importance of ergonomics in reducing the driver fatigue.
4. Explain the role of ergonomics in look and safe operation of the vehicle.
5. Apply the Knowledge in mirror design and logical formation of cockpit.

TEXT BOOKS:

AU3031  ERGONOMICS IN AUTOMOTIVE DESIGN  L T P C
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**REFERENCES:**

### AU3032 VEHICLE CONTROL SYSTEMS

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**COURSE OBJECTIVES:**
The objective of this course is to make the students to understand the basics of control system used in automobiles

**UNIT I INTRODUCTION TO VEHICLE CONTROL SYSTEM**
- Trends, overview and examples of vehicle control system- Sensors, actuators and controller modules-Vehicle communication Network-System Engineering V-diagram- Algorithm Development-
- Steps in vehicle control system design- Degree of freedom for vehicle control- selection of controlled, manipulated, measured disturbance variables- classification of the variables in various automotive systems like engines, suspension, braking, air conditioning – General types of vehicle controller configurations- Feedback, Inferential, Feed-Forward, Ratio control.

**UNIT II CONTROL SCHEMES, CRUISE AND HEADWAY CONTROL**
- Feed - Forward control - Cascade control- Design considerations for cascade control, Time delay compensation, Inferential control- Nonlinear control- Adaptive control etc. Cruise control design-

**UNIT III DRIVER MODELING AND POWERTRAIN CONTROL SYSTEMS**
- Driving simulators- percentage of road departure- Driver modeling- Transfer function models-
- Preview/ Predictive models- longitudinal driver models Control oriented engine modeling- Air intake model- Fuel dynamics model- Air Fuel ratio dynamics- Engine Control Loops- Air Fuel Ratio control-
- EGR Control- Spark Timing control- Idle speed control- Knock control-Adaptive knock control-
- Combustion torque estimation- Transmission control.

**UNIT IV CONTROL OF HYBRID AND FUEL CELL VEHICLES**
-
UNIT V  HUMAN FACTORS AND INTELLIGENT TRANSPORT SYSTEM

Human factors in vehicle automation- cross over model principle- Risk- Homeostatic Theory- Driving simulators- percentage of road departure Advanced traffic management system- Advanced traveller information system- commercial vehicle operation- Advanced vehicle control system- Preventing collisions- Longitudinal motion control and platoons- Site specific information comparison of longitudinal control approaches- String stability- Automated steering and lateral control – Lane sensing- automated lane change and follow control.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the student will be able to
1. Understand the basics of control system used in automobiles
2. Recognize the electronically controlled system used in driving mechanics.
3. Understand the working principle of driver modelling and power train control systems.
4. Identify the control system used in hybrid and electrical vehicles.
5. Illustrate the need of automated transport systems.

TEXT BOOKS:

REFERENCES:

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CME339  ADDITIVE MANUFACTURING

COURSE OBJECTIVES:
- To introduce the development of Additive Manufacturing (AM), various business opportunities and applications
- To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.
- To be acquainted with vat polymerization and direct energy deposition processes
- To be familiar with powder bed fusion and material extrusion processes.
To gain knowledge on applications of binder jetting, material jetting and sheet lamination processes.

UNIT I INTRODUCTION

UNIT II DESIGN FOR ADDITIVE MANUFACTURING (DfAM)

UNIT III VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION

UNIT IV POWDER BED FUSION AND MATERIAL EXTRUSION

UNIT V OTHER ADDITIVE MANUFACTURING PROCESSES

ADDITIVE MANUFACTURING LABORATORY
Experiments
1. Modelling and converting CAD models into STL file.
3. Design and fabrication of parts by varying part orientation and support structures.
4. Fabrication of parts with material extrusion AM process.
5. Fabrication of parts with vat polymerization AM process.
6. Design and fabrication of topology optimized parts.

Equipment required - lab
1. Extrusion based AM machine
2. Resin based AM machine
3. Mechanical design software
4. Open-source AM software for STL editing, manipulation and slicing.

COURSE OUTCOMES:
At the end of this course students shall be able to:
CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.

CO2: Acquire knowledge on process of transforming a concept into the final product in AM technology.

CO3: Elaborate the vat polymerization and direct energy deposition processes and its applications.

CO4: Acquire knowledge on process and applications of powder bed fusion and material extrusion.

CO5: Evaluate the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.

TEXT BOOKS:

REFERENCES:

AU3033 \textbf{FINITE ELEMENT ANALYSIS} \begin{tabular}{cccc} \hline L & T & P & C \hline 3 & 0 & 0 & 3 \hline \end{tabular}

\begin{center} \textbf{COURSE OBJECTIVES:} \end{center}

The objective of this course is to make the students to understand and perform engineering analysis of structural members using FEM.

\begin{center} \textbf{UNIT I \hspace{0.5cm} INTRODUCTION} \hspace{1.5cm} \begin{tabular}{c} 9 \end{tabular} \end{center}


\begin{center} \textbf{UNIT II \hspace{0.5cm} DISCRETE ELEMENTS} \hspace{1.5cm} \begin{tabular}{c} 9 \end{tabular} \end{center}


\begin{center} \textbf{UNIT III \hspace{0.5cm} CONTINUUM ELEMENTS} \hspace{1.5cm} \begin{tabular}{c} 9 \end{tabular} \end{center}

Plane stress, Plane strain and axisymmetric problems, constant and linear strain, triangular elements, stiffness matrix, axisymmetric load vector. Computer codes for CST and LST elements.

\begin{center} \textbf{UNIT IV \hspace{0.5cm} ISOPARAMETRIC ELEMENTS} \hspace{1.5cm} \begin{tabular}{c} 9 \end{tabular} \end{center}
Definitions, Shape function for 4, 8 and 9 nodal quadrilateral elements, Stiffness matrix and consistent load vector.

**UNIT V MODAL ANALYSIS**


**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

At the end of the course, the student will be able to

- Understand and perform engineering analysis of structural members using FEM.
- Demonstrate the ability to evaluate and interpret FEA analysis results for design and evaluation purposes
- Develop computer codes for FEM Elements.
- Derive the characteristics equation of Iso parametric elements.
- Apply knowledge towards Modal analysis in a vibrating element analytically.

**TEXT BOOKS:**


**REFERENCES:**


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CO3034 NEW PRODUCT DEVELOPMENT PROCESS

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**COURSES OBJECTIVES:**
The objective of this course is to make the students to understand the importance of product design on cost frame and need of the customer.

UNIT I INTRODUCTION
Need for developing products – the importance of engineering design – types of design – the design process – relevance of product lifecycle issues in design – designing to codes and standards – societal considerations in engineering design – generic product development process – various phases of product development–planning for products – establishing markets – market segments – relevance of market research.

UNIT II CUSTOMER NEEDS

UNIT III CREATIVE THINKING

UNIT IV DECISION MAKING AND PRODUCT ARCHITECTURE

UNIT V DESIGN AND COST ANALYSIS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Introduce the importance of product design
2. Describe the needs of a customer towards a product
3. Initiate the idea of creativeness on product
4. Understand the decision-making concepts.
5. Design a product based on cost frame and need of the customer.

TEXT BOOKS:

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AU3035 AUTOMOTIVE PRODUCT LIFE CYCLE MANAGEMENT L T P C

OBJECTIVES:
The objective of this course is to make the students to become familiar with the new product design and development with lifecycle management to industry needs.

UNIT I MOTIVATION AND INTRODUCTION 9
E-commerce, B to B, B to C forms of business, extended enterprise, concepts in PDM - product life cycle, business objects, work flows, versions, views, product structure, change processes, work list, information flow model in product development, engineering bill of materials and manufacturing bill of materials.

UNIT II COMPONENTS OF PLM SOLUTIONS 9
Object oriented approach in product development solutions, phase gate process in product design - disparate databases and connectivity, use of EAI technology (middleware) - cases for preparation of combined BOM and other reports. Component supplier management and sourcing.

UNIT III PRODUCT VISUALISATION 9
CAD neutral environment and visualization of products, standard software, use of visualization in several stages of lifecycle, reviews, mark-up - case studies.

UNIT IV ROLE OF PLM IN INDUSTRIES 9
Automotive sectors, ten step approach to PLM- Status Review, Data Gathering, Executive Education and Awareness ; Best Practice Positioning ; PLM Concept Generation and Analysis ; PLM Roadmap and Plan Generation Business Benefits and Business Case Development ; ROI Calculation ; Management Report Preparation ; Executive Presentation ; 1. Executive Decision Support- benefits of PLM.

UNIT V DETAILS OF MODULE 9
Details of modules in a PDM/PLM software, basics on customization and implementation of automotive PDM/PLM software.

COURSE OUTCOMES:
At the end of the course, the student will be able to
1. Understand the product lifecycle management in an automotive industry
2. Classify the suitable PLM components for OEMS’s and Tier-I industry.
3. Visualize new product design and styling
4. Identify several stages of lifecycle

TOTAL: 45 PERIODS
5. Appreciate the application of E-commerce

TEXT BOOKS:

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CAU332 DYNAMICS OF GROUND VEHICLES

COURSE OBJECTIVES:
The objective of this course is to make the students to develop physical and mathematical models to predict the dynamic response of vehicles.

UNIT I CONCEPT OF VIBRATION

UNIT II TYRES

UNIT III VERTICAL DYNAMICS

UNIT IV LONGITUDINAL DYNAMICS AND CONTROL
Aerodynamic forces and moments. Equation of motion. Load distribution for three-wheeler and four-wheeler. Calculation of maximum acceleration, tractive effort and reaction forces for different drive

UNIT V  LATERAL DYNAMICS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the students can able to
1. Develop physical and mathematical models to predict the dynamic response of vehicles
2. Apply vehicle design performance criteria and how to use the criteria to evaluate vehicle dynamic response
3. Use dynamic analyses in the design of vehicles.
4. Understand the principle behind the lateral dynamics.
5. Evaluate the longitudinal dynamics and control in an automobile

TEXT BOOKS:

REFERENCES:

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NON VERTICAL : GROUP 1

AU3041 ENGINE AND VEHICLE MANAGEMENT SYSTEMS L T P C 3 0 0 3

OBJECTIVE:
- To explain the principle of engines and vehicle electronic management system and different sensors used in the systems.

UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 9
Microprocessor architecture, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI engines and in the other parts of the automobile.

UNIT II SENSORS  9
Inductive, Hall effect, hot wire, thermistor, piezo electric, piezoresistive, based sensors. Throttle position, mass air flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque, fuel level, crash, exhaust oxygen level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure sensors, gyro sensors.

UNIT III SI ENGINE MANAGEMENT  9

UNIT IV CI ENGINE MANAGEMENT  9

UNIT V VEHICLE MANAGEMENT SYSTEMS  9

OUTCOME:
At the end of the course, the student will understand the role of various sensor, its construction and working principle and it influence in controlling pollution, enhancing safety of the vehicle.

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
- The students are able to manage a transport fleet and their related activities for minimizing operational cost.

UNIT I  INTRODUCTION  9
Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

UNIT II  TRANSPORT SYSTEMS  9
Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. chain of responsibility, forms of ownership by state, municipality, public body and private undertakings.

UNIT III  SCHEDULING AND FARE STRUCTURE  9
Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling.

UNIT IV  MOTOR VEHICLE ACT  9
Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.

UNIT V  MAINTENANCE  9
Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy. Design of bus depot layout.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, students will
- Describe different aspects related to transport system and management.
- List the features of scheduling, fixing the fares
- Know about the motor vehicle act and maintenance aspects of transport.

TEXT BOOKS:

REFERENCE:
1. Government Motor Vehicle Act, Publication on latest act to be used as on date
OBJECTIVE:
• To know about the various methods of maintaining vehicles and their subsystems.

UNIT I MAINTENANCE, WORKSHOP PRACTICES, SAFETY AND TOOLS 9

UNIT II ENGINE AND ENGINE SUBSYSTEM MAINTENANCE 9
General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management service - fault diagnosis- servicing emission controls

UNIT III TRANSMISSION AND DRIVELINE MAINTENANCE 9
Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, transaxle- road testing- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

UNIT IV STEERING, BRAKE, SUSPENSION, WHEEL MAINTENANCE 9
Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, Parking brake. Bleeding of brakes. Inspection, Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steering linkage, steering column, Rack and pinion steering, Recirculating ball steering service- Worm type steering, power steering system

UNIT V AUTO ELECTRICAL AND AIR CONDITIONING MAINTENANCE 9
Maintenance of batteries, starting system, charging system and body electrical - Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection- AC Charging- Fault diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

TOTAL : 45 PERIODS

OUTCOME:
• Upon the completion of the course, the student can able to understand the importance of maintenance and also the step by step procedure for maintain the various automotive sub systems

TEXT BOOKS:
2. Vehicle Service Manuals of reputed manufacturers

REFERENCE:
AU3044 TWO AND THREE WHEELERS

OBJECTIVE:
- The aim of this course is to make the students to know and understand the constructional details operating characteristics and vehicle design aspects.

UNIT I THE POWER UNIT
Two stroke and four stroke SI & CI engine Construction and Working, merits and demerits, Symmetrical and unsymmetrical valve & port timing diagrams. Scavenging process.

UNIT II FUEL AND IGNITION SYSTEMS
Fuel system – Different circuits in two wheeler fuel systems, fuel injection system. Lubrication system, Ignition systems - Magneto coil and battery coil spark ignition system, Electronic ignition System, Starting system - Kick starter system – Self starter system. Recent technologies.

UNIT III CHASSIS AND SUB-SYSTEMS
Main frame for two and three wheelers, its types, Chassis and different drive systems for two wheelers, Single, multiple plates and centrifugal clutches, Gear box and its and various gear control in two wheelers. Front and rear suspension systems, Shock absorbers, Panel meters and controls on handle bar, Freewheeling devices.

UNIT IV BRAKES AND WHEELS

UNIT V TWO & THREE WHEELERS – CASE STUDY
Case study of Sports bike, Motor cycles, Scooters and Mopeds - Auto rickshaws, Pick up van, Delivery van and Trailer. Servicing and maintenance. Recent developments.

TOTAL : 45 PERIODS

OUTCOME:
- The students can able to understand the various subsystem of two and three wheeler and also know how it is different from light motors and heavy motor vehicles.

TEXT BOOK:

REFERENCES:
1. Bryaut, R.V., Vespa "Maintenance and Repair series".

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CIE362 ENTREPRENEURSHIP DEVELOPMENT L T P C 3 0 0 3

OBJECTIVES:
- To understand of the scope of an entrepreneur
- To study the concepts of key areas of development
- To analyse the financial assistance by the institutions
- To learn the basic concepts of methods of taxation and tax benefits
- To understand the concepts of support to entrepreneur

UNIT I ENTREPRENEURSHIP 9

UNIT II MOTIVATION 9

UNIT III BUSINESS 9

UNIT IV FINANCING AND ACCOUNTING 9

UNIT V SUPPORT TO ENTREPRENEURS 9

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Understanding of the scope of an entrepreneur
CO2: Studying the concepts of key areas of development
CO3: Analyzing the financial assistance by the institutions
CO4: Learning the basic concepts of methods of taxation and tax benefits
CO5: Understanding the concepts of support to entrepreneur

**CO’s- PO’s & PSO’s MAPPING**

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**TEXT BOOKS:**

**REFERENCES:**

**CSF331 DISASTER MANAGEMENT**

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**OBJECTIVES:**
CO1: Provide students an exposure to disasters, their significance and types.
CO2: Ensure that students begin to understand the relationship between Vulnerability, Disasters, Disaster prevention and risk reduction.
CO3: Study a preliminary understanding of approaches of Disaster Risk Reduction (DRR).
CO4: Enhance awareness of institutional processes 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.
UNIT I INTRODUCTION TO DISASTERS

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 II APPROACHES TO DISASTER RISK REDUCTION (DRR)

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- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority (SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, Embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmers And legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS

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, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

COURSE OUTCOMES:

Student will be able to

CO1Differentiate the types of disasters, causes and their impact on environment and Society

CO2Assess vulnerability and various methods of risk reduction measures as well as Mitigation.

CO3Draw the hazard and vulnerability profile of India, Scenarios in the Indian context. Know the Disaster damage assessment and management.

CO4Awareness of institutional processes in the country and to develop rudimentary

CO5Ability to respond to their surroundings with potential disaster response in areas where they live. Complete preparedness, response and recovery in order to reduce the impact of Disasters.

TEXT BOOKS:


REFERENCES

**CO’s – PO’s & PSO’s MAPPING**

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**AU3036** ADVANCE THEORY OF IC ENGINES L T P C 3 0 0 3

**OBJECTIVES:**
- Knowledge in usage of software for simulating the performance of IC engines
- Acquiring ability to simulate the various types combustion processes of IC engines.
- Knowledge in performance simulation of IC engines.

**UNIT I** COMBUSTION OF FUELS 9

**UNIT II** ENGINE CYCLE ANALYSIS 9
Ideal air, fuel air cycle and actual cycle analysis. Progressive combustion analysis in SI engines. Parametric studies on work output, efficiency and other engine performance.

**UNIT III** COMBUSTION MODELLING 9

**UNIT IV** NON-CONVENTIONAL IC ENGINES 9

**UNIT V** COMBUSTION ANALYSIS IN IC ENGINES 9
Photographic studies of combustion processes – Analysis of Pressure crank angle diagrams in SI and CI engines. Knock study for Pressure crank angle histories. Apparent heat release rate and Wiebe’s law analysis for combustion. Calculation of Ignition delay and combustion duration. — Hot wire andlaser Doppler anemometry and velocimetry for flow and combustion analysis in IC engines.
engines.

TOTAL : 45 PERIODS

OUTCOME:
- At the end of the course, the student can able to model and simulate the engine cycle, perform combustion analysis, instruments used in measurement, recent developments in the IC engines.

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IE3491 OPERATIONS RESEARCH

COURSE OBJECTIVES:
- Provide knowledge of optimization techniques and approaches.
- Formulate a real-world problem as a mathematical programming model.
- Enable the students apply mathematical, computational and communication skills needed for the practical utility of Operations Research.
- Knowledge to solve networking problems.
- Knowledge to solve various inventory problems.
- Gain knowledge on solving different waiting line models.

UNIT I LINEAR PROGRAMMING

UNIT II ADVANCES IN LINEAR PROGRAMMING

UNIT III NETWORK ANALYSIS
Transportation problems: Northwest corner rule, least cost method, Vogel's approximation
UNIT IV INVENTORY MODELS
Purchase model with no shortages – Manufacturing model with no shortages - Model with price breaks - Reorder point model - Probabilistic inventory model

UNIT V QUEUING THEORY
Queueing theory terminology – Single server, multi server- limited and unlimited queue capacity- limited and unlimited population –limited and infinite queue length.

COURSE OUTCOMES:
CO1: Learned to translate a real-world problem, given in words, into a mathematical Formulation.
CO2: An understanding of the role of algorithmic thinking in the solution of operations research problems.
CO3: Be able to build and solve Transportation Models and Assignment Models, maximal flow problem, minimum spanning tree and shortest path problem.
CO4: Able to handle issues in various Inventory models.
CO5: The students acquire capability in applying and using of queuing models for day today problem

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TEXT BOOKS:

REFERENCES:

UNIT I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS
1. To provide the knowledge on the working principles of fluid power systems.
2. To study the fluids and components used in modern industrial fluid power system.
3. To develop the design, construction and operation of fluid power circuits.
4. To learn the working principles of pneumatic power system and its components.
5. To provide the knowledge of trouble shooting methods in fluid power systems.

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, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits, –Servo and Proportional valves – Applications- Mechanical, hydraulic servo systems.

UNIT – IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS

UNIT – V TROUBLE SHOOTING AND APPLICATIONS
Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics
Note: (Use of standard Design Data Book is permitted in the University examination)

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course the students would be able to
1. Apply the working principles of fluid power systems and hydraulic pumps.
2. Apply the working principles of hydraulic actuators and control components.
3. Design and develop hydraulic circuits and systems.
4. Apply the working principles of pneumatic circuits and power system and its components.
5. Identify various troubles shooting methods in fluid power systems.

TEXT BOOKS:

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

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

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

UNIT II ZERO DIMENSIONAL NANOMATERIALS

UNIT III ONE DIMENSIONAL NANOMATERIALS


UNIT IV SUPER HARD COATINGS AND BULK NANOSTRUCTURED MATERIALS
Superhard coating – types – characteristics – thermal stability – case studies (nc-TiN/a-Si3N4 coating) – Applications.
Buck nanostructure formation – Equal Channel angular pressing (ECAP) – High pressure torsion (HPT), Accumulative roll bending – Reciprocating extrusion - compression, cyclic close die forging – Repetitive corrugation and straightening – Grain refinement mechanisms.

UNIT V  CHARACTERIZATION OF NANOMATERIALS

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

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CAU331  INTELLECTUAL PROPERTY RIGHTS  L T P C
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COURSE OBJECTIVES:
- To understand the basic concepts of IPR
- To learn the basic concepts of Registrations of IPRs
- To study the concepts of Agreements and Legislations
- To apply the knowledge of digital products and law
- To apply the concepts of enforcement of IPRs
UNIT I  INTRODUCTION

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO – TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II  REGISTRATION OF IPRs

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad.

UNIT III  AGREEMENTS AND LEGISLATIONS


UNIT IV  DIGITAL PRODUCTS AND LAW


UNIT V  ENFORCEMENT OF IPRs

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL :45 PERIODS

COURSE OUTCOMES:
CO1: Understanding the basic concepts of IPR
CO2: Learning the basic concepts of Registrations of IPRs
CO3: Studying the concepts of Agreements and Legislations
CO4: Applying the knowledge of digital products and law
CO5: Applying the concepts of enforcement of IPRs

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COURSE OBJECTIVES:

i. To learn the basics of fluid mechanics on vehicle motion.
ii. To expose to the shape optimization techniques followed in passenger car industry.
iii. To relate the influence of rolling resistance and air resistance of various commercial vehicles upon drag force.
iv. To interpret the relation between motorcycle shape and coefficient of drag.
v. To give insight to wind tunnel and road testing techniques practiced in industry.

UNIT I  SCOPE OF ROAD VEHICLE AERODYNAMICS


UNIT II  AIR RESISTANCE ON PASSENGER CARS


UNIT III  AERODYNAMIC DRAG ON COMMERCIAL VEHICLES


UNIT IV  MOTORCYCLE AERODYNAMICS


UNIT V  WIND TUNNELS, MEASUREMENT AND TEST TECHNIQUES


COURSE OUTCOMES:

i. Knowledge upon the forces & moments influencing drag.
ii. Solve exercises related to fuel economy & drag.
iii. Appraise upon the techniques of shape based optimization practiced in industry.
iv. Awareness about the influence of rider position in motorcycle aerodynamics.
v. Expose to fundamentals of Experimental testing.

TEXT BOOKS:

REFERENCES:
1. R.H.Barnard-“Road vehicle aerodynamic design, An Introduction”, Mechaero publications, Third edition, 2010
CIE350

LEAN SIX SIGMA

UNIT I
INTRODUCTION TO LEAN AND SIX SIGMA
9
Introduction to Lean- Definition, Purpose, Features of Lean; Top seven wastes, Need for Lean management, The philosophy of lean management, Creating a lean enterprise, Elements of Lean, Lean principles, the lean metric, Hidden time traps. Introduction to quality, Definition of six sigma, origin of six sigma, Six sigma concept and Critical success factors for six sigma.

UNIT II
INTEGRATION OF LEAN AND SIX SIGMA
9
Evolution of lean six sigma, the synergy of Lean and six sigma, Definition of lean six sigma, the principles of lean six sigma, Scope for lean six sigma, Features of lean six sigma. The laws of lean six sigma, Key elements of LSS, the LSS model and the benefits of lean six sigma. Initiation - Top management commitment – Infrastructure and deployment planning, Process focus, organizational structures, Measures – Rewards and recognition, Infrastructure tools, the structure of transforming event and Launch preparation.

UNIT III
PROJECT SELECTION AND TEAM BUILDING
9
Resource and project selection, Selection of Black belts, Training of Black belts and Champions, Identification of potential projects, top down (Balanced score card) and Bottom up approach – Methods of selecting projects – Benefit/Effort graph, Process mapping, value stream mapping, Predicting and improving team performance, Nine team roles and Team leadership.

UNIT IV
THE DMAIC PROCESS AND TOOLS
9
The DMAIC process – Toll gate reviews; The DMAIC tools; Define tools – Project definition form, SIPOC diagram; Measure tools – Process mapping, Lead time/cycle time, Cause and Effect matrix, Idea – generating and organizing tools – Brainstorming, Nominal group technique and Multi-voting; Data collection and accuracy tools- Check sheet, Gauge R&R; Understanding and eliminating variation- run charts; Analyze tools - Scatter plots, ANOVA, Regression analysis, Time trap analysis; Improve tools – Mistake proofing, Set up time reduction (SMED) and the pull system; Control tools – statistical process control.
Institutionalizing lean six sigma – improving design velocity, creating cycle time base line, valuing projects, gating the projects, reducing product line complexity, Design for lean six sigma, QFD, Theory of Inventive Problem solving (TRIZ), Robust design; Case study presentations

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: The students will be able to understand what is Lean and Six sigma and their importance in the globalized competitive world.

CO2: The students will be able to understand the importance of integrating Lean and Six sigma and also the process of their integration.

CO3: The students will be able to plan the Resources required to undertake the LSS projects and also acquire how to select the suitable projects and the teams.

CO4: The students will be able to apply DMAIC methodology to execute LSS projects and in this regard they will be acquainted with various LSS tools.

CO5: The students will be able to understand the process of institutionalizing the LSS effort and also understand the Design for LSS.

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AU3038 RENEWABLE SOURCES OF ENERGY LT P C

OBJECTIVES:

At the end of the course, the students are expected to identify the new methodologies/technologies for effective utilization of renewable energy sources.

UNIT I INTRODUCTION


UNIT II SOLAR ENERGY

UNIT III  WIND ENERGY  9

UNIT IV  BIO - ENERGY  9
Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters – Ethanol production Bio diesel – Cogeneration - Biomass Applications

UNIT V  OTHER RENEWABLE ENERGY SOURCES  9

TOTAL : 45 PERIODS

OUTCOMES:
Upon the completion of this course the students will be able to
CO1 Discuss the importance and Economics of renewable Energy
CO2 Discuss the method of power generation from Solar Energy
CO3 Discuss the method of power generation from Wind Energy
CO4 Explain the method of power generation from Bio Energy

TEXT BOOKS:

REFERENCES:
2. David M. Mousdale — "Introduction to Biofuels", CRC Press, Taylor & Francis Group, USA2017

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AU3039  VEHICLE AIR-CONDITIONING  L T P C  3 0 0 3

OBJECTIVE:
• At the end of the course, the students will be able to understand the components of the automotive air-conditioning and their functions and the latest developments in this field.

UNIT I  AUTOMOTIVE AIRCONDITIONING FUNDAMENTALS  9
Purposes of Heating, Ventilation and Air Conditioning- Environmental Concerns- Ozone layer depletion- Location of air conditioning components in a car – Schematic layout of a vehicle refrigeration system. Psychrometry – Basic terminology and Psychrometric mixtures- Psychrometric Chart- Related problems
UNIT II  AUTOMOTIVE COOLING AND HEATING SYSTEM  
Vehicle Refrigeration System and related problems- Fixed thermostatic and Orifice tube system- Variable displacement thermostatic and Orifice tube system- Vehicle air conditioning operation Types of compressor- Compressor Clutches- Compressor Clutch electrical circuit- Compressor lubrication- Condensers- Evaporators- Expansion devices- Evaporator temperature and pressure controls- receiver-drier- Accumulators- refrigerant hoses, Connections and other assemblies- Heating system

UNIT III  AIR-CONDITIONING CONTROLS, DELIVERY SYSTEM AND REFRIGERANTS  
Types of Control devices- Preventing Compressor damage- Preventing damage to other systems- Maintaining driveability- Preventing Overheating Ram air ventilation- Air delivery Components- Control devices- Vacuum Controls Containers – Handling refrigerants – Discharging, Charging & Leak detection – Refrigeration system diagnosis – Diagnostic procedure – Ambient conditions affecting system pressures.

UNIT IV  AUTOMATIC TEMPERATURE CONTROL  
Different types of sensors and 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

UNIT V  SYSTEM SERVICING AND TESTING  
Special tools for servicing vehicle air conditioning – Diagnosing components and air conditioning systems- Diagnosing cooling system- Air delivery system- Automatic temperature Control system diagnosis and service

TOTAL : 45 PERIODS

OUTCOME
Upon the completion of the course, the student should understand the basic of vehicle air-conditioning system, its components, working principle, control mechanism, service etc.

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PSO: 45 PERIODS
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
- Describing the solar radiation and various solar collectors.
- Explaining the various solar thermal energy technologies and their applications.
- Analyzing the various solar PV cell materials and conversion techniques.
- Discussing various Solar SPV systems designs and their applications.
- Applying solar passive building techniques for cooling and heating applications.

UNIT I SOLAR RADIATION AND COLLECTORS 9
Solar angles – Sun path diagrams – Radiation - extraterrestrial characteristics - measurement and estimation on horizontal and tilted surfaces - flat plate collector thermal analysis - testing methods-evacuated tubular collectors - concentrator collectors – classification - design and performance parameters - tracking systems - compound parabolic concentrators - parabolic trough concentrators - concentrators with point focus - Heliostats – performance of the collectors

UNIT II SOLAR THERMAL TECHNOLOGIES 9

UNIT III SOLAR PV FUNDAMENTALS 9

UNIT IV SPV SYSTEM DESIGN AND APPLICATIONS 9
Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPV systems - standalone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems

UNIT V SOLAR PASSIVE ARCHITECTURE 9
Thermal comfort - bioclimatic classification – passive heating concepts: direct heat gain - indirect heat gain - isolated gain and sunspaces - passive cooling concepts: evaporative cooling - Radiative cooling- application of wind, water and earth for cooling; shading - paints and cavity walls for cooling roof radiation traps - earth air-tunnel – energy efficient landscape design - thermal comfort

TOTAL : 45 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:
1. Describe the solar radiation and various solar collectors
2. Explain the various solar thermal energy technologies and their applications
3. Analyze the various solar PV cell materials and conversion techniques
4. Discuss various Solar SPV systems designs and their applications
5. Apply solar passive building techniques for cooling and heating applications

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GE3751 PRINCIPLES OF MANAGEMENT L T P C
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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 9

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

TOTAL : 45 PERIODS

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

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GE3752 TOTAL QUALITY MANAGEMENT L T P C 3 0 0 3

COURSE OBJECTIVES:
- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Describe Taguchi’s Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.
UNIT I  INTRODUCTION
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality – Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II  TQM PRINCIPLES

UNIT III  TQM TOOLS & TECHNIQUES I

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

UNIT V  QUALITY MANAGEMENT SYSTEM

TOTAL: 45 PERIODS

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

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REFERENCES:

GE3753 ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING

COURSE OBJECTIVES:
- Understanding the concept of Engineering Economics.
- Implement various micro economics concepts 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. Maheswari and Dr. S. K. Maheshwari: Financial Accounting, Vikas, 2009

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GE3754 HUMAN RESOURCE MANAGEMENT  L T P C
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OBJECTIVE:
- To provide knowledge about management issues related to staffing,
- To provide knowledge about management issues related to training,
- To provide knowledge about management issues related to performance
- To provide knowledge about management issues related to compensation
- To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.

UNIT I INTRODUCTION TO HUMAN RESOURCE MANAGEMENT

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

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

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

COURSE OUTCOMES:
Upon completion of the course, the student should be able to:

CO1: Understand the process of acquiry knowledge from experts
CO2: Understand the learning organization.
CO3: Use the knowledge management tools.
CO4: Develop knowledge management Applications.
CO5: Design and develop enterprise applications.

CO’s- PO’s & PSO’s MAPPING

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TEXT BOOK:

REFERENCE:

GE3792 INDUSTRIAL MANAGEMENT L T P C
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COURSE OBJECTIVES
1. To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. To study the planning; organizing and staffing functions of management in professional organization.
3. To study the leading; controlling and decision making functions of management in professional organization.
4. To learn the organizational theory in professional organization.
5. To learn the principles of productivity and modern concepts in management in professional organization.
UNIT – I  INTRODUCTION TO MANAGEMENT
Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg’s Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

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

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

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

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

TOTAL : 45 PERIODS

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

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

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

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

CO4 Discuss the organizational theory in professional organization.

CO5 Apply principles of productivity and modern concepts in management in professional organization.

TEXT BOOKS:

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MANDATORY COURSES I

MX3081  INTRODUCTION TO WOMEN AND GENDER STUDIES  L T P C
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COURSE OUTLINE

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

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

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

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

UNIT V   GENDER AND REPRESENTATION
Advertising and popular visual media.

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

TOTAL : 45 PERIODS

MX3082  ELEMENTS OF LITERATURE  L T P C
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OBJECTIVE:

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

1. COURSE CONTENTS
   Introduction to Elements of Literature

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

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

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

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

3. READINGS:

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

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

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

TOTAL: 45 PERIODS

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

MX3083 FILM APPRECIATION

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

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

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

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

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

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

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

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

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

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

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

REFERENCES
5. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

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

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**MANDATORY COURSES II**

**MX3085 WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA 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 health.


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

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

**UNIT II DIET 4+6**

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


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

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

*Common cooking mistakes - Different cooking methods, merits and demerits of each method*
UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 4+4
AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.

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

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

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

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


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

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

TOTAL : 45 PERIODS

TEXT BOOKS:
1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California
REFERENCES:
1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts
   The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001
   1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
   2. Simple lifestyle modifications to maintain health
      https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20ook.
   3. Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html
   7. BMI https://www.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
UNIT- I CONCEPTS AND PERSPECTIVES
Meaning of History
Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history
Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism.
Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

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

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

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

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

TOTAL : 45 PERIODS

MX3087 POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY 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 society. Future directions. (4 lectures) (Refs: Nandkishore Acharya, David Dixon, Levis Mumford)

Conclusion (2 lectures)

Total lectures: 39

Preferred Textbooks: See Reference Books

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

GRADING:

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**TOTAL**: 45 PERIODS

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

MX3088 STATE, NATION BUILDING AND POLITICS IN INDIA L T P C 3 0 0 0

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

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

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

1857 and the national awakening.

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

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

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

SUGGESTED READING:

TOTAL : 45 PERIODS

MX3089

INDUSTRIAL SAFETY

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

UNIT I

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

UNIT III SAFETY ACTIVITIES

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

UNIT V HAZARD IDENTIFICATION TECHNIQUES
Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-if Analysis- and Hazard Identification and Risk Assessment
Course outcomes on completion of this course the student will be able:
- Understand the basic concept of safety.
- Obtain knowledge of Statutory Regulations and standards.
- Know about the safety Activities of the Working Place.
- Analyze on the impact of Occupational Exposures and their Remedies
- Obtain knowledge of Risk Assessment Techniques.

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

REFERENCES
5. Society of Safety Engineers, USA

ONLINE RESOURCES
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<td>Obtain knowledge of Statutory Regulations and standards.</td>
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<td>CO3</td>
<td>Know about the safety Activities of the Working Place.</td>
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<td>CO4</td>
<td>Analyze on the impact of Occupational Exposures and their Remedies</td>
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<td>CO5</td>
<td>Obtain knowledge of Risk Assessment Techniques.</td>
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**OPEN ELECTIVE I AND II**

**OCS351 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS**  

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

**UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH**

**Introduction** - Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI - **Intelligent Agents** - Nature of Environment - Structure of Agent - Problem Solving Agents - Formulating Problems - **Uninformed Search** - Breadth First Search - Dijkstra's algorithm or uniform-cost search - Depth First Search - Depth Limited Search

**UNIT II PROBLEM SOLVING WITH SEARCH TECHNIQUES**

**Informed Search** - Greedy Best First - A* algorithm - Adversarial Game and Search - **Game theory** - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning - **Constraint Satisfaction Problems (CSP)** - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP
UNIT III LEARNING
Machine Learning: Definitions – Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra – Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance - Regression: Linear Regression - Logistic Regression

UNIT IV SUPERVISED LEARNING

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

TOTAL : 30 PERIODS

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

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

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

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

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

TOTAL: 60 PERIODS

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

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

UNIT I INTRODUCTION TO INTERNET OF THINGS 5

UNIT II COMPONENTS IN INTERNET OF THINGS 5
Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee, Wifi, GPS, GSM Modules).

UNIT III PROTOCOLS AND TECHNOLOGIES BEHIND IOT 6

UNIT IV OPEN PLATFORMS AND PROGRAMMING 7

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

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

TOTAL: 60 PERIODS

TEXTBOOKS

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

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

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

UNIT I INTRODUCTION 6
Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data

UNIT II DATA MANIPULATION 9

UNIT III MACHINE LEARNING 5
The modeling process - Types of machine learning - Supervised learning - Unsupervised learning - Semi-supervised learning- Classification, regression - Clustering – Outliers and Outlier Analysis
UNIT IV  DATA VISUALIZATION

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

30 PERIODS

PRACTICAL EXERCISES:

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

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

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

TOTAL:60 PERIODS

TEXT BOOKS

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

UNIT I INTRODUCTION

UNIT II VR MODELING

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

UNIT IV APPLICATIONS

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

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

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

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

OPEN ELECTIVE III
OHS351 ENGLISH FOR COMPETITIVE EXAMINATIONS L T P C 3 0 0 3

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

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

UNIT I

UNIT II

UNIT III
UNIT IV

UNIT V

TOTAL: 45 PERIODS

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

CO-PO & PSO MAPPING

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

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

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

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

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

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

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

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

TOTAL 45 : PERIODS
OUTCOMES
Upon completion of this course, the student will:

CO1 Have a thorough grounding on the issues and challenges being faced in attaining sustainable development.

CO2 Have a knowledge on the role of NGOs towards sustainable development.

CO3 Present strategies for NGOs in attaining sustainable development.

CO4 Recognize the importance of providing energy, food security and health equity to all members of the society without damaging the environment.

CO5 Understand the environmental legislations.

REFERENCE BOOKS

OMG353 DEMOCRACY AND GOOD GOVERNANCE

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UNIT-I

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

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

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

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

TOTAL 45 : PERIODS

REFERENCES:
4. Saima Saeed: Screening the Public Sphere: Media and Democracy in India,2013
OBJECTIVE:
- To impart knowledge about the basics of lean principles, tools and techniques, and implementation in the construction industry.

UNIT I  INTRODUCTION  9
Introduction and overview of the construction project management - Review of Project Management & Productivity Measurement Systems - Productivity in Construction - Daily Progress Report - The state of the industry with respect to its management practices - Construction project phases - The problems with current construction management techniques.

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

UNIT III  CORE CONCEPTS IN LEAN  9

UNIT IV  LEAN TOOLS AND TECHNIQUES  9

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

TOTAL: 45 PERIODS

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

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

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

UNIT – II SOLAR ENERGY

UNIT – III WIND ENERGY

UNIT – IV BIO-ENERGY

UNIT – V OCEAN AND GEOTHERMAL ENERGY

TOTAL: 45 PERIODS

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

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

OME354
APPLIED DESIGN THINKING
L T P C
3 0 0 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

TOTAL: 45 PERIODS

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

TEXT BOOKS
1. Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.

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

MF3003 REVERSE ENGINEERING LT P C
3 0 0 3

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

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


UNIT III DATA PROCESSING


UNIT IV 3D SCANNING AND MODELLING


UNIT V INDUSTRIAL APPLICATIONS


TOTAL : 45 PERIODS

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

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

TEXT BOOKS:

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

UNIT – I ECONOMIC SUSTAINABILITY

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

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

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

UNIT – V TRENDS IN SUSTAINABLE OPERATIONS

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

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1 – Slight, 2 – Moderate, 3 – Substantial

OAS352 SPACE ENGINEERING

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.

TOTAL: 45 PERIODS
OUTCOMES:
- Illustrate the history of aviation & developments over the years
- Ability to identify the types & classifications of components and control systems
- Explain the basic concepts of flight & Physical properties of Atmosphere
- Identify the types of fuselage and constructions.
- Distinguish the types of Engines and explain the principles of Rocket

TEXT BOOKS:

REFERENCE:

OIM351 INDUSTRIAL MANAGEMENT L T P C
3 0 0 3

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

UNIT I INTRODUCTION

UNIT II FUNCTIONS OF MANAGEMENT

UNIT III ORGANIZATIONAL BEHAVIOUR

UNIT IV GROUPDYNAMICS
Group Behaviour - Groups - Contributing factors - Group Norms, Communication - Process - Barriers to communication - Effective communication, leadership - formal and informal characteristics – Managerial Grid - Leadership styles - Group Decision Making - Leadership Role in Group Decision, Group Conflicts - Types - Causes - Conflict Resolution - Inter group relations and conflict,
Organization centralization and decentralization - Formal and informal - Organizational Structures
Organizational Change and Development - Change Process – Resistance to Change - Culture and Ethics.

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

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

TOTAL: 45 PERIODS

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

UNIT V  ACCEPTANCESAMPLING  9
The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS2500 standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students will be able to:
CO1: Control the quality of processes using control charts for variables in manufacturing industries.
CO2: Control the occurrence of defective product and the defects in manufacturing companies.
CO3: Control the occurrence of defects in services.
CO4: Analyzing and understanding the process capability study.
CO5: Developing the acceptance sampling procedures for incoming raw material.

CO’s- PO’s & PSO’s MAPPING

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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

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

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

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

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

UNIT III  EDDY CURRENT TESTING & THERMOGRAPHY 9

UNIT IV  ULTRASONIC TESTING & AET 9

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.  

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.

TOTAL: 45 PERIODS
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 L T P C
3 0 0 3

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

UNIT – I  INTRODUCTION AND SENSORS

UNIT – II  8085 MICROPROCESSOR

UNIT – III  PROGRAMMABLE PERIPHERAL INTERFACE

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

UNIT – V ACTUATORS AND MECHATRONICS SYSTEM DESIGN

TOTAL: 45 PERIODS

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

Mapping of COs with POs and PSOs

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<tr>
<th>COs/POs &amp; PSOs</th>
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1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS:

REFERENCES:

ORA351 FOUNDATION OF ROBOTICS L T P C
COURSE OBJECTIVES:
1. To study the kinematics, drive systems and programming of robots.
2. To study the basics of robot laws and transmission systems.
3. To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
4. To familiarize students with the various Programming and Machine Vision application in robots.
5. To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

UNIT – I  FUNDAMENTALS OF ROBOT  9

UNIT – II  ROBOT KINEMATICS  9
Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.

UNIT – III  ROBOT DRIVE SYSTEMS AND END EFFECTORS  9
Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper

UNIT – IV  SENSORS IN ROBOTICS  9
Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation.

UNIT – V  PROGRAMMING AND APPLICATIONS OF ROBOT  9
Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effectors Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

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

TOTAL : 45 PERIODS
Mapping of COs with POs and PSOs

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1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS:

REFERENCES:

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

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

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

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

UNIT III BASICS OF AERODYNAMICS 9

UNIT IV BASICS OF AIRCRAFT STRUCTURES 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

TEXT BOOKS

REFERENCE

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

OBJECTIVES:

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

UNIT I  REMOTE SENSING AND ELECTROMAGNETIC RADIATION  9

UNIT II  EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL  9

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

UNIT IV SENSING TECHNIQUES 9

UNIT V DATA PRODUCTS AND INTERPRETATION 9
Photographic and digital products – Types, levels and open source satellite data products — selection and procurement of data– Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification

TOTAL:45 PERIODS

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

TEXTBOOKS:

REFERENCES:

CO-PO MAPPING

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OBJECTIVES:
- To introduce the students the principles of agricultural crop production and the production practices of crops in modern ways.
- To delineate the role of agricultural engineers in relation to various crop production practices.

UNIT I INTRODUCTION
Benefits of urban agriculture- economic benefits, environmental benefits, social and cultural benefits, educational, skill-building and job training benefits, health, nutrition and food accessibility benefits.

UNIT II VERTICAL FARMING

UNIT III SOIL LESS CULTIVATION
Hydroponics, aeroponics, aquaponics: merits and limitations, costs and Challenges, backyard gardens- tactical gardens- street landscaping- forest gardening, greenhouses, urban beekeeping

UNIT IV MODERN CONCEPTS
Growth of plants in vertical pipes in terraces and inside buildings, micro irrigation concepts suitable for roof top gardening, rain hose system, Green house, polyhouse and shade net system of crop production on roof tops

UNIT V WASTE MANAGEMENT
Concept, scope and maintenance of waste management- recycle of organic waste, garden wastes- solid waste management-scope, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, waste utilization.

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:


### CO-PO MAPPING

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<tr>
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### OEN351 DRINKING WATER SUPPLY AND TREATMENT

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

**UNIT I SOURCES OF WATER**

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

UNIT IV ADVANCED WATER TREATMENT

UNIT V WATER DISTRIBUTION AND SUPPLY

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

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

OEE352 ELECTRIC VEHICLE TECHNOLOGY

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

UNIT I ROTATING POWER CONVERTERS

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

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

UNIT IV HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS

UNIT V MECHANICS OF HYBRID ELECTRIC VEHICLES AND CONTROL OF VEHICLES
Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of HEV's - motor torque and power rating and battery capacity. HEV supervisory control - Selection of modes - power 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:
OEI353 INTRODUCTION TO PLC PROGRAMMING

L T P C
3 0 0 3

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

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

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

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

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

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

TOTAL:45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Market survey of the recent PLCs and comparison of their features.
2. Summarize the PLC standards
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)
4. Market survey of Communication Network Used for PLC/SCADA.
COURSE OUTCOMES:
CO1 Know the basic requirement of a PLC input/output devices and architecture. (L1)
CO2 Ability to apply Basics Instruction Sets used for ladder Logic and Function Block Programming. (L2)
CO3 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block. (L3)
CO4 Able to develop a PLC logic for a specific application on real world problem. (L5)
CO5 Ability to understand the Concepts of Communication used for PLC/SCADA. (L1)

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

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

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

<table>
<thead>
<tr>
<th>PO</th>
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OCH351 NANO TECHNOLOGY L T P C 3 0 0 3

UNIT I INTRODUCTION 8
General definition and size effects—important nano structured materials and nano particles—importance of nano materials—Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials—surface area—band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials—Ionic properties of nanomaterials—Nano catalysis.

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

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

UNIT IV  NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES

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

UNIT V  APPLICATIONS OF NANO MATERIALS

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

TOTAL : 45 PERIODS

OUTCOMES:

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

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

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

CO4 Understand the different characterization techniques for nanomaterials

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

TEXT BOOKS


REFERENCES


COURSE ARTICULATION MATRIX

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<td>understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications</td>
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<td>acquire knowledge about the different types of nano material synthesis</td>
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<td>understand the different characterization techniques for nanomaterials</td>
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<td>CO5</td>
<td>develop a deeper knowledge in the application of nanomaterials in different fields</td>
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**OCH352 FUNCTIONAL MATERIALS**

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

**UNIT I INTRODUCTION**

**UNIT II MOLECULAR SELF ASSEMBLY**

**UNIT III BIO-INSPIRED MATERIALS**

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

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

**TOTAL: 45 PERIODS**

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

REFERENCE:

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

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

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

UNIT II TRADITIONAL METHODS OF FOOD PROCESSING 9

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

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

UNIT V HEALTH ASPECTS OF TRADITIONAL FOODS 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.

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:
COURSE OBJECTIVES:

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

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

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

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

UNIT IV ENFORCEMENT AND PRACTICAL ASPECTS OF IPR

UNIT V INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
2. Basic Principles of patent law – Basics principles and acquisition of IPR. Ramakrishna T. CIPRA, NLSIU, Bangalore, 2005
The student will be able to:

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

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<th>CO – PO MAPPING</th>
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OTT351 **BASICS OF TEXTILE FINISHING**

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

**UNIT I** **RESIN FINISHING**

**UNIT II** **FLAME PROOF & WATERPROOF**
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**

**UNIT IV** **MECHANICAL FINISHES**

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

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

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

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

UNIT I INTRODUCTION
Scope of industrial engineering in apparel Industry, role of industrial engineers.
Productivity: Definition - Productivity, Productivity measures. Reduction of work content due to the product and process, Reduction of ineffective time due to the management, due to the worker. Causes for low productivity in apparel industry and measures for improvement.

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

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

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

UNIT V WORK STUDY APPLICATION
Application of work study techniques in cutting, stitching and packing in garment industry. Workaids in sewing, Pitch diagram, Line balancing, Capacity planning, scientific method of training. TOTAL: 45 PERIODS

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

TEXTBOOKS:

REFERENCES

Course Articulation Matrix:

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

OTT353 BASICS OF TEXTILE MANUFACTURE L T P C

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:

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

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:
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 9

UNIT II ELECTRICAL SYSTEMS 9

UNIT III THERMAL SYSTEMS 9

UNIT IV ENERGY CONSERVATION IN MAJOR UTILITIES 9
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V ECONOMICS 9
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

OPT351 BASICS OF PLASTICS PROCESSING L T P C
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 plastic 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 troubleshooting

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

REFERENCES:

OEC351 SIGNALS AND SYSTEMS

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

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

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

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS

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

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES:

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

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

UNIT I  SEMICONDUCTOR DEVICES  9
PN junction diode, Zener diode, BJT, MOSFET, UJT –structure, operation and V-I characteristics, Rectifiers – Half Wave and Full Wave Rectifier, Zener as regulator
UNIT II AMPLIFIERS 9
Load line, operating point, biasing methods for BJT and MOSFET, BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT III MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9
Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis – Tuned amplifiers – Gain and frequency response – Neutralization methods.

UNIT IV FEEDBACK AMPLIFIERS AND OSCILLATORS 9

UNIT V POWER AMPLIFIERS AND DC/DC CONVERTERS 9
Power amplifiers- class A-Class B-Class AB-Class C-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.

TOTAL: 45 PERIODS

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

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OBJECTIVES:

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

UNIT I BASICS OF PRODUCT DEVELOPMENT


UNIT II REQUIREMENTS AND SYSTEM DESIGN


UNIT III DESIGN AND TESTING


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


UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY


TOTAL: 45 PERIODS

OUTCOMES:

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

- Define, formulate, and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish
TEXT BOOKS:
1. Book specially prepared by NASSCOM as per the MoU.

REFERENCES:

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OBM333 ASSISTIVE TECHNOLOGY L T P C
3 0 0 3

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

UNIT I CARDIAC ASSIST DEVICES 9
Cardiac functions and parameters, principle of External counter pulsation techniques, intra aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, cardiac pacemaker.

UNIT II HEMODIALYSERS 9
Physiology of kidney, Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.

UNIT III HEARING AIDS 9
Anatomy of ear, Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT IV PROSTHETIC AND ORTHODIC DEVICES 9
Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices.
UNIT V RECENT TRENDS
Transcutaneous electrical nerve stimulator, bio-feedback, assistive devices in drug delivery

TOTAL: 45 PERIODS

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

TEXT BOOKS:

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

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OMA352 OPERATIONS RESEARCH

OBJECTIVES:
This course will help the students to
- Determine the optimum solution for Linear programming problems.
- Study the Transportation and assignment models and various techniques to solve them.
- Acquire the knowledge of optimality, formulation and computation of integer programming problems.
- Acquire the knowledge of optimality, formulation and computation of dynamic programming problems.
- Determine the optimum solution for non-linear programming problems.
UNIT I  LINEAR PROGRAMMING  9

UNIT II  TRANSPORTATION AND ASSIGNMENT PROBLEMS  9

UNIT III  INTEGER PROGRAMMING  9

UNIT IV  DYNAMIC PROGRAMMING PROBLEMS  9

UNIT V  NON-LINEAR PROGRAMMING PROBLEMS  9

TOTAL:45 PERIODS

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

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

TEXT BOOKS:

REFERENCES:
OMA353  ALGEBRA AND NUMBER THEORY  

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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OMA354 LINEAR ALGEBRA

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

UNIT I MATRICES AND SYSTEM OF LINEAR EQUATIONS

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

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

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

UNIT V EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION

TOTAL : 45 PERIODS
COURSE OUTCOMES:
After the completion of the course the student will be able to
1. Test the consistency and solve system of linear equations.
2. Find the basis and dimension of vector space.
3. Obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
4. Find orthonormal basis of inner product space and find least square approximation.
5. Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

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OBT352
BASICS OF MICROBIAL TECHNOLOGY

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
Introduction to microbes, existence of microbes, inventions of great scientist and history, types of microorganisms – Bacteria, Virus, Fungi.

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

UNIT III
PATHOGENIC MICROBES
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, Vermicompost, Pharmaceutical products - Antibiotics, Vaccines

TOTAL: 45 PERIODS

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

TEXT BOOKS

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

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

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

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

UNIT III  AMINO ACIDS AND PROTEIN.  9

UNIT IV  NUCLEIC ACIDS  9
Introduction to nucleic acid, Difference between nucleotide and nucleoside, composition of DNA & 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

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

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
Physiochemical properties of cell membranes. Molecular constitute of membranes, asymmetrical
organisation of lipids and proteins. Solute transport across membrane’s-fick’s law, simple diffusion,
passive-facilitated diffusion, active transport- primary and secondary, group translocation, transport
ATPases, membrane transport in bacteria and animals. Transportmechanism- mobile carriers and
pores mechanisms. Transport by vesicle formation, endocytosis, exocytosis, cell respiration.

UNIT IV  CELL CYCLE  9
Cell cycle- Cell division by mitosis and meosis, Comparision of meosis and mitosis, regulation of cell
cycle, cell lysis, Cytokinesis, Cell signaling, Cell communication, Cell adhesion and Cell junction,
cell cycle checkpoints.

UNIT V  CENTRAL DOGMA  9
Overview of Central dogma DNA replication: Meselson &amp; Stahl experiment, bi–directional DNA
replication, Okazaki fragments. Structure and function of mRNA, rRNA and tRNA. RNA synthesis:
Initiation, elongation and termination of RNA synthesis Introduction to Genetic code- Steps in
translation: Initiation, Elongation and termination of protein synthesis.

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:
   Oxford University Press, 2018

REFERENCES:
OPEN ELECTIVE IV
OHS352 PROJECT REPORT WRITING  L  T  P  C
3 0 0 3

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

UNIT I

UNIT II

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

UNIT IV

UNIT V

TOTAL:45 PERIODS

OUTCOMES
By the end of the course, learners will be able to
- Write effective project reports.
- Use statistical tools with confidence.
- Explain the purpose and intension of the proposed project coherently and with clarity.
- Create writing texts to suit achieve the intended purpose.
- Master the art of writing winning proposals and projects.

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

OMA355 ADVANCED NUMERICAL METHODS

UNIT I ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEM 9

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

UNIT III NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS 9

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

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

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
- To introduce the basic concepts of probability, one and two dimensional random variables with applications to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in communication networks.
- To acquaint with specialized random processes which are apt for modelling the real time scenario.
- To understand the concept of correlation and spectral densities.
- To understand the significance of linear systems with random inputs.

UNIT I RANDOM VARIABLES

UNIT II RANDOM PROCESSES

UNIT III SPECIAL RANDOM PROCESSES

UNIT IV CORRELATION AND SPECTRAL DENSITIES

UNIT V LINEAR SYSTEMS WITH RANDOM INPUTS
Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

TOTAL: 45 PERIODS

OUTCOMES
Upon successful completion of the course, students should be able to:
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept random processes in engineering disciplines.
- Understand and apply the concept of correlation and spectral densities.
- Get an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.
- Analyze the response of random inputs to linear time invariant systems.
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OMA357 Queueing and Reliability Modelling

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

UNIT I RANDOM PROCESSES

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

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

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

TOTAL: 45 PERIODS

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

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OMG354 PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS

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

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

UNIT II PRODUCTION & OPERATION SYSTEMS
Production Systems- principles – Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning- Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry

UNIT III PRODUCTION & OPERATIONS PLANNING
Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of production process systems – Steps for production process- Production Planning Control Functions – Planning phase- Action phase- Control phase - Aggregate production planning

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS

UNIT V CONTROLLING PRODUCTION & OPERATIONS MANAGEMENT

TOTAL 45 : PERIODS

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

REFERENCES

OCE354 BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT L T P C
3 0 0 3
OBJECTIVES
- To introduce the interdisciplinary approach of water management.
- To develop knowledge base and capacity building on IWRM.

UNIT I OVERVIEW OF IWRM

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

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

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

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

TOTAL: 45 PERIODS

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

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

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

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

CO4 Illustrate the recent trends in water management.

CO5 Understand the implementation hitches and the institutional frameworks.

TEXT BOOKS

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

OMG355 MULTIVARIATE DATA ANALYSIS
L T P C
3 0 0 3
259
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:

OME343 NEW PRODUCT DEVELOPMENT L T P C
UNIT – I FUNDAMENTALS OF NPD 9

UNIT – II MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS 9
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 9
UNIT – IV CRITERIONS OF NPD

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

UNIT – V REPORTING & FORWARD-THINKING OF NPD

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

TOTAL : 45 PERIODS

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

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

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

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OBJECTIVES:
The course aims to

- Outline Fundamental concepts in UI & UX
- Introduce the principles of Design and Building an mobile app
- Illustrate the use of CAD in product design
- Outline the choice and use of prototyping tools
- Understanding design of electronic circuits and fabrication of electronic devices

UNIT I  UI/UX

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

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

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

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

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

COURSE OBJECTIVES:
At the end of this course the student should be able to
- Learn about the precision machine tools
- Learn about the macro and micro components.
- Understand handling and operating of the precision machine tools.
- Learn to work with miniature models of existing machine tools/robots and other instruments.
- Learn metrology for micro system

UNIT I INTRODUCTION TO MICROSYSTEMS 9
Design, and material selection, micro-actuators: hydraulic, pneumatic, electrostatic/ magnetic etc. for medical to general purpose applications. Micro-sensors based on Thermal, mechanical, electrical properties; micro-sensors for measurement of pressure, flow, temperature, inertia, force, acceleration, torque, vibration, and monitoring of manufacturing systems.

UNIT II FABRICATION PROCESSES FOR MICRO-SYSTEMS 9
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 LT P C
3 0 0 3

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

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

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

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

UNIT – IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

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

TOTAL: 45 PERIODS
COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand the costing concepts and their role in decision making.
CO2: Understand the project management concepts and their various aspects in selection.
CO3: Interpret costing concepts with project execution.
CO4: Gain knowledge of costing techniques in service sector and various budgetary control techniques.
CO5: Become familiar with quantitative techniques in cost management.

TEXT BOOKS:

REFERENCES:

OAS353 SPACE VEHICLES

OBJECTIVES:
- To interpret the missile space stations, space vs earth environment.
- To explain the life support systems, mission logistics and planning.
- To deploy the skills effectively in the understanding of space vehicle configuration design.
- To explain Engine system and support of space vehicle
- To interpret nose cone configuration of space vehicle

UNIT I FUNDAMENTAL ASPECTS
Energy and Efficiencies of power plants for space vehicles – Typical Performance Values – Mission design – Structural design aspects during launch - role of launch environment on launch vehicle integrity.

UNIT II SELECTION OF ROCKET PROPULSION SYSTEMS
Ascent flight mechanics – Launch vehicle selection process – Criteria for Selection for different missions – selection of subsystems – types of staging – Interfaces – selection and criteria for stages and their role in launch vehicle configuration design.

UNIT III ENGINE SYSTEMS, CONTROLS, AND INTEGRATION
UNIT IV THRU4 VECTOR CONTROL 9
TVC Mechanisms with a Single Nozzle - TVC with Multiple Thrust Chambers or Nozzles - Testing - Integration with Vehicle - SITVC method - other jet control methods - exhaust plume problems in space environment

UNIT V NOSE CONE CONFIGURATION 9
Aerodynamic aspects on the selection of nose shape of a launch vehicle - design factors in the finalization of nose configuration with respect to payload - nose cone thermal protection system - separation of fairings - payload injection mechanism

TOTAL: 45 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
- Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.
- Apply knowledge in selecting the appropriate rocket propulsion systems.
- Interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.
- Analyze aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.
- Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.

OIM352 MANAGEMENT SCIENCE L T P C 3 0 0 3

COURSE OBJECTIVES:
Of this course are
- To introduce fundamental concepts of management and organization to students.
- To impart knowledge to students on various aspects of marketing, quality control and marketing strategies.
- To make students familiarize with the concepts of human resources management.
- To acquaint students with the concepts of project management and cost analysis.
- To make students familiarize with the concepts of planning process and business strategies.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANISATION 9

UNIT II OPERATIONS AND MARKETING MANAGEMENT 9
UNIT III  HUMAN RESOURCES MANAGEMENT  
Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager:Manpower planning, Recruitment, Selection, Training and Development, Wage and Salary Administration, Promotion, Transfer, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating – Capability Maturity Model (CMM) Levels.

UNIT IV  PROJECT MANAGEMENT  
Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

UNIT V  STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES  

TOTAL: 45 PERIODS

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

CO1: Plan an organizational structure for a given context in the organization to carryout production operations through Work-study.

CO2: Survey the markets, customers and competition better and price the given products appropriately.

CO3: Ensure quality for a given product or service.

CO4: Plan, schedule and control projects through PERT and CPM.

CO5: Evaluate strategy for a business or service organization.

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TEXT BOOKS:

REFERENCES:
OIM353 PRODUCTION PLANNING AND CONTROL 3 0 0 3

COURSE OBJECTIVES:
- To understand the concept of production planning and control act work study,
- To apply the concept of product planning,
- To analyze the production scheduling,
- To apply the Inventory Control concepts.
- To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION 9
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 9
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 9
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 9

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9
Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course,
CO1: The students can able to prepare production planning and control act work study,
CO2: The students can able to prepare product planning,
CO3: The students can able to prepare production scheduling,
CO4: The students can able to prepare Inventory Control.
CO5: They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

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OIE353 OPERATIONS MANAGEMENT

COURSE OBJECTIVE:
- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm’s competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
- Relate the interdependence of the operations function with the other key functional areas of a firm.
- Teach analytical skills and problem-solving tools to the analysis of the operations problems.
- Apply scheduling and Lean Concepts for improving System Performance.

UNIT I INTRODUCTION TO OPERATIONS MANAGEMENT
Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy - Strategic fit, framework; Supply Chain Management

UNIT II FORECASTING, CAPACITY AND FACILITY DESIGN
UNIT III DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS 9

UNIT IV MATERIALS MANAGEMENT 9

UNIT V SCHEDULING AND PROJECT MANAGEMENT 9
Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson’s Algorithm – Gantt charts; personnel scheduling in services.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: The students will appreciate the role of Production and Operations management in enabling and enhancing a firm’s competitive advantages in the dynamic business environment.

CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.

CO3: The students will able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.

CO4: The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.

CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance.

CO’s- PO’s & PSO’s MAPPING

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TEXT BOOKS

REFERENCES
OSF352 INDUSTRIAL HYGIENE  L T P C  3 0 0 3

COURSE OBJECTIVES:
1. Demonstrate an understanding of how occupational hygiene standards are set and used in work health and safety.
2. Compare and contrast the roles of environmental and biological monitoring in work health and safety.
3. Outline strategies for identifying, assessing and controlling risks associated with airborne gases, vapours and particulates.
4. Discuss how personal protective equipment can be used to reduce risks associated with workplace exposures.
5. Provide high-level advice on managing and controlling noise and noise-related hazards.

UNIT I INTRODUCTION AND SCOPE

UNIT II MONITORING FOR SAFETY, HEALTH & ENVIRONMENT
Occupational Health and Environment Safety Management System, ILO and EPA Standards Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.

UNIT III OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION

UNIT IV OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT

UNIT V INDUSTRIAL HAZARDS

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Students able to
CO1: Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems
CO2: Specify designs that avoid occupation related injuries
CO3: Define and apply the principles of work design, motion economy, and work environment design.
CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.
CO5: Acknowledge the impact of workplace design and environment on productivity

TEXT BOOKS:

REFERENCES:
2. Frank P Lees - Loss of prevention in Process Industries, Vol. 1 and 2,

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OSF353 CHEMICAL PROCESS SAFETY

COURSE OBJECTIVES
- Teach the principles of safety applicable to the design, and operation of chemical process plants.
- Ensure that potential hazards are identified and mitigation measures are in place to prevent unwanted release of energy.
- Learn about the hazardous chemicals into locations that could expose employees and others to serious harm.
- Focuses on preventing incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals.
- Ensure that the general design of the plant is capable of complying with the dose limits in force and with the radioactive releases.
UNIT I  
SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES  
Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief - relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation - pipe line transport - safety in chemical laboratories.

UNIT II  
CHEMICAL REACTION HAZARDS  
Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self - heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening.

UNIT III  
SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS  
Design principles -Process design development -types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares- new concepts in safety design and operation- Pressure vessel testing standards- Inspection techniques for boilers and reaction vessels.

UNIT IV  
SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS  
Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards -standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures- condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

UNIT V  
SAFETY AND ANALYSIS  
Safety vs reliability- quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students able to
CO1 Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants.
CO2 Develop thorough knowledge about safety in the operation of chemical plants.
CO3 Apply the principles of safety in the storage and handling of gases.
CO4 Identify the conditions that lead to reaction hazards and adopt measures to prevent them.
CO5 Develop thorough knowledge about

TEXT BOOK

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OML352                         ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS                         L T P C
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COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:

- Understanding the importance of various materials used in electrical, electronics and magnetic applications
- Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
- Gaining knowledge on the selection of suitable materials for the given application
- Knowing the fundamental concepts in Semiconducting materials
- Getting equipped with the materials used in optical and optoelectronic applications.

UNIT I  DIELECTRIC MATERIALS
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

UNIT II  MAGNETIC MATERIALS
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriiction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis

UNIT III  SEMICONDUCTOR MATERIALS
Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on specific superconducting materials; comments on fabrication and engineering applications.

UNIT IV  MATERIALS FOR ELECTRICAL APPLICATIONS
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetal fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.
UNIT V   OPTICAL AND OPTOELECTRONIC MATERIALS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
- Understand various types of dielectric materials, their properties in various conditions.
- Evaluate magnetic materials and their behavior.
- Evaluate semiconductor materials and technologies.
- Select suitable materials for electrical engineering applications.
- Identify right material for optical and optoelectronic applications

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OML353   NANOMATERIALS AND APPLICATIONS

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications
2. Gaining knowledge on dimensionality effects on different properties of nanomaterials
3. Getting acquainted with the different processing techniques employed for fabricating nanomaterials
4. Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
5. Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.
UNIT I  NANOMATERIALS  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 learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics.
2. To understand basic working principle, construction, Application and characteristics of displacement, speed and ranging sensors.
3. To understand and analyze the working principle, construction, application and characteristics of force, magnetic and heading sensors.
4. To learn and analyze the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors.
5. To familiarize students with different signal conditioning circuits design and data acquisition system.

UNIT I SENSORS CLASSIFICATION, CHARACTERISTICS AND SIGNAL TYPES

UNIT II DISPLACEMENT, PROXIMITY AND RANGING SENSORS

UNIT III FORCE, MAGNETIC AND HEADING SENSORS

UNIT IV OPTICAL, PRESSURE, TEMPERATURE AND OTHER SENSORS

UNIT V SIGNAL CONDITIONING

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Understand various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors. They can also analyze the sensor response.
CO2: Analyze and select suitable sensor for displacement, proximity and range measurement.
CO3: Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.
CO4: Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.
CO5: Select and design suitable signal conditioning circuit with proper compensation and linearizing element based on sensor output signal.

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Mapping of COs with POs and PSOs

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES:

COURSE OBJECTIVES
1. To introduce mobile robotic technology and its types in detail.
2. To learn the kinematics of wheeled and legged robot.
3. To familiarize the intelligence into the mobile robots using various sensors.
4. To acquaint the localization strategies and mapping technique for mobile robot.
5. To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT – I INTRODUCTION TO MOBILE ROBOTICS

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.

**TEXT BOOKS**

**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 I**
**BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS**

- law of floatation - Basics principle of propulsion- Earlier methods of propulsion- ship propulsion machinery- boiler, Marine steam engine, diesel engine, ship power transmission system, ship dynamic structure, Marine propulsion equipment - shaft tunnel, Intermediate shaft and bearing, stern tube, stern tube sealing etc.
- degree of freedom, Modern propelling methods- water jet propulsion, screw propulsion.

**UNIT II**
**SHIPS MOVEMENTS AND SHIP STABILIZATION**

- Thrust augmented devices, Ship hull, modern ship propulsion design, bow thruster – Advantages, various methods to stabilize the ship- passive and active stabilizer, fin stabilizer, bilge keel - stabilizing and securing ship in port- effect of tides on ship – effect of river water and sea water sailing vessel, Load line and load line of marking- draught markings.

**UNIT III**
**SHIPS SPEED AND ITS PERFORMANCE**

- Ship propulsion factors, factors affecting ships speed, various velocities of ship, hull drag, effects of fouling on ships hull, ship wake, relation between powers, Fuel consumption of ship, cavitations - effects of cavitation’s, ship turning radius.

**UNIT IV**
**BASICS OF PROPELLER**

- Propeller dimension, Propeller and its types – fixed propeller, control pitch propeller, kort nozzle, ducted propeller, voith schneider, Parts of propeller, 3 blade - 5 blade - 6 blade propellers and its
advantages, propeller boss hub, crown nut, propeller skew, pitch of propeller - Thrust creation by propeller. Propeller Material – Propeller balancing- static and dynamic.

UNIT V BASICS OF RUDDER
Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings- Rudder pintle - Rudder types- Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits of various types of rudders, Propeller and rudder interaction, Rudder stopper, movement of rudders, Basic construction of Rudder

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
CO1: Explain the basics of propulsion system and ship dynamic movements
CO2: Familiarize with various components assisting ship stabilization.
CO3: Demonstrate the performance of the ship.
CO4: Classify the Propeller and its types, Materials etc.
CO5: Categories the Rudder and its types, design criteria of rudder.

TEXT BOOKS:
1. GP. Ghose, “Basic Ship propulsion”,2015
REFERENCES BOOKS:

MAPPING OF COS AND POS:

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OMV351 MARINE MERCHANT VESSELS LT P C 3 0 0 3

OBJECTIVES:
At the end of the course, students are expected to acquire
1. Knowledge on basics of Hydrostatics
2. Familiarization on types of merchant ships
3. Knowledge on Shipbuilding Materials
4. Knowledge on marine propeller and rudder
5. Awareness on governing bodies in shipping industry

UNIT I INTRODUCTION TO HYDROSTATICS

UNIT II TYPES OF SHIP
General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers - Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gas carriers - Chemical tankers - Passenger ships

UNIT III SHIPBUILDING MATERIALS
Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys, Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced Composites

UNIT IV MARINE PROPELLER AND RUDDER
Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its effects on propeller

UNIT V GOVERNING BODIES FOR SHIPPING INDUSTRY
Role of IMO (International Maritime Organization), SOLAS (International Convention for the Safety of Life at Sea), MARPOL (International Convention for the Prevention of Pollution from Ships), MLC (Maritime Labour Convention), STCW 2010 (International Convention on Standards of Training, Certification and Watch keeping for Seafarers), Classification societies Administration authorities

TOTAL: 45 PERIODS
OUTCOMES:

Upon completion of this course, students would
1. Acquire Knowledge on floatation of ships
2. Acquire Knowledge on features of various ships
3. Acquire Knowledge of Shipbuilding Materials
4. Acquire Knowledge to identify the different types of marine propeller and rudder
5. Understand the Roles and responsibilities of governing bodies

TEXT BOOKS:
2. Dr.DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006

REFERENCES:
2. MARPOL Consolidated Edition, Bhandakar Publications, 2018

OMV352 ELEMENTS OF MARINE ENGINEERING L T P C 3 0 0 3

OBJECTIVES:
At the end of the course, students are expected to
1. Understand the role of Marine machinery systems
2. Be familiar with Marine propulsion machinery system
3. Acquaint with Marine Auxiliary machinery system
4. Have acquired basics of Marine Auxiliary boiler system
5. Be aware of ship propellers and steering system

UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS 9
Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems

UNIT II MARINE PROPULSION MACHINERY SYSTEM 9
Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system

UNIT III MARINE AUXILIARY MACHINERY SYSTEM 9
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications
UNIT IV          MARINE BOILER SYSTEM          9
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories

UNIT V          SHIP PROPELLERS AND STEERING MECHANISM          9
Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear

OUTCOMES:
At the end of the course, students should able to,
1. Distinguish the role of various marine machinery systems
2. Relate the components of marine propulsion machinery system
3. Explain the importance of marine auxiliary machinery system
4. Acquire knowledge of marine boiler system
5. Understand the importance of ship propellors and steering system

TEXT BOOKS:

REFERENCES:
1. Alan L.Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006
2. A.S.Tambwekar, “Naval Architecture and Ship Construction”, The Institute of Marine Engineers (India), Mumbai, 2015

CRA332          DRONE TECHNOLOGIES          L    T    P    C
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COURSE OBJECTIVES:
1. To understand the basics of drone concepts
2. To learn and understand the fundaments of design, fabrication and programming of drone
3. To impart the knowledge of an flying and operation of drone
4. To know about the various applications of drone
5. To understand the safety risks and guidelines of fly safely

UNIT I          INTRODUCTION TO DRONE TECHNOLOGY          9
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

UNIT II          DRONE DESIGN, FABRICATION AND PROGRAMMING          9
Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.
UNIT III  DRONE FLYING AND OPERATION  9
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- 
Drone controls Flight operations –management tool –Sensors-Onboard storage capacity - 
Removable storage devices- Linked mobile devices and applications

UNIT IV  DRONE COMMERCIAL APPLICATIONS  9
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering 
mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines 
and power distribution -Drones in filming and panoramic picturing

UNIT V  FUTURE DRONES AND SAFETY  9
The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- 
Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms 
TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Know about a various type of drone technology, drone fabrication and programming.
CO2: Execute the suitable operating procedures for functioning a drone
CO3: Select appropriate sensors and actuators for Drones
CO4: Develop a drone mechanism for specific applications
CO5: Create the programs for various drones

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1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS
1. Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and 
Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and 
Implementation”, 2021 John Wiley & Sons, Inc.
2. Terry Kilby and Belinda Kilby, “Make:Getting Started with Drones “,Maker Media, Inc, 
2016

REFERENCES
1. John Baichtal, “Building Your Own Drones: A Beginners’ Guide to Drones, UAVs, and 
ROVs”, Que Publishing, 2016
2. Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for 
OBJECTIVES:
To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.

UNIT I  FUNDAMENTALS OF GIS  9

UNIT II  SPATIAL DATA MODELS  9

UNIT III  DATA INPUT AND TOPOLOGY  9

UNIT IV  DATA QUALITY AND STANDARDS  9
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure

UNIT V  DATA MANAGEMENT AND OUTPUT  9
Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS- distributed GIS.

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.

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<td>PO9</td>
<td>Individual and Team Work</td>
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<td>PO10</td>
<td>Communication</td>
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<tr>
<td>PSO1</td>
<td>Knowledge of Geoinformatics discipline</td>
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<td>PSO2</td>
<td>Critical analysis of Geoinformatics Engineering problems and innovations</td>
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<td>PSO3</td>
<td>Conceptualization and evaluation of Design solutions</td>
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OAI352 AGRICULTURE ENTREPRENEURSHIP DEVELOPMENT L T P C 3 0 0 3

OBJECTIVES
- To introduce the importance of Agri-business management, its characteristics and principles
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.

UNIT I ENTREPRENEURIAL ENVIRONMENT IN INDIAN CONTEXT
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 AGRIPRENEURSHIP 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

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 9
Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis- Government schemes and incentives for promotions of entrepreneurship. Government policy on small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract framing (CF) and Joint Venture (JV), public-private partnerships (PPP) - overview of agricultural engineering industry, characteristics of Indian farm machinery industry.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
1. Judge about agricultural finance, banking and cooperation
2. Evaluate basic concepts, principles and functions of financial management
3. Improve the skills on basic banking and insurance schemes available to customers
4. Analyze various financial data for efficient farm management
5. Identify the financial institutions

TEXT BOOKS:

REFERENCES:
## CO-PO MAPPING

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
<th>Overall correlation of COs with POs</th>
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<tr>
<th>PSO1</th>
<th>To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill</th>
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<tbody>
<tr>
<td>PSO2</td>
<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>PSO3</td>
<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:

REFERENCES:

OUTCOMES:
Upon successful completion of this course, students will:
CO1: An insight into the structure and function of diversity for ecosystem stability.
CO2: Understand the concept of animal diversity and taxonomy
CO3: Understand socio-economic issues pertaining to biodiversity
CO4: An understanding of biodiversity in community resource management.
CO5: Student can apply fundamental knowledge of biodiversity conservation to solve problems associated with infrastructure development.

CO’s- PO’s & PSO’s MAPPING

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<th>CO’s</th>
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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

OBJECTIVES
- To impart knowledge on various representations of systems.
- To familiarize time response analysis of LTI systems and steady state error.
- To analyze the frequency responses and stability of the systems
- To analyze the stability of linear systems in frequency domain and time domain
- To develop linear models mainly state variable model and transfer function model
UNIT I  MATHEMATICAL MODELS OF PHYSICAL SYSTEMS  9
Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction–Signal flow graphs.

UNIT II  TIME RESPONSE ANALYSIS & ROOTLOCUSTECHNIQUE  9

UNIT III  FREQUENCY RESPONSE ANALYSIS  9
Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV  STABILITY CONCEPTS & ANALYSIS  9

UNIT V  STATE VARIABLE ANALYSIS  9
Concept of state – State Variable & State Model – State models for linear & continuous time systems–Solution of state & output equation–controllability & observability.

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.
COURSE OBJECTIVES:
1. To educate on design of signal conditioning circuits for various applications.
2. To introduce signal transmission techniques and their design.
3. Study of components used in data acquisition systems interface techniques
4. To educate on the components used in distributed control systems
5. To introduce the communication buses used in automation industries.

UNIT I INTRODUCTION

UNIT II AUTOMATION COMPONENTS
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT III COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS
Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT V DISTRIBUTED CONTROL SYSTEM
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL:45 PERIODS

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

COURSE OUTCOMES:
Students able to
CO1 Design a signal conditioning circuits for various application (L3).
CO2 Acquire a detail knowledge on data acquisition system interface and DCS system (L2).
CO3 Understand the basics and Importance of communication buses in applied automation Engineering (L2).
CO4 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.(L3)
CO5 Able to develop a PLC logic for a specific application on real world problem. (L5)

TEXT BOOKS:
REFERENCES:

List of Open Source Software/ Learning website:
1. https://archive.nptel.ac.in/courses/108/105/108105062/
2. https://nptel.ac.in/courses/108105063

CO’s- PO’s & PSO’s MAPPING

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<th>PSO’s</th>
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OCH353
ENERGY TECHNOLOGY

UNIT I
INTRODUCTION
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources.

UNIT II
CONVENTIONAL ENERGY
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III
NON-CONVENTIONAL ENERGY
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV
BIOMASS ENERGY
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT V
ENERGY CONSERVATION

Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.

TOTAL: 45 PERIODS

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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<tr>
<th>Course Outcomes</th>
<th>Statements</th>
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<td>Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.</td>
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the various fields of energy engineering

<table>
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<tr>
<th>CO3</th>
<th>Compare different renewable energy technologies and choose the most appropriate based on local conditions.</th>
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<td>Explain the technological basis for harnessing renewable energy sources.</td>
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<tr>
<td>CO5</td>
<td>Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level</td>
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OVERALL CO  
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

OCH354 SURFACE SCIENCE L T P C 3 0 0 3

OBJECTIVE:
- To enable the students to analyze properties of a surfaces and correlate them to structure, chemistry, and physics and surface modification technique.

UNIT I SURFACE STRUCTURE AND EXPERIMENTAL PROBES 9
Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, absorbate structure, Band and Vibrational structure, Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy

UNIT II ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT
SURFACES
Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods

UNIT III LIQUID INTERFACES
Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells

UNIT IV HETEROGENEOUS CATALYSIS
Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, Fishcher-Tropsch and Automotive catalysis, Role of promoters and poisons, Bimetallic surfaces, surface functionalization and clusters in catalysis, Role of Sabatier principle in catalyst design, Rate oscillations and spatiotemporal pattern formation

UNIT V EPITAXIAL GROWTH AND NANO SURFACE-STRUCTURES

OUTCOME:
• Upon completion of this course, the students can understand, predict and design surface properties based on surface structure. Students would understand the physics and chemistry behind surface phenomena

TEXT BOOK:

REFERENCE:

OFD354 FUNDAMENTALS OF FOOD ENGINEERING

OBJECTIVES:
The course aims to
• Acquaint and equip the students with different techniques of measurement of engineering properties.
• Make the students understand the nature of food constituents in the design of processing equipment

UNIT I Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.
UNIT II
Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foammat dryers

UNIT III
Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger's, Kick's and Bond's equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping)

UNIT IV
Mixing: theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for low- or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids.

UNIT V
Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine, Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids, Membrane separation: General considerations, materials for membrane construction, ultra-filtration, microfiltration, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, per-evaporation and osmotic dehydration.

COURSE OUTCOMES:
At the end of the course the students will be able to
CO1 understand the importance of food polymers
CO2 understand the effect of various methods of processing on the structure and texture of food materials
CO3 understand the interaction of food constituents with respect to thermal, electrical properties to develop new technologies for processing and preservation.

TEXT BOOKS:

TOTAL: 45 PERIODS
OBJECTIVES:
• To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
• To help become skilled in systems for food safety surveillance
• To be aware of the regulatory and statutory bodies in India and the world
• To ensure processed food meets global standards

UNIT I
Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labeling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection, ISO 22000 – Importance and Implementation

UNIT II
Food quality: Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities.

UNIT III
Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system. Food inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system to monitor food safety, risk communication

UNIT IV
Indian and global regulations: FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)

UNIT V
Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.

COURSE OUTCOMES:
CO1 Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments
CO2 Awareness on regulatory and statutory bodies in India and the world

REFERENCES:
1. Handbook of food toxicology by S. S. Deshpande, 2002
2. The food safety information handbook by Cynthia A. Robert, 2009
4. Microbiological safety of Food by Hobbs BC, 1973
OBJECTIVES:
- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease.

UNIT I  INTRODUCTION AND SIGNIFICANCE  6
Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoochemicals and microbes in food, plants, animals and microbes.

UNIT II  PHYTOCHEMICALS AS NUTRACEUTICALS  11
Phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, lycopene, chitin, carotenoids. Manufacturing practice of selected nutraceuticals such as lycopene, isoflavonoids, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals - stability, analytical and labelling issues.

UNIT III  ASSESSMENT OF ANTIOXIDANT ACTIVITY  11
In vitro and in vivo methods for the assessment of antioxidant activity, Comparison of different in vitro methods to evaluate the antioxidant, antioxidant mechanism, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

UNIT IV  ROLE IN HEALTH AND DISEASE  11
The health benefit of - Soy protein, Spirulina, Tea, Olive oil, plant sterols, Broccoli, omega3 fatty acid and eicosanoids. Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and synbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

UNIT V  SAFETY ISSUES  6
Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues International and national.

TOTAL: 45 PERIODS

TEXT BOOKS:
3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006

REFERENCES:
1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007
COURSE OUTCOME - NUTRACEUTICALS

CO 1  Acquire knowledge about the nutraceuticals and functional foods, their classification and benefits.
CO 2  Acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, animals and microbes
CO 3  Attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods.
CO 4  Distinguish the various \textit{in vitro} and \textit{in vivo} assessment of antioxidant activity of compounds from plant sources.
CO 5  Gain information about the health benefits of various functional foods and nutraceuticals in the prevention and treatment of various lifestyle diseases.
CO 6  Attain the knowledge of the regulatory and safety issues of nutraceuticals at national and international level.

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OTT354 BASICS OF DYEING AND PRINTING

OBJECTIVE:
- To enable the students to learn about the basics of Pretreatment, dyeing, printing and machinery in textile processing.

UNIT I INTRODUCTION
Impurities present in different fibres, Inspection of grey goods and lot preparation. Shearing.

UNIT II PRE TREATMENT

UNIT III DYEING

UNIT IV PRINTING
Definition of printing – Difference between printing and dying- Classification thickeners – Requirements to be good thickener, printing paste Preparation - different styles of printing.
UNIT V  MACHINERIES

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

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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 FIBRE S  9
Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass , carbon .Introduction to spin finishes and texturization

UNIT IV  SPECIALITY FIBRES  9
Properties and end uses of high tenacity and high modulus fibres, high temperature and flame retardant fibres, Chemical resistant fibres

UNIT V  FUNCTIONAL SPECIALITY FIBRES  9
Properties and end uses : Fibres for medical application – Biodegradable fibres based on PLA , Super absorbent fibres elastomeric fibres, ultra-fine fibres, electrospun nano fibres, metallic fibres – Gold and Silver coated.

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the student would be able to
- Understand the process sequence of various fibres
- Understand the properties of various fibres

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
- To enable the students to understand the basics of pattern making, cutting and sewing.
- To expose the students to various problems & remedies during garment manufacturing

UNIT I  PATTERN MAKING, MARKER PLANNING, CUTTING  9
Anthropometry, specification sheet, pattern making – principles, basic pattern set drafting, grading, marker planning, spreading & cutting

UNIT II  TYPES OF SEAMS, STITCHES AND FUNCTIONS OF NEEDLES  9
Different types of seams and stitches; single needle lock stitch machine – mechanism and accessories; needle – functions, special needles, needlepoint

UNIT III  COMPONENTS AND TRIMS USED IN GARMENT  9
Sewing thread-construction, material, thread size, packages, accessories – labels, linings, interlinings, wadding, lace, braid, elastic, hook and loop fastening, shoulder pads, eyelets and laces, zip fasteners, buttons

UNIT IV  GARMENT INSPECTION AND DIMENSIONAL CHANGES  9
Raw material, in process and final inspection; needle cutting; sewability of fabrics; strength properties of apparel; dimensional changes in apparel due to laundering, dry-cleaning, steaming and pressing.

UNIT V  GARMENT PRESSING, PACKING AND CARE LABELING  9
Garment pressing – categories and equipment, packing; care 304abelling 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 304abelling

TEXT BOOKS:
2. Gerry Cooklin, “Introduction to Clothing Manufacture” Blackwell Science Ltd., 1995. 64

REFERENCES:
OPE353 INDUSTRIAL SAFETY

OBJECTIVES:

- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen’s Compensation and other laws) enacted for the protection of employees health at work settings
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I INTRODUCTION

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

UNIT II OCCUPATIONAL HEALTH AND HYGIENE


UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS


UNIT IV HAZARDS AND RISK MANAGEMENT


UNIT V ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT


TOTAL: 45 PERIODS
OUTCOMES:
After completion of this course, the student is expected to be able to:

- Describe, with example, the common work-related diseases and accidents in occupational setting
- Name essential members of the Occupational Health team
- What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee

OPE354 UNIT OPERATIONS IN PETRO CHEMICAL INDUSTRIES L T P C 3 0 0 3

OBJECTIVES:

- To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.

UNIT I FLUID MECHANICS CONCEPTS
Fluid definition and classification of fluids, types of fluids, Rheological behaviour of fluids & Newton’s Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems),Basic equations of fluid flow - Continuity equation, Euler's equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits - Hagen Poiseuille equation (no derivation). Flow through stagnant fluids – theory of Settling and Sedimentation – Equipment (cyclones, thickeners) Conceptual numericals.

UNIT II FLOW MEASUREMENTS & MECHANICAL OPERATIONS

UNIT III CONDUCTIVE & CONVECTIVE HEAT TRANSFER
Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).

UNIT IV BASICS OF MASS TRANSFER

UNIT V MASS TRANSFER OPERATIONS
Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction).Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method.Drying- drying operations, batch and continuous drying. Conceptual numerical.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course the student will be able to:

- State and describe the nature and properties of the fluids.
- Study the different flow measuring instruments, the principles of various size reductions, conveying equipment’s, sedimentation and mixing tanks.
- Comprehend the laws governing the heat and mass transfer operations to solve the problems.
- Design the heat transfer equipment suitable for specific requirement.

TEXTBOOKS:
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008

REFERENCE BOOKS
2. Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996

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 9
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 9
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 9
Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.
UNIT IV  MISCELLANEOUS PLASTICS FOR END APPLICATIONS

Miscellaneous plastics - Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbazole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers- their synthesis, properties and applications

UNIT V  PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS

Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers- poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- To study the importance, advantages and classification of plastic materials
- Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics
- To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins
- Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU
- To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

REFERENCES

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 L T P C
3 0 0 3

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 9
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 9

UNIT III SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES 9

UNIT IV INTERCONNECT, MEMORY ARCHITECTURE 9
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 9
Arithmetic Building Blocks: Data Paths, Adders-Ripple Carry Adder, Carry-Bypass Adder, Carry Select Adder, Carry-Look Ahead Adder, Multipliers, Barrel Shifter, power and speed tradeoffs.

TOTAL: 45 PERIODS

OUTCOMES:
Upon successful completion of the course the student will be able to
CO1: Understand the working principle and characteristics of MOSFET
CO2: Design Combinational Logic Circuits
CO3: Design Sequential Logic Circuits and Clocking systems
CO4: Understand Memory architecture and interconnects
CO5: Design of arithmetic building blocks.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
The student should be made to:

- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS

UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES
Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS

UNIT IV SMART TEXTILE

UNIT V APPLICATIONS OF WEARABLE SYSTEMS
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Describe the concepts of wearable system.
CO2: Explain the energy harvestings in wearable device.
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile
CO5: Compare the various wearable devices in healthcare system

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES:
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CBM356 MEDICAL INFORMATICS L T P C
3 0 0 3

PREAMBLE:
1. To study the applications of information technology in health care management.
2. This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

UNIT I INTRODUCTION TO MEDICAL INFORMATICS
Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues , Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics

UNIT II COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING
Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III COMPUTERISED PATIENT RECORD
Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT IV COMPUTER ASSISTED MEDICAL DECISION-MAKING
Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer–assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis inclinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS
Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
1. Explain the structure and functional capabilities of Hospital Information System.
2. Describe the need of computers in medical imaging and automated clinical laboratory.
3. Articulate the functioning of information storage and retrieval in computerized patient record system.
4. Apply the suitable decision support system for automated clinical diagnosis.
5. Discuss the application of virtual reality and telehealth technology in medical industry.
TEXT BOOKS:

REFERENCES:

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AVG.

OBT355 BIOTECHNOLOGY FOR WASTE MANAGEMENT L T P C
3 0 0 3

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

UNIT I BIOLOGICAL TREATMENT PROCESS

UNIT II WASTE BIOMASS AND ITS VALUE ADDITION
Types of waste biomass – Solid waste management - Nature of biomass feedstock – Biobased economy/process – Value addition of waste biomass – Biotransformation of biomass – Biotransformation of marine processing wastes – Direct extraction of biochemicals from biomass – Plant biomass for industrial application

UNIT III BIOCONVERSION OF WASTES TO ENERGY
Perspective of biofuels from wastes - Bioethanol production – Biohydrogen Production – dark and photofermentative process - Biobutanol production – Biogas and Biomethane production - Single stage anaerobic digestion, Two stage anaerobic digestion - Biodiesel production - Enzymatic hydrolysis technologies

UNIT IV CHEMICALS AND ENZYME PRODUCTION FROM WASTES
Production of lactic acid, succinic acid, citric acid – Biopolymer synthesis – Production of Amylases - Lignocellulolytic enzymes - Pectinolytic enzymes - Proteases – Lipases
UNIT V BIOCOMPOSTING OF ORGANIC WASTES

Overview of composting process - Benefits of composting, Role of microorganisms in composting - Factors affecting the composting process - Waste Materials for Composting, Fundamentals of composting process - Composting technologies, Composting systems – Nonreactor Composting, Reactor composting - Compost Quality

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE BOOKS

OBT356 LIFESTYLE DISEASES

UNIT I INTRODUCTION
Lifestyle diseases – Definition ; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use ; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise.

UNIT II CANCER
Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment

UNIT III CARDIOVASCULAR DISEASES
Coronary atherosclerosis – Coronary artery disease; Causes -Fat and lipids, Alcohol abuse -- Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation

UNIT IV DIABETES AND OBESITY
Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI

UNIT V RESPIRATORY DISEASES
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

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

UNIT II CLINICAL DISEASES
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
History of Vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems. Instruments related to monitoring of temperature, sterilization, environment.

UNIT IV OUTPATIENT & IN PATIENT SERVICES
Radiotherapy, Nuclear medicine, surgical units, OT Medical units, G & Obs. units Pediatric, neonatal units, Critical care units, Physical medicine & Rehabilitation, Neurology, Gastroenterology, Endoscopy, Pulmonology, Cardiology.

UNIT V BASICS OF IMAGING MODALITIES

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCE BOOKS:
Learning Objectives
1. To acquire the knowledge of the decision areas in finance.
2. To learn the various sources of Finance
3. To describe about capital budgeting and cost of capital.
4. To discuss on how to construct a robust capital structure and dividend policy
5. To develop an understanding of tools on Working Capital Management.

UNIT I  INTRODUCTION TO FINANCIAL MANAGEMENT
Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of money- Risk and return concepts.

UNIT II  SOURCES OF FINANCE
Long term sources of Finance -Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc

UNIT III  INVESTMENT DECISIONS
Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV  FINANCING AND DIVIDEND DECISION

UNIT V WORKING CAPITAL DECISION

TOTAL : 45 PERIODS

TEXT BOOKS

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
The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, securitisation market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.

UNIT II FIXED INCOME SECURITIES
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.

UNIT III APPROACHES TO EQUITY ANALYSIS
Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT IV PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India

UNIT V INVESTOR PROTECTION
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors’ awareness and activism

TOTAL: 45 PERIODS

REFERENCES:

OBJECTIVES
- Understand the Banking system in India
- Grasp how banks raise their sources and how they deploy it
- Understand the development in banking technology
- Understand the financial services in India
- Understand the insurance Industry in India
UNIT I  INTRODUCTION TO INDIAN BANKING SYSTEM  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
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  

UNIT V  EMERGING TRENDS  

TOTAL: 45 PERIODS

REFERENCE
2. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018

CMG335  FINTECH PERSONAL FINANCE AND PAYMENTS

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  

TOTAL : 45 PERIODS
REFERENCES:
5. IIBF, Digital Banking, Taxmann Publication, 2016

CMG336 INTRODUCTION TO FINTECH LT P C 3 0 0 3

OBJECTIVES:
1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I INTRODUCTION
Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY
Fintech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, Fintech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III INSURANCE INDUSTRY

UNIT IV FINTECH AROUND THE GLOBE
Fintech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East, Regulatory and Policy Assessment for Growth of Fintech. Fintech as disruptors, Financial institutions collaborating with Fintech companies, The new financial world.
UNIT V  FUTURE OF FINTECH

How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

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
Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development.

UNIT II  BUSINESS OWNERSHIP & ENVIRONMENT

UNIT III  FUNDAMENTALS OF TECHNOPRENEURSHIP
Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends
UNIT IV APPLICATIONS OF TECHNOPRENEURSHIP
Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship — Success Stories of Technopreneurs - Case Studies

UNIT 5 EMERGING TRENDS IN ENTREPRENEURSHIP

TOTAL 45 : PERIODS

OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1  Learn the basics of Entrepreneurship
CO 2  Understand the business ownership patterns and environment
CO 3 Understand the Job opportunities in Industries relating to Technopreneurship
CO 4 Learn about applications of technopreneurship and successful technopreneurs
CO 5 Acquaint with the recent and emerging trends in entrepreneurship

TEXT BOOKS:

REFERENCES :
7. Basics of Technoprenuership: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP
8. Journal articles pertaining to Entrepreneurship

CMG338 TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS

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

322
UNIT I INTRODUCTION TO MANAGING TEAMS 9
Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) - Multicultural Teams.

UNIT II MANAGING AND DEVELOPING EFFECTIVE TEAMS 9
Team-based Organisations- Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.

UNIT III INTRODUCTION TO LEADERSHIP 9
Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership - Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment.

UNIT IV LEADERSHIP IN ORGANISATIONS 9

UNIT V LEADERSHIP EFFECTIVENESS 9

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of managing teams for business.
CO 2 Understand developing effective teams for business management.
CO 3 Understand the fundamentals of leadership for running a business.
CO 4 Learn about the importance of leadership for business development.
CO 5 Acquaint with emerging trends in leadership effectiveness for entrepreneurs.”

REFERENCES :
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

TOTAL 45 : PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of creativity for developing Entrepreneurship
CO 2 Understand the importance of creative intelligence for business growth
CO 3 Understand the advances through Innovation in Industries
CO 4 Learn about applications of innovation in building successful ventures
CO 5 Acquaint with developing innovative business models to run the business efficiently and effectively

SUGGESTED READINGS:
Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand
Strategic Innovation: Building and Sustaining Innovative Organizations- Course Era, Raj Echambadi.
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**
- Introduction - Market and Marketing – Concepts
- Functions of Marketing - Importance of Marketing
- Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix
- The Additional 3Ps - Developing an Effective Marketing Mix.

**UNIT II - MARKETING ENVIRONMENT**

**UNIT III - PRODUCT AND PRICING MANAGEMENT**
- Product - Meaning, Classification, Levels of Products – Product Life Cycle (PLC) - Product Strategies

**UNIT IV - PROMOTION AND DISTRIBUTION MANAGEMENT**

**UNIT V - CONTEMPORARY ISSUES IN MARKETING MANAGEMENT**

**COURSE OUTCOMES:**
After completion of this course, the students will be able to:
- CO1 Have the awareness of marketing management process
- CO 2 Understand the marketing environment
- CO 3 Acquaint about product and pricing strategies
- CO 4 Knowledge of promotion and distribution in marketing management.
- CO 5 Comprehend the contemporary marketing scenarios and offer solutions to marketing issues.

**REFERENCES:**
OBJECTIVES:
1. To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
2. To create an awareness of the roles, functions and functioning of human resource department.
3. To understand the methods and techniques followed by Human Resource Management practitioners.

UNIT I  INTRODUCTION TO HRM

UNIT II  HUMAN RESOURCE PLANNING
HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends

UNIT III  RECRUITMENT AND SELECTION
Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources - eRecruitment - Selection Process - Selection techniques - eSelection - Interview Types - Employee Engagement.

UNIT IV  TRAINING AND EMPLOYEE DEVELOPMENT

UNIT V  CONTROLLING HUMAN RESOURCES

COURSE OUTCOMES:
Upon completion of this course the learners will be able:
CO 1 To understand the Evolution of HRM and Challenges faced by HR Managers
CO 2 To learn about the HR Planning Methods and practices.
CO 3 To acquaint about the Recruitment and Selection Techniques followed in Industries.
CO 4 To known about the methods of Training and Employee Development.
CO 5 To comprehend the techniques of controlling human resources in organisations.

REFERENCES:
CMG342  FINANCING NEW BUSINESS VENTURES  

COURSE OBJECTIVES:
- To develop the basics of business venture financing.
- To impart the knowledge essential for entrepreneurs for financing new ventures.
- To acquaint the learners with the sources of debt and equity financing.
- To empower the learners towards fund raising for new ventures effectively.

UNIT I  ESSENTIALS OF NEW BUSINESS VENTURE  

UNIT II  INTRODUCTION TO VENTURE FINANCING  

UNIT III  SOURCES OF DEBT FINANCING  

UNIT IV  SOURCES OF EQUITY FINANCING  
Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.

UNIT V  METHODS OF FUND RAISING FOR NEW VENTURES  

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the students should be able to:
- CO 1 Learn the basics of starting a new business venture.
- CO 2 Understand the basics of venture financing.
- CO 3 Understand the sources of debt financing.
- CO 4 Understand the sources of equity financing.
- CO 5 Acquaint with the methods of fund raising for new business ventures.

REFERENCES:
1) Principles of Corporate Finance by Brealey and Myers et al.,12TH ed, McGraw Hill Education (India) Private Limited, 2018

VERTICAL 3: PUBLIC ADMINISTRATION

CMG343 PRINCIPLES OF PUBLIC ADMINISTRATION

UNIT-I
1. Meaning, Nature and Scope of Public Administration
2. Importance of Public Administration
3. Evolution of Public Administration

UNIT-II
1. New Public Administration
2. New Public Management
3. Public and Private Administration

UNIT-III
1. Relationships with Political Science, History and Sociology
2. Classical Approach
3. Scientific Management Approach

UNIT-IV
1. Bureaucratic Approach: Max Weber
2. Human Relations Approach : Elton Mayo
3. Ecological Approach : Riggs

UNIT-V
1. Leadership: Leadership - Styles - Approaches
2. Communication: Communication Types - Process - Barriers

TOTAL: 45 PERIODS

REFERENCES:
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.
UNIT- I
1. Constitutional Development Since 1909 to 1947
3. Constituent Assembly

UNIT-II
1. Fundamental Rights
2. Fundamental Duties
3. Directive Principles of State Policy

UNIT-III
1. President
2. Parliament
3. Supreme Court

UNIT-IV
1. Governor
2. State Legislature
3. High Court

UNIT-V
1. Secularism
2. Social Justice
3. Minority Safeguards

REFERENCES:
3. Johari J.C.: Indian Politics, Vishal Publications Ltd, New Delhi
4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi

UNIT-I
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

UNIT-II
1. Generalist Vs Specialist
2. Civil Servants’ Relationship with Political Executive
3. Integrity in Administration.

UNIT-III
1. Recruitment: Direct Recruitment and Recruitment from Within
2. Training: Kinds of Training
3. Promotion

UNIT-IV
1. All India Services
2. Service Conditions
3. State Public Service Commission

UNIT-V
1. Employer Employee Relations
2. Wage and Salary Administration
3. Allowances and Benefits

REFERENCES:
1. Stahl Glean O: Public Personnel Administration
4. Dwivedi O.P and Jain R.B: India’s Administrative state.
7. Davar R.S. Personnel Management & Industrial Relations

CMG346
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
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.

TOTAL: 45 PERIODS
REFERENCES:

VERTICAL 4: BUSINESS DATA ANALYTICS

CMG349 STATISTICS FOR MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:
- To learn the applications of statistics in business decision making.

UNIT I INTRODUCTION
Basic definitions and rules for probability, Baye’s theorem and random variables, Probability
distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT II SAMPLING DISTRIBUTION AND ESTIMATION
Introduction to sampling distributions, Central limit theorem and applications, sampling techniques,
Point and Interval estimates of population parameters.

UNIT III TESTING OF HYPOTHESIS - PARAMETRIC TESTS
Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one
sample and two sample tests for means of small samples (t-test), ANOVA one way.

UNIT IV NON-PARAMETRIC TESTS
Chi-square tests for independence of attributes and goodness of fit, Kolmogorov-Smirnov – test for

UNIT V CORRELATION AND REGRESSION
Correlation – Rank Correlation – Regression – Estimation of Regression line – Method of Least
Squares – Standard Error of estimate.

TOTAL:45 PERIODS

OUTCOMES:
- To facilitate objective solutions in business decision making.
- To understand and solve business problems
- To apply statistical techniques to data sets, and correctly interpret the results.
- To develop skill-set that is in demand in both the research and business environments
- To enable the students to apply the statistical techniques in a work setting.

REFERENCES:
2017.
5. David R. Anderson, Dennis J. Sweeney, Thomas A.Williams, Jeffrey D.Camm, James
6. Cochran, Statistics for business and economics, 13th edition, Thomson (South – Western) Asia,
Singapore, 2016.
OBJECTIVES:
- To know how to derive meaning form huge volume of data and information.
- To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION
Data mining, Text mining, Web mining, Data warehouse.

UNIT II DATA MINING PROCESS
Datamining process – KDD, CRISP-DM, SEMMA
Prediction performance measures

UNIT III PREDICTION TECHNIQUES
Data visualization, Time series – ARIMA, Winter Holts,

UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES
Classification, Association, Clustering.

UNIT V MACHINE LEARNING AND AI
Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization

OUTCOMES:
1. Learn to apply various data mining techniques into various areas of different domains.
2. Be able to interact competently on the topic of data mining for business intelligence.
3. Apply various prediction techniques.
4. Learn about supervised and unsupervised learning technique.
5. Develop and implement machine learning algorithms

REFERENCES:
1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
7. G. K. Gupta, Introduction to Data mining with Case Studies, Prentice hall of India, 2011
9. Elizabeth Vitt, Michael Luckevich Stacia Misner, Business Intelligence, Microsoft, 2011
OBJECTIVES:
- To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
- To know the different types of HR metrics and understand their respective impact and application.
- To understand the impact and use of HR metrics and their connection with HR analytics.
- To understand common workforce issues and resolving them using people analytics.

UNIT I INTRODUCTION TO HR ANALYTICS
People Analytics - stages of maturity - Human Capital in the Value Chain: impact on business – HR metrics and KPIs.

UNIT II HR ANALYTICS I: RECRUITMENT
Recruitment Metrics: Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio - Quality of hire.

UNIT III HR ANALYTICS - TRAINING AND DEVELOPMENT
Training & Development Metrics: Percentage of employees trained - Internally and externally trained - Training hours and cost per employee - ROI.

UNIT IV HR ANALYTICS EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION
Employee Engagement Metrics: Talent Retention index - Voluntary and involuntary turnover - grades, performance, and service tenure - Internal hired index Career Progression Metrics: Promotion index - Rotation index - Career path index.

UNIT V - HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT
Workforce Diversity and Development Metrics: Employees per manager - Workforce age profiling - Workforce service profiling - Churnover index - Workforce diversity index - Gender mix

TOTAL: 45 PERIODS

OUTCOME:
- The learners will be conversant about HR metrics and ready to apply at work settings.
- The learners will be able to resolve HR issues using people analytics.

REFERENCES:
OBJECTIVE:
To showcase the opportunities that exist today to leverage the power of the web and social media

UNIT I  MARKETING ANALYTICS
Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT II  COMMUNITY BUILDING AND MANAGEMENT
History and Evolution of Social Media - Understanding Science of Social Media - Goals for using Social Media - Social Media Audience and Influencers - Digital PR - Promoting Social Media Pages - Linking Social Media Accounts - The Viral Impact of Social Media.

UNIT III  SOCIAL MEDIA POLICIES AND MEASUREMENTS
Social Media Policies - Etiquette, Privacy - ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV  WEB ANALYTICS
Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT V  SEARCH ANALYTICS
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

TOTAL: 45 PERIODS

OUTCOME:
- The Learners will understand social media, web and social media analytics and their potential impact.

REFERENCES:
2. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014
5. Ric T. Peterson, Web Analytics Demystified, Celillo 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 and Techniques, the analytical network process (ANP), TOPSIS.

TOTAL: 45 PERIODS

OUTCOME:
• To enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.

REFERENCES:

CMG354 FINANCIAL ANALYTICS L T P C
3 0 0 3

OBJECTIVE:
• This course introduces a core set of modern analytical tools that specifically target finance applications.

UNIT I CORPORATE FINANCE ANALYSIS
Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.

UNIT II FINANCIAL MARKET ANALYSIS
Estimation and prediction of risk and return (bond investment and stock investment) –Time series-examining nature of data, Value at risk, ARMA, ARCH and GARCH.

UNIT III PORTFOLIO ANALYSIS
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.
UNIT IV  TECHNICAL ANALYSIS  9

UNIT V  CREDIT RISK ANALYSIS  9
Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.

TOTAL: 45 PERIODS

OUTCOME
• The learners should be able to perform financial analysis for decision making using excel, Python and R.

REFERENCES:

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

CES331 SUSTAINABLE INFRASTRUCTURE DEVELOPMENT 3 0 0 3

OBJECTIVE:
• To impart knowledge about sustainable Infrastructure development goals, practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.

UNIT I  SUSTAINABLE DEVELOPMENT GOALS  9

UNIT II  SUSTAINABLE INFRASTRUCTURE PLANNING  9
UNIT III   SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES  9

UNIT IV   SUSTAINABLE CONSTRUCTION MATERIALS  9

UNIT V   SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS  9

TOTAL: 45 PERIODS

OUTCOME:
On completion of the course, the student is expected to be able to
CO1 Understand the environment sustainability goals at global and Indian scenario.
CO2 Understand risks in development of projects and suggest mitigation measures.
CO3 Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
CO4 Explain Life Cycle Analysis and life cycle cost of construction materials.
CO5 Explain the new technologies for maintenance of infrastructure projects.

REFERENCES:
5. New Building Materials and Construction World magazine
7. Munier N, "Introduction to Sustainability", Springer2005

**CO’s- PO’s & PSO’s MAPPING**

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**CES332 SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT**

**OBJECTIVES:**
- To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.

**UNIT I AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS**
Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

**UNIT II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT**
Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

**UNIT III WATER MANAGEMENT**
Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

**UNIT IV ENERGY AND WASTE MANAGEMENT**
Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

**UNIT V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS**
Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS

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

CO1 Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture

CO2 Discuss the sustainable ways in managing soil health, nutrients, pests and diseases

CO3 Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources

CO4 Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas

CO5 Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

REFERENCES:
1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020

CO – PO Mapping - SUSTAINABLE AGRICULTURE PRACTICES

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CES333 SUSTAINABLE BIOMATERIALS

OBJECTIVES
- To Impart knowledge of biomaterials and their properties
- To learn about Fundamentals aspects of Biopolymers and their applications
- To learn about bioceramics and biopolymers
- To introduce the students about metals as biomaterials and their usage as implants
- To make the students understand the significance of bionanomaterials and its applications.

UNIT I INTRODUCTION TO BIOMATERIALS

Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials-

UNIT II BIO POLYMERS
Molecular structure of polymers-Molecular weight-Types of polymerization techniques—Types of polymerization reactions-Physical states of polymers-Common polymeric biomaterials-Polyethylene-Poly(methylmethacrylate) (PMMA)-Poly(lactic acid) (PLA) and polyglycolic acid (PGA)-Polycaprolactone (PCL)-Other biodegradable polymers—Polyurethane-reactions polymers for medical purposes-Collagens-Elastin-Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT III BIO CERAMICS AND BIOCOMPOSITES
General properties-Bio ceramics-Silicate glass-Alumina (Al2O3)-Zirconia (ZrO2)-Calcium phosphate (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 NANOBIOIMATERIALS

OUTCOMES
- Students will gain familiarity with Biomaterials and they will understand their importance.
- Students will get an overview of different biopolymers and their properties.
- Students gain knowledge on some of the important Bioceramics and Biocomposite materials.
- Students gain knowledge on metals as biomaterials.
- Students gain knowledge on the importance of nanobiomaterials in biomedical applications.

REFERENCES
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 of supercapacitors and the materials used.

UNIT I  SUSTAINABLE ENERGY SOURCES  9
Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy

UNIT II  ELECTROCHEMICAL DEVICES  9
Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O₂ battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO₂, LiFePO₄, LiMn₂O₄) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)

UNIT III  FUEL CELLS  9

UNIT IV  PHOTOVOLTAICS  9
UNIT V  SUPERCAPACITORS  
Supercapacitor – types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF) - Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL : 45 PERIODS

OUTCOMES
- Students will acquire knowledge about energy sustainability.
- Students understand the principles of different electrochemical devices.
- Students learn about the working of fuel cells and their application.
- Students will learn about various Photovoltaic applications and the materials used.
- The students gain knowledge on different types of supercapacitors and the performance of various materials

REFERENCES
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh
UNIT II POLLUTION TYPES
Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT III GREEN REAGENTS AND GREEN SYNTHESIS
Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions

UNIT IV DESIGNING GREEN PROCESSES
Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention

UNIT V GREEN NANOTECHNOLOGY
Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: To understand the principles of green engineering and technology
CO2: To learn about pollution using hazardous chemicals and solvents
CO3: To modify processes and products to make them green and safe.
CO4: To design processes and products using green technology
CO5 – To understand advanced technology in green synthesis

TEXT BOOKS

REFERENCE BOOKS
1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

CES336 ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS

OBJECTIVES:
- to understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.

UNIT I ENVIRONMENTAL MONITORING AND STANDARDS
UNIT II MONITORING OF ENVIRONMENTAL PARAMETERS


UNIT III ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING

Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods -Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT IV ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISK ASSESSMENT


UNIT V AUTOMATED DATA ACQUISITION AND PROCESSING

Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks -Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

COURSE OUTCOMES

After completion of this course, the students will know

| CO1 | Basic concepts of environmental standards and monitoring. |
| CO2 | the ambient air quality and water quality standards; |
| CO3 | the various instrumental methods and their principles for environmental monitoring |
| CO4 | The significance of environmental standards in monitoring quality and sustainability of the environment. |
| CO5 | the various ways of raising environmental awareness among the people. |
| CO6 | Know the standard research methods that are used worldwide for monitoring the environment. |

TEXTBOOKS

2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and solid wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc

REFERENCES

1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.
### Course Articulation Matrix

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### CES337  Integrated Energy Planning for Sustainable Development  L T P C  3 0 0 3

#### COURSE OBJECTIVES:
1. To create awareness on the energy scenario of India with respect to world
2. To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation
3. Familiarisation on the concept of sustainable development and its benefits
4. Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development
5. Acquainting with energy policies and energy planning for sustainable development

#### UNIT I  ENERGY SCENARIO  9
Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security

#### UNIT II  ENERGY AND ENVIRONMENT  9
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

#### UNIT III  SUSTAINABLE DEVELOPMENT  9

#### UNIT IV  RENEWABLE ENERGY TECHNOLOGY  9

#### UNIT V  ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT  9

**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 3 0 0 3

COURSE OBJECTIVES:
1. To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
2. To create awareness on energy audit and its impacts
3. To acquaint the techniques adopted for performance evaluation of thermal utilities
4. To familiarise on the procedures adopted for performance evaluation of electrical utilities
5. To learn the concept of sustainable development and the implication of energy usage

UNIT I ENERGY AND ENVIRONMENT 9
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 9
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 9
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 9
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: