PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

I. To prepare students to excel in research and to succeed in the areas of materials science and metallurgical engineering.

II. To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve materials science and metallurgical engineering problems.

III. To train students to have sound knowledge on the production, processing, characterization, structural properties correlation and application of all different engineering materials.

IV. To inculcate students with professional and ethical attitude, effective communication skills, teamwork skills and multidisciplinary approach.

V. To develop student with an academic excellence, leadership qualities, leading to life-long learning for a successful professional career.

PROGRAM OUTCOMES (POs)

PO  Graduate Attribute

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

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

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

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

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

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

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

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

9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10 **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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

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

**PROGRAM SPECIFIC OUTCOMES (PSOs)**

1. Graduates will have an ability to identify, analyse and provide solution to the problems related to Materials and metallurgical engineering

2. Graduates will have the ability to implement/use appropriate characterisation techniques, analytical skills, and latest/recent development in materials technology to solve engineering problems related to materials selection and design.

3. Graduates will be able to design and develop materials and processing techniques to meet the industry needs within the realistic constraints economic, environmental, social, ethical, health and safety, manufacturability and sustainability

**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. MATERIALS SCIENCE AND ENGINEERING
CURRICULUM FOR SEMESTERS I TO VIII AND SYLLABI FOR SEMESTERS I TO IV

### SEMESTER I

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

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$ NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA
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*Two weeks Summer Internship carries one credit and it will be done during IV semester summer vacation and same will be evaluated in V semester.

*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.
## SEMESTER VII / VIII*

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<tr>
<th>S. No.</th>
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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).

#Elective – management shall be chosen from the Elective – Management Courses

## SEMESTER VIII / VII*

<table>
<thead>
<tr>
<th>S. 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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*If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.

TOTAL CREDITS = 166
### ELECTIVE – MANAGEMENT COURSES

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### MANDATORY COURSES I

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### MANDATORY COURSES II

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### PROFESSIONAL ELECTIVE COURSES: VERTICALS

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<th>Vertical 1</th>
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<th>Vertical 3</th>
<th>Vertical 4</th>
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<tr>
<td><strong>MECHANICAL BEHAVIOUR AND MATERIALS CHARACTERIZATION</strong></td>
<td><strong>ADVANCED MATERIALS AND PROCESSING</strong></td>
<td><strong>MATERIALS FOR ELECTRICAL, ELECTRONIC AND MAGNETIC APPLICATIONS</strong></td>
<td><strong>DIVERSIFIED COURSES GROUP 1</strong></td>
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<tr>
<td>Fracture Mechanics and Failure Analysis</td>
<td>Fundamentals of Nanoscience</td>
<td>Smart Materials</td>
<td>Introduction to Transport Phenomena</td>
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<tr>
<td>Creep and Fatigue Behaviour of Materials</td>
<td>Metallurgy of Tool Materials and Special Steels</td>
<td>Energy Storage Devices</td>
<td>Materials Selection and design</td>
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<tr>
<td>Electron Microscopy</td>
<td>Automotive Materials</td>
<td>Fuel Cell Technology</td>
<td>Materials for Green Engineering</td>
</tr>
<tr>
<td>X-ray Diffraction and Associated Techniques</td>
<td>Additive Manufacturing</td>
<td>Semiconductors and optoelectronic Materials and Devices</td>
<td>Unconventional Machining Processes</td>
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<tr>
<td>Advanced Metallographic Techniques</td>
<td>Cryogenic Treatment of Materials</td>
<td>Advanced Materials Characterisation</td>
<td>Laser Processing of Materials</td>
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<tr>
<td>Finite Element Analysis</td>
<td>Nuclear Materials</td>
<td>Thin Film Technology</td>
<td>Making and Metallurgy of Stainless steels</td>
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<tr>
<td>Modelling and Simulation in Materials Engineering</td>
<td>Composite Materials</td>
<td>MEMS and Nanotechnology</td>
<td>Fuels, Furnaces and Refractories</td>
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<td>Phase Transformations</td>
<td>Advanced Ceramics</td>
<td>Micro and Nano Fabrication</td>
<td>High Temperature Materials</td>
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### Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E./B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2021, Clause 4.10.
# PROFESSIONAL ELECTIVE COURSES: VERTICALS

## VERTICAL 1: MECHANICAL BEHAVIOUR AND MATERIALS CHARACTERIZATION

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## VERTICAL 2: ADVANCED MATERIALS AND PROCESSING

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### VERTICAL 4: 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

<table>
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<th>COURSE TITLE</th>
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</table>
ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) 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 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>
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<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>
</tr>
<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>
</tr>
<tr>
<td>Fundamentals of Investment</td>
<td>Team Building and Leadership Management for Business</td>
<td>Constitution of India</td>
<td>Data Mining for Business Intelligence</td>
<td>Sustainable Agriculture and Environmental Management</td>
</tr>
<tr>
<td>Banking, Financial Services and Insurance</td>
<td>Creativity and Innovation in Entrepreneurship</td>
<td>Public Personnel Administration</td>
<td>Human Resource Analytics</td>
<td>Sustainable Bio Materials</td>
</tr>
<tr>
<td>Introduction to Blockchain and its Applications</td>
<td>Principles of Marketing Management for Business</td>
<td>Administrative Theories</td>
<td>Marketing and Social Media Web Analytics</td>
<td>Materials for Energy Sustainability</td>
</tr>
<tr>
<td>Fintech Personal Finance and Payments</td>
<td>Human Resource Management for Entrepreneurs</td>
<td>Indian Administrative System</td>
<td>Operation and Supply Chain Analytics</td>
<td>Green Technology</td>
</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>-</td>
<td>Integrated Energy Planning for Sustainable Development</td>
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<td>-</td>
<td>Energy Efficiency for Sustainable 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 BLOCK CHAIN**

<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>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CMG331</td>
<td>Financial Management</td>
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</tr>
<tr>
<td>2.</td>
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<td>Fundamentals of Investment</td>
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<td>3.</td>
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<td>Banking, Financial Services and Insurance</td>
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<td>4.</td>
<td>CMG334</td>
<td>Introduction to Blockchain and its Applications</td>
<td>PEC</td>
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<tr>
<td>6.</td>
<td>CMG336</td>
<td>Introduction to Fintech</td>
<td>PEC</td>
<td>3 0 0</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>
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<th>CREDITS</th>
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<tbody>
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<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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<tr>
<td>3.</td>
<td>CMG339</td>
<td>Creativity and Innovation in Entrepreneurship</td>
<td>PEC</td>
<td>3 0 0</td>
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<td>4.</td>
<td>CMG340</td>
<td>Principles of Marketing Management for Business</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>
<td>PEC</td>
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### VERTICAL 3: PUBLIC ADMINISTRATION

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<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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<tbody>
<tr>
<td>1.</td>
<td>CMG343</td>
<td>Principles of Public Administration</td>
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<td>3 0 0</td>
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<tr>
<td>2.</td>
<td>CMG344</td>
<td>Constitution of India</td>
<td>PEC</td>
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<td>3.</td>
<td>CMG345</td>
<td>Public Personnel Administration</td>
<td>PEC</td>
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<td>4.</td>
<td>CMG346</td>
<td>Administrative Theories</td>
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<td>5.</td>
<td>CMG347</td>
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<td>PEC</td>
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<td>6.</td>
<td>CMG348</td>
<td>Public Policy Administration</td>
<td>PEC</td>
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### VERTICAL 4: BUSINESS DATA ANALYTICS

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<th>COURSE CODE</th>
<th>COURSE TITLE</th>
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<tr>
<td>1.</td>
<td>CMG349</td>
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<td>2.</td>
<td>CMG350</td>
<td>Datamining for Business Intelligence</td>
<td>PEC</td>
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<td>3.</td>
<td>CMG351</td>
<td>Human Resource Analytics</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>6.</td>
<td>CMG354</td>
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<td>SL. NO.</td>
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<tr>
<td>1.</td>
<td>CES331</td>
<td>Sustainable infrastructure Development</td>
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<td>2.</td>
<td>CES332</td>
<td>Sustainable Agriculture and Environmental Management</td>
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<td>3.</td>
<td>CES333</td>
<td>Sustainable Bio Materials</td>
<td>PEC</td>
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<td>4.</td>
<td>CES334</td>
<td>Materials for Energy Sustainability</td>
<td>PEC</td>
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<tr>
<td>5.</td>
<td>CES335</td>
<td>Green Technology</td>
<td>PEC</td>
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<td>6.</td>
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<td>Environmental Quality Monitoring and Analysis</td>
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<td>7.</td>
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<td>8.</td>
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<td>Energy Efficiency for Sustainable Development</td>
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This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

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

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

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

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

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

(i) Physical Activity

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

(ii) Creative Arts

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

(iii) Universal Human Values

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

(iv) Literary Activity

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

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

(vi) Lectures by Eminent People

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

(vii) Visits to Local Area

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

(viii) Familiarization to Dept./Branch & Innovations

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

(ix) Department Specific Activities

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

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

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

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

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 grammatic structures and use them in right context.
- To read and infer the denotative and connotative meanings of technical texts
- To write definitions, descriptions, narrations and essays on various topics

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

REFERENCE BOOKS:

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

MA3151 MATRICES AND CALCULUS  
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</table>

COURSE OBJECTIVES:
- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT - I  MATRICES  
9 + 3
UNIT - II DIFFERENTIAL CALCULUS 9 + 3

UNIT - III FUNCTIONS OF SEVERAL VARIABLES 9 + 3

UNIT - IV INTEGRAL CALCULUS 9 + 3
Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications : Hydrostatic force and pressure, moments and centres of mass.

UNIT - V MULTIPLE INTEGRALS 9 + 3

TOTAL: 60 PERIODS

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

CY3151 ENGINEERING CHEMISTRY

COURSE OBJECTIVES:
- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I WATER AND ITS TREATMENT

UNIT II NANOCEMISTRY
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  9
Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel.
Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO₂ emission and carbon foot print.

UNIT V  ENERGY SOURCES AND STORAGE DEVICES  9
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:

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

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

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

TOTAL : 45 PERIODS

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

UNIT I

LANGUAGE AND LITERATURE

UNIT II

HERITAGE - ROYAL ART PAINTINGS TO MODERN ART – SCULPTURE

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. தமிழக வரலோறு – மக்களும் பண்பொடும் – சு.ச. பிரசாத (தெய்வியின்: தமிழும் பண்பொடும் மக்களும் பண்பொடும் பண்பொடும் துறைமுகம்).

2. கணினித் தமிழ் – முமனவர் இல். சுந்தரம். (விகடன் பிரசுரம்).

3. நூற்றாண்டு கொண்டாட்டம் தொகுதிகள் தொகுதிகள் தொகுதிகள் (தெய்வியின்: கணினித் துறைமுக).

4. வரலோறு களாக தொன்றுதலம். (தெய்வியின்: களாக தொன்றுதலம்)

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)


Course Code: GE3171
Course Title: PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY
L T P C 0 0 4 2

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/
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.

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 Na$_2$CO$_3$ 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 (TiO$_2$/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

TEXT BOOK:

GE3172 ENGLISH LABORATORY

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

UNIT I INTRODUCTION TO FUNDAMENTALS OF 6 COMMUNICATION
Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies- making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions( filling out a bank application for example).
UNIT II NARRATION AND SUMMATION 6
Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings-engaging in small talk- describing requirements and abilities.

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

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

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

TOTAL : 30 PERIODS

LEARNING OUTCOMES:
At the end of the course, learners will be able
- To listen and comprehend complex academic texts
- To speak fluently and accurately in formal and informal communicative contexts
- To express their opinions effectively in both oral and written medium of communication

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.

HS3251 PROFESSIONAL ENGLISH - II L T P C 2 0 0 2

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

UNIT I MAKING COMPARISONS 6
Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases
UNIT II EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING 6
Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds

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

UNIT IV REPORTING OF EVENTS AND RESEARCH 6

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

TOTAL : 30 PERIODS

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

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

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.
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 derivatives using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson’s 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

TOTAL: 60 PERIODS

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.
TEXT BOOKS:

REFERENCES:

CY3202 SOLID STATE CHEMISTRY

COURSE OBJECTIVES:
- To understand and apply the basics of principles of solid state chemistry.
- To identify and apply the concepts involved in the syntheses, structure and physical properties of crystalline inorganic solids.
- To apply various techniques for the preparation of different types of solids.
- To understand the principles of solid characterization techniques.

UNIT I CRYSTAL STRUCTURE
Solids-Types-Crystalline, Amorphous and poly crystalline; Properties: Isotropy and anisotropy-interfacial angles-symmetry in crystal systems-elements of symmetry – space lattice and unit cell, Bravias lattice-seven crystal systems. Bond types: molecular, covalent, metallic and ionic. Born-Heber Cycle, Lattice energy, Imperfections in crystalstoichiometric defects-Schottky, Frenkel, Non-stoichiometric defects-Colour Centre, F-Centre

UNIT II ELECTRICAL PROPERTIES
Band theory of solids -metals and their properties; semiconductors – extrinsic and intrinsic, insulators – dielectric, ferroelectric, pyroelectric and piezoelectric properties, multiferroics. Superconductivity: Basics, discovery and high Tc materials.

UNIT III MAGNETIC PROPERTIES
Dia, para, ferro, ferri, and antiferro magnetic types; soft and hard magnetic materials; select magnetic materials such as spinels, garnets and perovskites, hexaferrites and lanthanide-transition metal compounds; magneto resistance

UNIT IV SYNTHETIC METHODS
Thin film-Electro chemical methods, PVD & CVD: Crystal growth-Thermal methods-Bridgman, Stockbarger and Zone refining, High temperature ceramic methods. Particle size reduction, precursor method. Sol-Gel, Co-precipitation, microwave assisted synthesis, combustion synthesis,
High pressure methods for preparing single crystals-Czochralski, molecular beam epitaxy-Flame and plasma fusion methods, intercalated compounds.

UNIT V SOLID CHARACTERIZATION TECHNIQUES
Powder x-ray diffraction, indexing the powder XRD patterns, Systematic absences, Structure factor, determination of lattice type, unit cell parameter and density for fcc, bcc and hcp metals, Thermal analysis: TGA, DTA, DSC

COURSE OUTCOME:
At the end of the course, the learners should be able to:
- Arrive at the chemical compositions based on unit cell contents and fractional coordinates.

TEXT BOOKS:

BE3251 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C 3 0 0 3

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:

REFERENCES:

GE3251 ENGINEERING GRAPHICS

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
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)

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 BOOK:

REFERENCES:

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

GE3252

Kumaran Engineering Academy

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Special points applicable to University Examinations on Engineering Graphics:

1. The examination will be conducted in appropriate sessions on the same day.
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3. The examination will be conducted in appropriate sessions on the same day.

Publication of Bureau of Indian Standards:

Publications of Bureau of Indian Standards:

TEXT-CUM-REFERENCE BOOKS
1. கூர்க்குறுந்து – வதிக்குறு பொண்டப்பை – கோழி. பிரித்தல் (மொழிபெற்று: கூர்க்குறுந்து பொண்டப்பை கோழி. பிரித்தல்).
2. கல்லிதார் கூர்க்குறு – வானாந்த வாட்டார். பதிவு (மொழிபெற்று).
3. சின்னார் – தொட்டார் தின்மகர்வால் கம்மகார நான்காரியும் (தமிழ்மொழி கூர்க்குறு)
4. பார்க்குறு – கன்றகுறு தகரியும். (தமிழ்மொழி கூடாத வைப்பு)
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)

GE3252 TAMILS AND TECHNOLOGY L T P C 1 0 0 1

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

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

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. தமிழகவரலொறு – மக்களும் பணபொடும் – மக.மக.பிள்மள (தவளியீடு: தமிழ்நொடுபொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கல்வித்துவி தமிழ் – பலீகாசல் திண்ம.சின்னபராம். (மஞ்சல பிரசுரம்).
3. மின் – செம்மநச்சக்கிள்ளாரினி சர்வகல தொடர் தகரிகம் (தந்தாண்டி பிள்மள தவளியீடு)
4. பொம்புமாட்டு – கிள்ளாரினி தகரிகம். (தந்தாண்டி பிள்மள தவளியீடு)
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11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
## NCC CREDIT COURSE LEVEL 1*

### (ARMY WING) NCC CREDIT COURSE LEVEL - I

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

NATIONAL INTEGRATION AND AWARENESS

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

PERSONALITY DEVELOPMENT

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

LEADERSHIP

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

SOCIAL SERVICE AND COMMUNITY DEVELOPMENT

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

TOTAL : 30 PERIODS
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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 air conditioner.

SHEET METAL WORK:
  a) Making of a square tray

FOUNDARY 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 processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
4. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

TOTAL = 60 PERIODS
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

OBJECTIVES
- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To be able to communicate effectively through writing.

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- making arrangements- describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms- Writing: - writing different types of emails.
UNIT III
Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios- talking about purchasing-discussing advantages and disadvantages- making comparisons- discussing likes and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.

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

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

TOTAL: 60 PERIODS

LEARNING OUTCOMES
- Speak effectively in group discussions held in a formal/semi formal contexts.
- Write emails and effective job applications.

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

COURSE 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 APPLICATONS 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

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

TEXT BOOKS:

REFERENCES:
ML3301 POLYMER SCIENCE AND ENGINEERING

COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Understanding the basics of polymers, its formation and polymerization types.
2. Getting acquainted with the significance and the molecular weights of polymers.
3. Characterizing the polymers for their thermal behaviour and solution properties.
4. Gaining knowledge on the thermodynamics of polymer dissolution and the factors influencing them.
5. Identifying suitable polymer processing methods for polymer products.

UNIT I POLYMERS AND POLYMERIZATION

UNIT II MOLECULAR WEIGHTS OF POLYMERS
Number average and weight average molecular weights – Degree of polymerization – Molecular weight distribution – Polydispersity – Molecular weight determination-Methods – Viscometry - Gel Permeation Chromatography.

UNIT III TRANSITIONS IN POLYMERS

UNIT IV SOLUTION PROPERTIES OF POLYMERS

UNIT V POLYMER PROCESSING

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Describe the basics concepts and fundamental principles of polymers and polymerization.
2. Evaluate and determine the molecular weights of polymers.
3. Characterize and evaluate the thermal and solution properties of polymers.
4. Analyse the thermodynamics of polymer dissolution.
5. Produce tailor-made polymers to suit the demanding applications.

TEXT BOOKS

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ML3302 METALLURGICAL THERMODYNAMICS

COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Having an overview on the fundamental concepts in metallurgical thermodynamics
2. Gaining knowledge about the state functions such as internal energy, entropy and criteria of equilibrium.
3. Getting an insight to the auxiliary functions, heat capacities and thermodynamic potentials.
4. Knowing the essentials of thermodynamic behaviour of solutions,
5. Having an exposure on thermodynamics of electrochemical cells, surfaces and defects.

UNIT I FUNDAMENTAL CONCEPTS
Definition of thermodynamic terms; concept of states, systems and surroundings, Types of systems, equilibrium. Equation of states, extensive and intensive properties, homogeneous and heterogeneous, micro-macro systems. Phase diagrams and its classification, Internal energy, heat capacity, enthalpy, isothermal, and adiabatic processes.

UNIT II INTERNAL ENERGY AND ENTROPY
First law of Thermodynamics: Relation between Heat and work, Internal energy and Enthalpy. The Second law of thermodynamics: Spontaneous process, Degree of measure of reversibility and irreversibility, Maximum work, criteria of equilibrium. Combined statement of first and second laws on thermodynamics. Statistical interpretation of entropy: Concept of microstate, most probable microstate, Thermal equilibrium, Boltzman equation, configurational entropy

UNIT III AUXILLARY FUNCTIONS AND THERMODYNAMIC POTENTIALS
UNIT IV  THERMODYNAMICS OF SOLUTIONS  9+3

UNIT V  THERMODYNAMICS OF REACTIONS  9+3

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Recognize the nature of the system and properties.
2. Explain the concept of internal energy, entropy and criteria for equilibrium.
3. Realize the importance of auxiliary functions and thermodynamic potentials
4. Apply the concepts of thermodynamics in the behaviour of solutions.
5. Outline the thermodynamic approaches towards electrochemical cells, surfaces and defects.

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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. Analysing 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  9
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. Analyse 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. Analyse the thin and thick shells and principal stresses in beam for various engineering applications.
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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 STATICS 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

TOTAL : 45 PERIODS

COURSE 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

TEXT BOOKS:

REFERENCES:
ML3303 PHYSICAL METALLURGY

COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Acquiring a sound background in predicting the behaviour of a metallic material to a certain application.
2. Understanding the fundamental principles of Physical Metallurgy
3. Getting familiarized with the interpretation of phase diagrams.
4. Having an insight on the thermodynamics aspect of physical metallurgy
5. Gaining knowledge on the various strengthening mechanisms in materials

UNIT I STRUCTURE OF SOLIDS & SOLIDIFICATION OF PURE METALS
Atomic Bonding & Crystal Structure: Metallic bond, unit cell, atomic packing, interstitial sites, Miller indices, crystal orientation, stereographic projection.
Phase rule, Concept of Free Energy, Entropy, Surface Energy (grain boundary) & under cooling, Nucleation & Growth, homogeneous & heterogeneous nucleation, directional solidification. Mechanisms (slip & twin), critical resolved shear stress, single crystal tensile test (FCC), theoretical strength of ideal crystal.

UNIT II CRYSTAL IMPERFECTIONS AND DIFFUSION
Vacancy, interstitial, substitutional, free energy of mixing, dislocation (elementary concepts only), edge / screw dislocation, partial dislocation, stacking fault, dislocation lock, dislocation pile up, Hall Petch relation, grain boundary structure.
Elementary concepts of phenomenological & atomistic approaches in Diffusion

UNIT III SOLIDIFICATION OF BINARY ALLOYS
Limits of solubility, isomorphous system, lever rule, constitutional super cooling, effect of nonequilibrium cooling, eutectic, peritectic, eutectoid & peritectoid system, complex phase diagram, ternary diagram, structure of cast metal, segregation & porosity, iron-carbon diagram, steel & cast iron. Phase Diagrams of common commercial alloys: Cu-Ni, Ni-Cr, Al-Si, Al-Zn, Cu-Zn, Cu-Al, Ti-Al, Ti-V, interpretation of microstructure & properties.

UNIT IV COLD WORKING, ANNEALING AND PRECIPITATION

UNIT V APPLICATIONS OF PHYSICAL METALLURGY
Strengthening mechanism, strength vs. toughness (ductility), thermo-mechanical processing, micro alloyed steel, ultra-high strength steel, superalloy, control of texture.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of the Course, the students will be able to
1. Recognize the basic nomenclature, microstructure, and associated terms with the appropriate structure/phenomena and differentiate between related structure/phenomena.
2. Perform simple calculations to quantify material properties and microstructural characteristics.
3. Interpret the effect of composition and microstructure on material properties.
4. Perform phase equilibrium calculation and construct phase diagram.
5. Discuss on the various strengthening mechanisms and thermal mechanical processing.

TEXT BOOKS

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PO1: Process Technology of Materials
PO2: Phase Diagrams
PO3: Phase Transformations
PO4: Thermodynamics
PO5: Crystallography
PO6: Microstructure
PO7: Crystal Plasticity
PO8: Crystal Defects
PO9: Metallurgical Processing
PO10: Failure Analysis
PSO1: Product Sustainability
PSO2: Process Sustainability
PSO3: Sustainability Assessment
COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Having hands on experience on the preparation of samples for microscopic examination.
2. Analysing the microstructure of plain carbon steels and its influence on the properties of materials.
3. Interpreting the microstructure of the cast irons and its effect on the mechanical properties.
4. Distinguishing the microstructures of the different stainless steels and high-speed steels.
5. Examining the banded structures in steels, structure of welded joints and copper alloys.

LIST OF EXPERIMENTS
1. Mounting and preparation of metallurgical samples.
2. Study of metallurgical microscope and sample preparation.
3. Quantitative Metallography & image analysis.
4. Macro etching - cast, forged and welded components.
5. Electrolytic Etching and Polishing
6. Microscopic examination of cast irons - Gray, White, Malleable and Nodular types.
7. Microscopic examination of Plain carbon steels (low carbon, medium carbon, high carbon steels).
8. Microscopic examination of Austenitic Stainless steels and High Speed Steels.
10. Microscopic examination of Copper alloys.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of the Course, the students will be able to:
1. Prepare the samples for microscopic examination
2. Recognize the microstructures of various ferrous and non-ferrous materials
3. Differentiate the different types of cast irons based on their morphology and analyse the effect of the processing on the microstructure.
4. Interpret the microstructures of various materials and also understand the effect of the various phase constituents on the properties of the materials.
5. Perform a quantitative analysis on any given microstructure.

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COURSE OBJECTIVES:
To study the mechanical properties of metals, wood and spring by testing in laboratory

LIST OF EXPERIMENTS
1. Tension test on mild steel rod
2. Torsion test on mild steel rod
3. Compression test on wood
4. Deflection test on metal beam
5. Double shear test on metal
6. Impact test on metal specimen (Izod and Charpy)
7. Hardness test on metal (Rockwell and Brinell Hardness)
8. Compression test on helical spring
9. Deflection test on carriage spring

TOTAL: 60 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to be able to

CO1  Determine the tensile and torsion properties of steel rod by testing
CO2  Determine the elastic modulus of a metal beam by conducting deflection test
CO3  Determine the shear strength and impact strength of metals.
CO4  Determine the hardness of various metals.
CO5  Determine the stiffness properties of helical and carriage spring.

CO – PO Mapping – STRENGTH OF MATERIALS LABORATORY

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OBJECTIVES:
To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.

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

MS WORD:

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

10 Hours

MS EXCEL:

Create worksheets, insert and format data
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 formulæ
Create and Work with different types of charts
Use pivot tables to summarize and analyse data
Perform data analysis using own formulæ and functions
Combine data from multiple worksheets using own formulæ and built-in functions to generate results
Export data and sheets to other file formats
Working with macros
Protecting data and Securing the workbook

10 Hours

MS POWERPOINT:

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

10 Hours

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.

ML3401  CHARACTERISATION OF MATERIALS  L  T  P  C
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COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Understanding the various techniques of structural characterization of materials.
2. Interpreting the microstructure, crystal structure and surface structure of materials.
3. on X-Ray diffraction techniques and analysis
4. To import knowledge on different electron microscopy techniques used for characterisation
5. To import knowledge on different electron microscopy techniques used for characterisation
6. To import knowledge on techniques of elemental chemical composition and structure of surface.

UNIT I  METALLOGRAPHIC TECHNIQUES  9
Macro examination - applications, metallurgical microscope - construction and principle of working, specimen preparation, light material interaction – Rayleigh Scattering, Abbes theory; magnification, numerical aperture, resolving power, depth of focus, depth of field, different light sources; lenses aberrations and their remedial measures, Principles of microscopy - bright field, dark field, phase-contrast, polarization, differential interference contrast, high temperature microscopy; Quantitative metallography – Image analysis for grain size distribution and grain/precipitate shape.

UNIT II  X-RAY DIFFRACTION TECHNIQUES  9
Reciprocal lattice, Stereographic projection, X-ray generation, absorption edges, characteristic and continuous spectrum, Bragg's law, Ewald’s Sphere, Diffraction methods – Laue, rotating crystal and powder methods. Intensity of diffracted beams – structure factor calculations and other factors. Diffractometer – General features and optics, Counters - Proportional, Scintillating, Geiger counters and semiconductor based.

UNIT III  ANALYSIS OF X-RAY DIFFRACTION  9
Line broadening-crystallite size, residual stress; Texture Analysis; Crystal structure determination-indexing - Phase identification- ASTM catalogue of Materials identification, quantitative phase estimation, Phase diagram determination, Precise lattice parameter calculation, Determination of residual stress – double angle diffraction.

UNIT IV  ELECTRON MICROSCOPY  9
Electron specimen interaction; Construction and operation of Transmission electron microscope (TEM) – specimen preparation techniques- Diffraction mode and image mode, Sources of contrast-Selected Area Electron Diffraction, Zone axis, indexing ; Construction, modes of operation and sources of contrast of Scanning electron microscope(SEM), Electron probe micro analysis, Basics of Field ion microscopy (FIB), Scanning Tunnelling Microscope (STM) and Atomic Force Microscope(AFM).

UNIT V  SURFACE ANALYSIS  9
X-ray emission spectroscopy - Energy Dispersive Spectroscopy- Wave Dispersive Spectroscopy-Ultraviolet Photo Electron Spectroscopy (UPS), X ray Photoelectron Spectroscopy (XPS), Auger Electron Spectroscopy (AES), Electron Energy Analysers, Secondary ion mass spectrometry - Quadrupole mass spectrometer ; Surface Structure -Unit meshes of five types of surface nets -

COURSE OUTCOMES:
Upon completion of course, the student will be able to
1. Describe the principle of metallography and its application.
2. Explain the principle of XRD and its scope for metallurgical analysis.
3. Interpret and analyse the XRD results.
4. Discuss the various techniques of electron microscopy and their applications.
5. Describe the different techniques for the analysis of elemental chemical composition and structure of surface.

TEXT BOOKS:

REFERENCES:
5. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Hong Kong University of Science and Technology, John Wiley & Sons (Asia) Pte Ltd. 2010.

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ML3402 IRON AND STEEL MAKING L T P C 3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Acquiring the basic knowledge on the need for the beneficiation of iron ores and the different preliminary treatments given to the iron ores.
2. Discussing the various parts of blast furnace and the reactions that take place in the various zones of blast furnace
3. Understanding the principles and kinetics of pig iron production as well as steel making.
4. Getting insight on the various primary and secondary processes employed for making of steel
5. Producing the different types of steels by adopting the ladle metallurgy technique.
UNIT I  RAW MATERIALS AND BURDEN PREPARATION
Iron ore classification, Indian iron ores, limestone and coking coal deposits, problems associated with Indian raw materials, Iron ore beneficiation and agglomeration, Briquetting, sintering, Nodulising and pelletizing, testing of burden materials, burden distribution on blast furnace performance.

UNIT II  PRINCIPLES AND PROCESSES OF IRON MAKING
Blast furnace parts, construction and design aspects, ancillary equipment for charging, preheating the blast, hot blast stoves, gas cleaning, Blast furnace operation, irregularities and remedies, Blast furnace instrumentation and control of furnace Compositional control of metal and slag in blast furnace, modern trends in blast furnace practice.
Reduction of iron ores and oxides of iron by solid and gaseous reductions- thermodynamics and kinetics study of direct and indirect reduction, Gruner’s theorem, blast furnace reactions. C-O and Fe-C-O equilibria, Rist diagrams, Ellingham diagram, material and heat balance- Sponge Iron making.

UNIT III  PRINCIPLES OF STEEL MAKING

UNIT IV  STEEL MAKING PROCESSES

UNIT V  LADLE METALLURGY

COURSE OUTCOMES:
Upon the completion of the course, the students will be able to:
1. Identify the suitable preliminary treatments to be given to the iron ore for the beneficiation of ores.
2. Discuss the construction of Blast furnace, its operation and the various reactions that takes place in the various zones of blast furnace.
3. Interpret the slag theories and slag functions in the steel making processes.
4. Compare the various steel making processes and analyse the advantages and limitations of the different processes.
5. Select the suitable secondary refining processes for producing a good quality steel.

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ML3403 MECHANICAL BEHAVIOUR OF MATERIALS

COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Having an overview of elastic and plastic behaviour of materials
2. Getting enlightened with the different strengthening mechanisms.
3. Obtaining an insight into the types of fracture and mechanics of fracture.
4. Interpreting the fatigue behaviour of materials.
5. Having an insight on the high temperature behaviour of materials.

UNIT I ELASTIC AND PLASTIC BEHAVIOUR
Elastic behaviour of materials - Hooke’s law, plastic behaviour: dislocation theory, Types of dislocations- Burger’s vectors and dislocation loops, dislocations in the FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, dislocation climb, intersections of dislocations, Jogs, dislocation sources, multiplication of dislocations, dislocation pile-ups, Slip and twinning. Methods of observing dislocations

UNIT II STRENGTHENING MECHANISMS
Elementary discussion of cold working, grain boundary strengthening. Solid solution strengthening, Martensitic strengthening, Precipitation strengthening, Particulate Strengthening, Dispersion strengthening, Fibre strengthening, Yield point phenomenon, strain aging and dynamic strain aging

UNIT III FRACTURE AND FRACTURE MECHANICS
Types of fracture, Basic mechanisms of ductile and brittle fracture, Griffith’s theory of brittle fracture, Orowan’s modification. Izod and Charpy Impacts tests, Ductile to Brittle Transition Temperature (DBTT), Factors affecting DBTT, Determination of DBTT. Fracture mechanics-Introduction, Modes of fracture, Stress intensity factor, Fracture toughness and Determination of KIC.
UNIT IV  FATIGUE BEHAVIOUR AND TESTING  9

UNIT V  CREEP BEHAVIOUR AND TESTING  9
Creep curve, Stages in creep curve and explanation, Structural changes during creep, Creep mechanisms, Metallurgical factors affecting creep, High temperature alloys, Stress rupture testing, Creep testing machines, creep life prediction-Omega (Damage rate) method, Larson-Miller (parametric) method. Deformation Mechanism Maps according to Frost/Ashby, Super plasticity.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Identify the role of dislocations and the mechanisms of plastic deformation.
2. Explain the strengthening mechanisms of polycrystalline and composite materials.
3. Analyse the nature of fracture and its underlying mechanism.
4. Appraise the micro-mechanics, factors and life predictions of components under fatigue loading.
5. Assess the behaviour of materials under high temperature, metallurgical factors and life prediction of high temperature materials.

TEXT BOOKS:

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

1. Having necessary background to design/select the necessary heat treatment for attaining the appropriate microstructure for the desired properties.
2. Getting a comprehensive understanding of the various transformation reactions associated with the changes in microstructures and properties that occur due to controlled heat treatment.
3. Understanding different case hardening techniques used in industries
4. Distinguishing the various Heat treatment furnaces, Quenching media and the heat treatment of some special alloys.
5. Getting an insight on the heat treatments employed for special alloys

UNIT I TRANSFORMATIONS IN STEELS

UNIT II HEAT TREATMENT PROCESSES

UNIT III CASE HARDENING

UNIT IV FURNACES, ATMOSPHERE AND PROCESS CONTROL
Various heating atmosphere used for heat treatment, temperature and atmosphere control– carburising atmosphere and carbon potential measurement, Temperature Measurement Control devices – Nitriding gas atmospheres, quenching media and their characteristics, Stages of Quenching, polymer quenching, Various Heat Treatment furnaces- Roller and Mesh type continuous furnaces- fluidised bed furnaces, cryo-chamber, cryo-treatment of steels, sealed quench furnace, Vacuum furnace, Plasma equipment-Elements of Process control systems-PLC, PID controllers and continuous monitoring systems.

UNIT V HEAT TREATMENT OF SPECIFIC ALLOYS

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Discuss the various transformation reactions associated with the changes in microstructures and properties that occur due to controlled heat treatment.
2. Explain the various heat treatment processes that can be applied for different ferrous and non-ferrous alloys.
3. Analyse the effect of various case hardening treatments on the metals and alloys.
4. Compare the various heat treatment furnaces, quenching media and furnace atmospheres.
5. Interpret the results of heat treatments on the various other non-ferrous materials, alloy steels and cast irons.

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Low (1) ; Medium (2) ; High (3)
CE3391 FLUID MECHANICS AND MACHINERY

COURSE OBJECTIVES:

1. To introduce the students about properties of the fluids, behaviour of fluids under static conditions.
2. To impart basic knowledge of the dynamics of fluids and boundary layer concept.
3. To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends.
4. To exposure to the significance of boundary layer theory and its thicknesses.
5. To expose the students to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 10+3
Properties of fluids – Fluid statics - Pressure Measurements - Buoyancy and floatation - Flow characteristics - Eulerian and Lagrangian approach - Concept of control volume and system - Reynold’s transportation theorem - Continuity equation, energy equation and momentum equation - Applications.

UNIT II FLOW THROUGH PIPES AND BOUNDARY LAYER 9+3
Reynold’s Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 8+3
Fundamental dimensions - Dimensional homogeneity - Rayleigh’s method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT IV TURBINES 9+3

UNIT V PUMPS 9+3
Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies– Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and its variations - Work saved by fitting air vessels - Rotary pumps.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to be able to
1. Understand the properties and behaviour in static conditions. Also to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics
2. Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also to understand the concept of boundary layer and its thickness on the flat solid surface.
3. Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies
4. Explain the working principles of various turbines and design the various types of turbines.
5. Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps
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GE3451 ENVI RONMENTAL SCIENCE AND SUSTAINABILITY L T P C 2 0 0 2

COURSE OBJECTIVES:
1. To study the nature and its impacts on human life.
2. To study the environmental pollution, its types, control methods and protection acts
3. To provide the knowledge of about the energy management and energy resources
4. To study the concepts of Sustainability, global warming and Management
5. To study the Sustainability Practices and socio economical changes

UNIT I ENVIRONMENT AND BIODIVERSITY
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  9

TOTAL: 30 PERIODS

COURSE 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

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:
1. Gaining practical experience on handling sophisticated instruments.
2. Obtaining hands-on-practice for sample preparation.
3. Experiencing the procedure involved in the instrumentation methods.
4. Calibrating and standardizing the sensitive instruments.
5. Using the spectrometers, electron microscopes and thermal analysers for analysing the specimens.

LIST OF EXPERIMENTS:
1. Verification of Beer Lambert’s law using Absorption Spectrophotometer.
2. Determination of concentration of metal ions using UV Visible spectrophotometer.
3. Determination of thermal coefficient using dilatometer.
4. Determination of conductivity using conductivity meter.
5. Identification of organic compounds using IR spectroscopy.
6. Quantitative analysis using column chromatography.
7. Qualitative identification of species using TLC.
8. Thermal degradation analysis using TGA
9. Thermal transition analysis using DSC.
10. Analysis of electron microscopic images

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Apply the theoretical principles and concepts of spectroscopy in characterization of materials.
2. Analyse and interpret the results obtained from the instrumental methods.
3. Demonstrate the use of suitable equipment to analyse the thermal behaviour of materials.
4. Examine the mixture of materials using chromatography technique.
5. Analyse and interpret the microstructural images obtained by electron microscopy.

TOTAL: 60 PERIODS
COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Performing heat treatment operations on the plain carbon steels
2. Interpreting the effect of quenching media and tempering temperature and time on the
   hardness of the steels
3. Enhancing the case hardness of the low carbon steels by carburizing treatment
4. Measuring the case depth of the case-hardened steels
5. Identifying the suitable heat treatment for non-ferrous materials.

LIST OF EXPERIMENTS:
1. Hardening and tempering of High carbon steels
2. Annealing and normalizing of hardened steels
3. Spheroidization annealing of high carbon steels
4. Effect of quenching media on hardening of steel
5. Effect of tempering temperature and time on tempering of steel
6. Effect of carbon percentage on the hardening of steel
7. Carburizing of low carbon steel
8. Case hardness depth measurements
9. Hardenability test – Jominy End Quench Test
10. Heat treatment of cast iron
11. Heat treatment of Stainless Steels and High speed steels
12. Heat treatment of non-ferrous alloys

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Perform various heat treatment processes on plain carbon steels and analyze the effect of
   the processes on steels.
2. Execute the case hardening effect on low carbon steel and to analyze the case depth
   measurements.
3. Interpret the effect of quenching media and the carbon percentage on the hardening of steel
4. Exemplify the effect of Jominy end quench test on the hardenability of steel.
5. Apply heat treatment on the various non-ferrous materials and analyze the effect of heat
   treatment on these materials.

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