Vision:

**Short Term Goal**
- To develop infrastructure facilities for establishing ceramic laboratory with specialization on Traditional Ceramics, Structural Ceramics, Bio-Ceramics and Electronic Ceramics.
- To concentrate on development of research activities and generate funds through R&D projects.
- To serve as nodal centre for testing and quality analysis for catering the needs of Ceramic and Allied Industries in and around Tamilnadu.

**Long Term Goal**
- To develop processing and testing Centre for Excellence similar to that of CERAM, UK in the area of ceramics and cater the needs of Ceramic and Allied Industries.

Mission:
- To serve as a resource centre for Ceramic Science and Technology.
- To stimulate R&D activities in the technological and commercial development of new products and processes useful for the Ceramic and Allied Industries.
- To contribute to education in Ceramic Science and Technology.
- To conduct basic and applied programmes at the forefront of Ceramic Science and Technology which is relevant to the Indian Industry.
ANNA UNIVERSITY: : CHENNAI: 600 025
UNIVERSITY DEPARTMENTS
B.TECH. CERAMIC TECHNOLOGY
REGULATIONS – 2019
choice based credit system (cbcs)

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. To gain progress in manufacturing and Technology sector.
II. To have a vertical growth in managerial position and a competitive lead in an organization.
III. To provide a platform for educational advancement in career.
IV. To become a preferable consultant and a sorter to solve the practical problems of any organization.
V. To be an enterprising entrepreneur in the supply chain or a well-established executive.

2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Ceramic Technology Graduates will exhibitability in:

<table>
<thead>
<tr>
<th>Graduate Attribute</th>
<th>Programme Outcome</th>
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<tbody>
<tr>
<td>PO1 Engineering knowledge</td>
<td>Enhance the knowledge in mathematics, basic science and engineering science.</td>
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<tr>
<td>PO2 Problem analysis</td>
<td>Capable of identifying engineering problems and formulating tools to solve the same.</td>
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<tr>
<td>PO3 Design/development of solutions</td>
<td>Design a system or process to improve its performance within the constraints</td>
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<td>PO4 Conduct investigations of complex problems</td>
<td>Ability to conduct experiments and collecting data, analyzing and drawing inferences.</td>
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<td>PO5 Usage of Modern tools</td>
<td>Use modern tools and techniques to improve the efficiency of the system.</td>
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<td>PO6 The Engineer and society</td>
<td>Ability to have Professional excellence and strive for societies upliftment</td>
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<tr>
<td>PO7 Environment and sustainability</td>
<td>Design to be environment conscious and growth oriented</td>
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<tr>
<td>PO8 Ethics</td>
<td>To boost the industry, business and society in a professional and ethical manner.</td>
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<tr>
<td>PO9 Individual and team work</td>
<td>Composition of an integrated team.</td>
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<tr>
<td>PO10 Communication</td>
<td>Proficiency in oral and written Communication.</td>
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<tr>
<td>PO11 Project management and finance</td>
<td>To be innovatively progressive within resources</td>
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<td>PO12 Life-long learning</td>
<td>Continue professional development and learning as a life-long activity.</td>
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</table>
3. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of Ceramic Technology program the student will have the following Program specific outcomes.

1. Foundation of Basic Engineering and Computer Programming: Ability to understand the Engineering principles and computer programming. Students can solve basic Engineering concepts and fundamental programming in computer language.

2. Foundations of Traditional Ceramics: Ability to understand the formulation, processing and development of traditional Ceramic bodies. Possess professional skills and knowledge on manufacturing and testing of Traditional Ceramics. Familiarity and practical competence with a broad range of Traditional Ceramic products.

3. Foundation of Advanced Ceramics: Ability to understand the formulation, processing and development of Advanced Ceramics. Possess professional skills and knowledge on manufacturing properties and testing of Advanced Ceramics. Ability to apply methodologies to solve practical problems, model real world problem using appropriate Technologies.

4. Applications of Ceramics and Research Ability: Ability to use knowledge of Ceramic materials and processing in various Applications in order to identify the research gaps and hence to provide solution by new ideas and innovations

4. PEO / PO Mapping:

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<tr>
<th>PROGRAMME EDUCATIONAL OBJECTIVES</th>
<th>PROGRAMME OUTCOMES</th>
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## Mapping of Course Outcomes and Programme Outcomes

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

## UNIVERSITY DEPARTMENTS

### B.TECH. CERAMIC TECHNOLOGY

#### REGULATIONS – 2019

**CHOICE BASED CREDIT SYSTEM**

**CURRICULUM AND SYLLABI FOR I TO VIII SEMESTERS**

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* Audit Course is optional
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* Audit Course is optional

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* Students have to undergo Internship / Training for a period of 4 weeks during summer and assessments will be done during VII semester.
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### AUDIT COURSES (AC)

Registration for any of these courses is optional to students

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<th>Sl. No.</th>
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OBJECTIVES:
The first semester English course entitled ‘Technical English ’ aims to,

- Familiarise first year students of engineering and technology with the fundamental aspects of technical English.
- Develop all the four language skills by giving sufficient practice in the use of the skills in real life contexts.
- Enhance the linguistic and communicative competence of first year engineering and technology students.

UNIT I  INTRODUCING ONESELF  12
Listening: Listening and filling a form, listening to speeches by specialists from various branches of engineering and completing activities such as answering questions, identifying the main ideas of the listening text, style of the speaker (tone and tenor) – Speaking: Introducing oneself –introducing friend/ family - Reading: Descriptive passages (from newspapers / magazines) - Writing: Writing a paragraph (native place, school life) - Grammar: Simple present, present continuous – Vocabulary Development: One word substitution

UNIT II  DIALOGUE WRITING  12
Listening: Listening to conversations (asking for and giving directions) – Speaking: making conversation using (asking for directions, making an enquiry), Role plays-dialogues - Reading: Reading a print interview and answering comprehension questions - Writing: Writing a checklist, Dialogue writing - Grammar: Simple past – question formation (Wh-questions, Yes or No questions, Tag questions) - Vocabulary Development: Stress shift, lexical items related to the theme of the given unit.

UNIT III  FORMAL LETTER WRITING  12
Listening: Listening to speeches by famous people and identifying the central message of the speech – answering multiple-choice questions) – Speaking: Giving short talks on a given topic - Reading: Reading motivational essays on famous engineers and technologists (answering open-ended and closed questions) - Writing: Writing formal letters/ emails (Complaint letters) - Grammar: Future Tense forms of verbs, subject and verb agreement - Vocabulary Development: Collocations – Fixed expressions

UNIT IV  WRITING COMPLAINT LETTERS  12

UNIT V  WRITING DEFINITIONS AND PRODUCT DESCRIPTION  12
Listening: Listening to a product description (labeling and gap filling) exercises - Speaking: Describing a product and comparing and contrasting it with other products- Reading: Reading graphical material for comparison (advertisements) - Writing: Writing Definitions (short and long) – compare and contrast paragraphs - Grammar: Adjectives – Degrees of comparison - compound nouns - Vocabulary Development: Use of discourse markers – suffixes (adjectival endings).

TOTAL : 60 PERIODS

Learning Outcomes
At the end of the course the students will have gained,

- Exposure to basic aspects of technical English.
- The confidence to communicate effectively I various academic situations.
• Learnt the use of basic features of Technical English

Textbook:

Assessment Pattern
• Assessments will assess all the four skills through both pen and paper and computer based tests.
• Assessments can be pen and paper based, quizzes.

MA5158 ENGINEERING MATHEMATICS – I
(Common to all branches of B.E. / B.Tech. Programmes in I Semester)

L T P C
3 1 0 4

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
12

UNIT II DIFFERENTIAL CALCULUS
12

UNIT III FUNCTIONS OF SEVERAL VARIABLES
12

UNIT IV INTEGRAL CALCULUS
12
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.

UNIT V MULTIPLE INTEGRALS
12

TOTAL :60 PERIODS
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 n 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.

TEXTBOOKS:


REFERENCES:

PH5151 ENGINEERING PHYSICS
(Common to all branches of B.E / B.Tech programmes)

3 0 0 3

OBJECTIVE
- To make the students in understanding the importance of mechanics.
- To equip the students on the knowledge of electromagnetic waves.
- To introduce the basics of oscillations, optics and lasers.
- To enable the students in understanding the importance of quantum physics.
- To elucidate the application of quantum mechanics towards the formation of energy bands in crystalline materials.

UNIT I MECHANICS

UNIT II ELECTROMAGNETIC WAVES

UNIT III OSCILLATIONS, OPTICS AND LASERS

UNIT IV BASIC QUANTUM MECHANICS
- Photons and light waves - Electrons and matter waves - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization - Particle in a infinite potential well - Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS
- The harmonic oscillator - Barrier penetration and quantum tunneling - Tunneling microscope - Resonant diode - Finite potential wells - particle in a three dimensional box - Bloch’s theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

OUTCOMES:
After completion of this course, the students should able to
- Understanding the importance of mechanics.
- Express the knowledge of electromagnetic waves.
- Know the basics of oscillations, optics and lasers.
- Understanding the importance of quantum physics.
- Apply quantum mechanical principles towards the formation of energy bands in crystalline materials.
TEXT BOOKS:

REFERENCES:

CY5151 ENGINEERING CHEMISTRY (COMMON TO ALL BRANCHES)

OBJECTIVES:
- To introduce the basic concepts of polymers, their properties and some of the important applications.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To facilitate the understanding of the laws of photochemistry, photoprocesses and instrumentation & applications of spectroscopic techniques.
- To familiarize the operating principles and applications of energy conversion, its processes and storage devices.
- To inculcate sound understanding of water quality parameters and water treatment techniques.

UNIT I POLYMER CHEMISTRY

UNIT II NANO CHEMISTRY

UNIT III PHOTO CHEMISTRY AND SPECTROSCOPY
UNIT IV ENERGY CONVERSIONS AND STORAGE

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant – fast breeder reactor. Solar energy conversion - solar cells. Wind energy. Batteries - types of batteries – primary battery (dry cell), secondary battery (lead acid, nickel-cadmium and lithium-ion-battery). Fuel cells – $\text{H}_2\text{-O}_2$ and microbial fuel cell. Explosives – classification, examples: TNT, RDX, Dynamite; Rocket fuels and propellants – definition and uses.

UNIT V WATER TECHNOLOGY


TOTAL: 45 PERIODS

OUTCOMES:

• To recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.
• To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
• To identify and apply suitable spectroscopic technique for material analysis and study different forms of photochemical reactions.
• To recognize different forms of energy resources and apply them for suitable applications in energy sectors.
• To demonstrate the knowledge of water and their quality in using at different industries.

TEXT BOOKS:

REFERENCE BOOKS:
COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:
1. Drawing free hand sketches of basic geometrical shapes and multiple views of objects.
2. Drawing orthographic projections of lines and planes.
3. Drawing orthographic projections of solids.
4. Drawing development of the surfaces of objects.
5. Drawing isometric and perspective views 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 AND FREE HANDSKETCHING

UNIT II  PROJECTION OF POINTS, LINES AND PLANE SURFACES
Orthographic projection- principles-Principle 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 trapezoidal 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
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method.

UNIT IV  PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES
Sectioning of 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. Development of lateral surfaces of solids with cut-outs and holes.

UNIT V  ISOOMETRIC AND PERSPECTIVE PROJECTIONS
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 and miscellaneous problems. Perspective projection of simple solids-Prisms pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) 3
Introduction to drafting packages and demonstration of their use

TOTAL  (L: 15 + P: 60)=75 PERIODS
COURSE OUTCOMES: Upon completion of this course, the students will be able to:
1. Draw free hand sketching of basic geometrical shapes and multiple views of objects.
2. Draw orthographic projections of lines and planes
3. Draw orthographic projections of solids
4. Draw development of the surfaces of objects
5. Draw isometric and perspective views of simple solids.

TEXT BOOKS:

REFERENCES:

Publication of Bureau of Indian Standards:

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

GE5153 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C 3 0 0 3

OBJECTIVES:
- To know the basics of algorithmic problem solving.
- To develop Python programs with conditionals and loops.
- To define Python functions and use function calls.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I INTRODUCTION TO COMPUTING AND PROBLEM SOLVING 9

Suggested Activities:
- Developing Pseudocodes and flowcharts for real life activities such as railway ticket booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
Developing algorithms for basic mathematical expressions using arithmetic operations.
Installing Python.
Simple programs on print statements, arithmetic operations.

Suggested Evaluation Methods:
- Assignments on pseudocodes and flowcharts.
- Tutorials on Python programs.

UNIT II CONDITIONALS AND FUNCTIONS

Suggested Activities:
- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.
- Implementation of a simple calculator.
- Developing simple applications like calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and iterative statements.
- External learning - Recursion vs. Iteration.

Suggested Evaluation Methods:
- Tutorials on the above activities.
- Group Discussion on external learning.

UNIT III SIMPLE DATA STRUCTURES IN PYTHON

Suggested Activities:
- Implementing python program using lists, tuples, sets for the following scenario:
  Simple sorting techniques
  Student Examination Report
  Billing Scheme during shopping.
- External learning - List vs. Tuple vs. Set – Implementing any application using all the three data structures.

Suggested Evaluation Methods:
- Tutorials on the above activities.
- Group Discussion on external learning component.

UNIT IV STRINGS, DICTIONARIES, MODULES

Suggested Activities:
- Implementing Python program by importing Time module, Math package etc.
- Creation of any package (student's choice) and importing into the application.

Suggested Evaluation Methods:
- Tutorials on the above activities.
UNIT V  FILE HANDLING AND EXCEPTION HANDLING

Introduction to Files – File Path – Opening and Closing Files – Reading and Writing Files – File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions.

Suggested Activities:
- Developing modules using Python to handle files and apply various operations on files.
- Usage of exceptions, multiple except blocks -for applications that use delimiters like age, range of numerals etc.
- Implementing Python program to open a non-existent file using exceptions.

Suggested Evaluation Methods:
- Tutorials on the above activities.
- Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, students will be able to:
1. Develop algorithmic solutions to simple computational problems.
2. Develop and execute simple Python programs.
3. Write simple Python programs for solving problems.
4. Decompose a Python program into functions.
5. Represent compound data using Python lists, tuples, dictionaries etc.
6. Read and write data from/to files in Python programs.

TEXT BOOK:

REFERENCES:

BS5161  BASIC SCIENCES LABORATORY  L T P C
(0 0 4 2)

PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVE
- To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- To induce the students to familiarize with experimental determination of velocity of ultrasonic waves and band gap determination.
LIST OF EXPERIMENTS:
1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young’s modulus
3. Uniform bending – Determination of young’s modulus
4. Lee’s disc - Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre - Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box - Determination of Band gap of a semiconductor.
13. Photoelectric effect
14. Michelson Interferometer.
16. Melde’s string experiment

TOTAL: 30 PERIODS

OUTCOME
Upon completion of the course, the students will be able
- To determine various moduli of elasticity and also various thermal and optical properties of materials.
- To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

CHEMISTRY LABORATORY: (Minimum of 8 experiments to be conducted)

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, pHmetry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and polymers by spectroscopy and viscometry methods.

LIST OF EXPERIMENTS:
1. Estimation of HCl using Na$_2$CO$_3$ as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler’s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenantherline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
12. Pseudo first order kinetics-ester hydrolysis.
14. Phase change in a solid.

TOTAL: 30 PERIODS

OUTCOMES:
- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques
- To determine the molecular weight of polymers by viscometric method.
- To quantitatively analyse the impurities in solution by electroanalytical techniques
- To design and analyse the kinetics of reactions and corrosion of metals

TEXTBOOKS:

GE5161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C
0 0 4 2

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

EXPERIMENTS:
1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same.
2. Python programming using simple statements and expressions.
3. Scientific problems using Conditionals and Iterative loops.
4. Implementing real-time/technical applications using Lists, Tuples.
5. Implementing real-time/technical applications using Sets, Dictionaries.
6. Implementing programs using Functions.
7. Implementing programs using Strings.
9. Implementing real-time/technical applications using File handling.
10. Implementing real-time/technical applications using Exception handling.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

OUTCOMES:
On completion of the course, students will be able to:
- Develop algorithmic solutions to simple computational problems
- Develop and execute simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python data structures.
  Apply Python features in developing software applications.
COURSE OBJECTIVES
The course entitled 'professional communication' aims to,
- Improve the relevant language skills necessary for professional communication.
- Develop linguistic and strategic competence in workplace context.
- Enhance language proficiency and thereby the employability of budding engineers and technologists.

UNIT I  TECHNICAL COMMUNICATION  12
Listening: Listening to telephone conversations (intent of the speaker and note taking exercises)-Speaking: Role play exercises based on workplace contexts, introducing oneself-Reading: Reading the interview of an achiever and completing exercises (skimming, scanning and predicting)- Writing: Writing a short biography of an achiever based on given hints- Grammar: Asking and answering questions, punctuation in writing, prepositional phrases- Vocabulary Development: use of adjectives.

UNIT II  SUMMARY WRITING  12
Listening: Listening to talks/lectures both general and technical and summarizing the main points- Speaking: Participating in debates- Reading: Reading technical essays/ articles and answering comprehension questions- Writing: Summary writing- Grammar: Participle forms, relative clauses- Vocabulary Development: Use of compound words, abbreviations and acronyms.

UNIT III  PROCESS DESCRIPTION  12
Listening: Listening to a process description and drawing a flowchart-Speaking: Participating in Group Discussions, giving instructions- Reading: Reading instruction manuals- Writing: Writing process descriptions- Writing instructions- Grammar: Use of imperatives, active and passive voice, sequence words- Vocabulary Development: Technical jargon

UNIT IV  REPORT WRITING  12
Listening: Listening to a presentation and completing gap-filling exercises- Speaking: Making formal presentations- Reading: Reading and interpreting charts/tables and diagrams- Writing: Interpreting charts/tables and diagrams, writing a report- Grammar: Direct into indirect speech, use of phrases- Vocabulary Development: Reporting words

UNIT V  WRITING JOB APPLICATIONS  12
Listening: Listening to a job interview and completing gap-filling exercises- Speaking: Mock interview, telephone interviews- Reading: Reading a job interview, SOP, company profile and completing comprehension exercises- Writing: job applications and resumes and SOPs- Grammar: Present perfect and continuous tenses- Vocabulary Development: Technical vocabulary.

TOTAL : 60 PERIODS

LEARNING OUTCOMES
At the end of the second semester the learners should be able to,
- Read and comprehend technical texts effortlessly.
- Write reports of a technical kind.
- Speak with confidence in interviews and thereby gain employability

Textbook

Assessment Pattern
- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.
OBJECTIVES:

- To acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To acquaint the students with Differential Equations which are significantly used in Engineering problems.
- To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I VECTOR CALCULUS


UNIT II ANALYTIC FUNCTION

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions - Bilinear transformation \( w = c + z, \quad az, \quad 1/z, \quad z^2 \).

UNIT III COMPLEX INTEGRATION


UNIT IV DIFFERENTIAL EQUATIONS

Method of variation of parameters – Method of undetermined coefficients – Homogenous equations of Euler’s and Legendre’s type – System of simultaneous linear differential equations with constant coefficients.

UNIT V LAPLACE TRANSFORMS


TOTAL : 60 PERIODS

OUTCOMES:

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

- Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.
- Construct analytic functions and use their conformal mapping property in application problems.
- Evaluate real and complex integrals using the Cauchy’s integral formula and residue theorem.
- Apply various methods of solving differential equation which arise in many application problems.
- Apply Laplace transform methods for solving linear differential equations.
COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:

1. Applying the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
2. Applying the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force-couple system acting on rigid bodies in 2D and 3D.
3. Applying the concepts of locating centroids/center of gravity of various sections/volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
4. Applying the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Applying the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subject to concurrent coplanar forces.

UNIT I  STATICS OF PARTICLES (9+3)

UNIT II  EQUILIBRIUM OF RIGID BODIES (9+3)
Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples,
Resolution of a Given Force into a Force - Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

UNIT III DISTRIBUTED FORCES (9+3)
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 (9+3)
The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction, Rolling Resistance, Ladder friction.

UNIT V DYNAMICS OF PARTICLES (9+3)

TOTAL (L: 45 + T: 15) = 60 PERIODS

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

1. Apply the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
2. Apply the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.
3. Apply the concepts of locating centroids / center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
4. Apply the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Apply the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
The course is aimed to
- familiarize the materials and measurements used in Civil Engineering.
- provide the exposure on the fundamental elements of civil engineering structures.
- enable the students to distinguish the components and working principle of power plant units, IC engines, and R & AC system.

UNIT I  SURVEYING AND CIVIL ENGINEERING MATERIALS  9

UNIT II  BUILDING COMPONENTS AND STRUCTURES  9

UNIT III  INTERNAL COMBUSTION ENGINES  9
Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines - Principle of electrical and hybrid vehicles.

UNIT IV  POWER PLANT ENGINEERING  9
Classification Power Plants - Working principle of steam, Gas, Diesel, Hydro – electric and Nuclear Power plants — working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps

UNIT V  REFRIGERATION AND AIR CONDITIONING SYSTEM  9

TOTAL: 45 PERIODS
OUTCOMES:
On completion of the course students are expected to
   CO1. explain the usage of construction material and proper selection of construction materials.
   CO2. measure distances and area by surveying
   CO3. demonstrate working principles of petrol and diesel engine
   CO4. identify the components used in power plant cycle.
   CO5. elaborate the components of refrigeration and Air conditioning cycle.

TEXTBOOKS:

REFERENCES:
## Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO1</th>
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<td>explain the usage of construction material and proper selection of</td>
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<td>construction materials.</td>
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<tr>
<td>CO2</td>
<td>measure distances and area by surveying</td>
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<td>CO3</td>
<td>demonstrate working principles of petrol and diesel engine</td>
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<tr>
<td>CO4</td>
<td>identify the components used in power plant cycle.</td>
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<tr>
<td>CO5</td>
<td>elaborate the components of refrigeration and Air conditioning cycle.</td>
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<td>BASICS OF CIVIL AND MECHANICAL ENGINEERING</td>
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</tbody>
</table>

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

- Impart knowledge on the fluid statics and the fluid flow phenomena.
- Introduce different equations involved in fluid flow and the changes that occur in a fluid flowing past immersed solids.
- Familiarize the concepts involved in transfer of heat by conduction and convection.
- Acquaint with the principle of heat transfer by radiation and radiative heat transfer between different surfaces.
- Explain basic mass transfer operations commonly come across in ceramic technology, like diffusion, humidification, drying of solids and crystallization.

UNIT I      FLUID STATICS AND FLUID FLOW PHENOMENA  8

UNIT II     FLUID FLOW EQUATIONS AND FLOW PAST IMMERSED SOLID  9

UNIT III    CONDUCTIVE AND CONVECTIVE HEAT TRANSFER  10
Conductive heat transfer – basic laws of conduction, steady state conduction, unsteady state conduction. Convective heat transfer – typical heat transfer equipments, energy balance, heat flux and heat transfer coefficient, heat transfer by forced convection in laminar flow, turbulent flow and transition region between laminar and turbulent flow, natural convection.

UNIT IV     RADIATIVE HEAT TRANSFER  8
Emission of radiation, absorption of radiation by opaque bodies, radiation between surface, radiations to semi transparent materials, combined heat transfer by conduction, convection and radiation.

UNIT V      BASICS OF MASS TRANSFER OPERATIONS  10

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course students are expected to

CO1. Comprehend the rheological behaviour of fluids and its application.
CO2. Do mass balance in controlled volume and also to calculate drag force and drag coefficient for flow past objects.
CO3. Be aware of the conduction and convection involved in heat exchanger and furnace wall.
CO4. Calculate the radiation to different bodies and combined heat transfer through convection, conduction and radiation.
CO5. Have knowledge about mass transfer operations involved in ceramic technology.

TEXT BOOKS:


REFERENCES:

**Course Articulation Matrix:**

<table>
<thead>
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<tr>
<td>CO1</td>
<td>Comprehend the rheological behaviour of fluids and its application.</td>
<td>3 3 3 2 2 - - - - - - 3 - - - 3</td>
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<tr>
<td>CO2</td>
<td>Do mass balance in controlled volume and also to calculate drag force and drag coefficient for flow past objects.</td>
<td>3 3 3 2 2 - - - - - - 3 - - - 3</td>
</tr>
<tr>
<td>CO3</td>
<td>Be aware of the conduction and convection involved in heat exchanger and furnace wall.</td>
<td>3 3 3 2 2 - - - - - - 3 - - - 3</td>
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<tr>
<td>CO4</td>
<td>Calculate the radiation to different bodies and combined heat transfer through convection, conduction and radiation.</td>
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<td>CO5</td>
<td>Have knowledge about mass transfer operations involved in ceramic technology.</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightingsas Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to

- Introduce various traditional and advanced ceramic products and industries that manufacture them.
- Familiarize the ceramic products which the students come across in their day to day life.
- Serve as a preparatory course for the subjects which the students will be learning in the subsequent years.

UNIT I  WHITEWARES  9
Introduction, definition, triaxial bodies, general flow sheet for whiteware preparation, types of whitewares, different applications of whitewares. Major Whiteware industries in India and the World. Market scenario of whiteware industry.

UNIT II  REFRACTORIES  9

UNIT III  GLASS  9
Introduction, definition, difference between glass and crystalline materials, types of glasses, general flow sheet for glass preparation, brief description on different glass shaping methods, importance of annealing and tempering. Major glass industries in India and the World. Market scenario of glass industry.

UNIT IV  OTHER CONVENTIONAL CERAMIC PRODUCTS  9

UNIT V  ADVANCED CERAMICS  9
Introduction, properties and applications of oxides - ZrO₂, Al₂O₃; non-oxides - carbides - SiC, WC; nitrides - Si₃N₄, BN. Properties and applications of ceramic products - ceramic fibers, glass ceramics. Major manufacturers of advanced ceramics in India and in the World. Market scenario of advanced ceramics.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students are expected to

CO1. Be aware of the traditional and advanced ceramic products.
CO2. Have knowledge on basic preparatory methods for the various ceramic products.
CO3. Have overall idea about the industries manufacturing various ceramic products and the market scenario.
TEXT BOOKS:


REFERENCES:

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<td>Be aware of the traditional and advanced ceramic products.</td>
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<tr>
<td>CO2</td>
<td>Have knowledge on basic preparatory methods for the various ceramic products.</td>
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<tr>
<td>CO3</td>
<td>Have overall idea about the industries manufacturing various ceramic products and the market scenario.</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
COURSE OBJECTIVES: The main learning objective of this course is to 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 mechanical 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 15

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

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

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

PART II ELECTRICAL ENGINEERING PRACTICES 15

WIRING WORK:
  a) Wiring Switches, Fuse, Indicator and Lamp etc. such as in basic household,
  b) Wiring Stair case light.
  c) Wiring tube – light.
  d) Preparing wiring diagrams for a given situation.

Wiring Study:
  a) Studying an Iron-Box wiring.
  b) Studying a Fan Regulator wiring.
  c) Studying an Emergency Lamp wiring.

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:
  a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
  b) Practicing gas welding.
BASIC MACHINING WORK:
   a) (simple)Turning.
   b) (simple)Drilling.
   c) (simple)Tapping.

ASSEMBLY WORK:
   a) Assembling a centrifugal pump.
   b) Assembling a household mixer.
   c) Assembling an air conditioner.

SHEET METAL WORK:
   a) Making of a square tray

FOUNDRY WORK:
   a) Demonstrating basic foundry operations.

PART IV  ELECTRONIC ENGINEERING PRACTICES  15

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

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

ELECTRONIC EQUIPMENT STUDY:
   a) Studying a FM radio.
   b) Studying an electronic telephone.

TOTAL (P: 60) = 60 PERIODS

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.
OBJECTIVES:
The course is aimed to
- impart knowledge on concepts of fluid mechanics
- teach concepts of heat and mass transfer

EXPERIMENTS:
1. Determination of pressure drop in a fluid passing through Orificometer and Venturimeter
2. Determination of liquid viscosity using Oswald Viscometer
3. Estimation of settling velocity of particles in fluid
4. Separation of solid from suspension by sedimentation
5. Estimation of thermal conductivity of composite material
6. Effect of $N_{Re}$ on Heat Transfer
7. Estimation of LMTD in Co-current Heat Transfer
8. Estimation of LMTD in Counter-current Heat Transfer
9. Calculation of RH, Enthalpy and Specific Volume of Air using Humidity Chart
10. Crystallization of solid from a super saturated solution
11. Drying rate estimation during drying of a solid

TOTAL :30 PERIODS

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

CO1. be thorough with the use of manometers and viscometers
CO2. measure particle size of the given powder using sedimentation principle
CO3. estimate LMTD in heat transfer
CO4. calculate humidity and drying rate
CO5. crystallize solids from super saturated solution

EQUIPMENTS REQUIRED:

1. Manometer
2. Orificemeter
3. Venturimeter
4. Ostwald viscometer
5. Dryer
6. Electronic balance
7. Hotplate
8. Concentric tube heat exchanger
9. Crystalliser
10. Compound wall Thermal conductivity Measurement equipment
<table>
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<tbody>
<tr>
<td>CO1</td>
<td>be thorough with the use of manometers and viscometers</td>
<td>PO1 2 3 4 5 6 7 8 9 10 11 12 13 14</td>
</tr>
<tr>
<td>CO2</td>
<td>measure particle size of the given powder using sedimentation principle</td>
<td>PO1 2 3 4 5 6 7 8 9 10 11 12 13 14</td>
</tr>
<tr>
<td>CO3</td>
<td>estimate LMTD in heat transfer</td>
<td>PO1 2 3 4 5 6 7 8 9 10 11 12 13 14</td>
</tr>
<tr>
<td>CO4</td>
<td>calculate humidity and drying rate</td>
<td>PO1 2 3 4 5 6 7 8 9 10 11 12 13 14</td>
</tr>
<tr>
<td>CO5</td>
<td>crystallize solids from super saturated solution</td>
<td>PO1 2 3 4 5 6 7 8 9 10 11 12 13 14</td>
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</tbody>
</table>

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

- To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
- To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables and the significance of the Central Limit theorem.
- To apply the small/large sample tests through Tests of hypothesis.
- To understand the concept of analysis of variance and use it to investigate factorial dependence.
- To monitor a process and detect a situation when the process is out of control.

UNIT I RANDOM VARIABLES 12
Discrete and continuous random variables – moments – moment generating functions – binomial, poisson, geometric, uniform, exponential, gamma, weibull and normal distributions – functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 12

UNIT III TESTS OF SIGNIFICANCE 12
Type I and Type II errors – tests for single mean, proportion, 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 – non-parametric tests: test for randomness and rank – sum test (wilcoxon test).

UNIT IV DESIGN OF EXPERIMENTS 12
Completely randomized design – randomized block design – latin square design – factorial design – taguchi’s robust parameter design.

UNIT V STATISTICAL QUALITY CONTROL 12
Control charts for measurements (X and R charts) – control charts for attributes (p, c and np charts) tolerance limits – acceptance sampling.

TOTAL: 60 PERIODS

OUTCOMES

- CO1 To analyze the performance in terms of probabilities and distributions achieved by the determined solutions
- CO2 To be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis
- CO3 To apply the basic principles underlying statistical inference (estimation and hypothesis testing)
- CO4 To demonstrate the knowledge of applicable large sample theory of estimators and tests To obtain a better understanding of the importance of the methods in modern industrial processes.

TEXT BOOKS:

REFERENCES:

EE5251 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

OBJECTIVES:
- To understand the basic concepts of electric circuits, magnetic circuits and wiring.
- To understand the operation of AC and DC machines.
- To understand the working principle of electronic devices and circuits.

UNIT I BASIC CIRCUITS AND DOMESTIC WIRING

UNIT II THREE PHASE CIRCUITS AND MAGNETIC CIRCUITS

UNIT III ELECTRICAL MACHINES

UNIT IV BASICS OF ELECTRONICS
Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics-Rectifier circuits-Wave shaping.

UNIT V CURRENT CONTROLLED AND VOLTAGE CONTROLLED DEVICES
Working principle and characteristics - BJT, SCR, JFET, MOSFET.

OUTCOMES:
CO1 To be able to understand the concepts related with electrical circuits and wiring.
CO2 To be able to study the different three phase connections and the concepts of magnetic circuits.
CO3 Capable of understanding the operating principle of AC and DC machines.
CO4 To be able to understand the working principle of electronic devices such as diode and zener diode.
CO 5 To be able to understand the characteristics and working of current controlled and voltage controlled devices.
TEXT BOOKS:

REFERENCES:

CT5301 PROCESSING OF CERAMIC RAW MATERIALS

OBJECTIVES:
The course is aimed to
- Introduce the methods of material recovery by quarrying
- Describe the various processes involved in making the quarried raw material into fine, fractioned powders
- Discuss the means of mixing, conveying and storage of the processed raw materials.

UNIT I QUARRYING

UNIT II SIZE REDUCTION

UNIT III MECHANICAL SEPARATION

UNIT IV MIXING
Mixing – mechanism of mixing, types of mixers – batch and continuous mixers – pan mixer, shaft mixer, U mixer, muller mixer and other mixers, liquid mixers – mechanism, blungers, agitators.

UNIT V CONVEYING AND STORAGE OF MATERIALS
Conveying – solid conveying- types of conveyors, criteria for selecting a conveyor; liquid conveying- condition for liquid conveying, different types of pumps. Storage methods for different ceramic powders. Problems in bin storage.

TOTAL: 45 PERIODS
OUTCOMES:
On completion of the course, the students are expected to
CO1. Know the different quarrying methods to extract materials and its purification
CO2. Select a proper size reduction method for the given input size and for the expected final size
CO3. Discuss different size separation methods
CO4. Identify a suitable method of mixing and conveying for the given material
CO5. Discern different storage methods

TEXT BOOKS:

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<td>Know the different quarrying methods to extract materials and its purification</td>
<td>PO1</td>
</tr>
<tr>
<td>CO2</td>
<td>Select a proper size reduction method for the given input size and for the expected final size</td>
<td>-</td>
</tr>
<tr>
<td>CO3</td>
<td>Discuss different size separation methods</td>
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<tr>
<td>CO4</td>
<td>Identify a suitable method of mixing and conveying for the given material</td>
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</tr>
<tr>
<td>CO5</td>
<td>Discern different storage methods</td>
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<td>PROCESSING OF CERAMIC RAW MATERIALS</td>
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</tbody>
</table>

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

- Introduce the basics of rock formation, its types, and mineral formation and its physical and optical properties.
- Impart knowledge about various natural and synthetic ceramic raw materials.
- Explain the various testing methods of ceramic raw materials.

UNITI  GENERAL GEOLOGY AND MINEROLOGY  9
Minerals – formation, relation of mineral deposit to igneous activity; chemical and physical properties like composition, color, streak, luster, fracture, cleavage, hardness, density and tenacity; radioactive properties and optical properties. Rocks – formation, characteristics, classification into igneous, sedimentary and metamorphic. Some important rocks – granite, sandstone, marble - Availability, Industries and Demand.

UNITII  ALUMINO SILICATE MATERIALS  10

UNITIII  ALUMINA AND SILICA  9

UNITIV  OTHER RAW MATERIALS  7
Occurrence, properties, industrial importance of Wollastonite, Magnesite, dolomite, chromite, limestone, rutile, zircon, beryllia, gypsum minerals, lithium containing minerals, Preparation / Occurrence, properties and uses of Silicon carbide, Tungsten carbide, Silicon nitride, Aluminium nitride, Boron nitride, Plaster of Paris, Bone ash, cullet, slag, Fly ash.

UNITV  TESTING  10

TOTAL: 45 PERIODS
OUTCOMES:
On completion of the course, the students are expected to
   CO1. Recognize different rocks and minerals
   CO2. Describe various types of natural and synthetic ceramic minerals
   CO3. Define the properties and applications of natural and synthetic ceramic minerals
   CO4. Employ the testing methods to analyse the raw materials.

TEXT BOOKS:

REFERENCES:
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<th>Course Outcomes</th>
<th>Statement</th>
<th>PO1</th>
<th>PO2</th>
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<td>Recognize different rocks and minerals</td>
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<tr>
<td>CO2</td>
<td>Describe various types of natural and synthetic ceramic minerals</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>-</td>
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<tr>
<td>CO3</td>
<td>Define the properties and applications of natural and synthetic ceramic minerals</td>
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<td>2</td>
<td>2</td>
<td>2</td>
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<td>CO4</td>
<td>Employ the testing methods to analyse the raw materials.</td>
<td>-</td>
<td>2</td>
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</table>

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

OBJECTIVES:

The course is aimed to

- Give basic knowledge of science behind materials and introduce the concept of structure property relations.
- Lay the groundwork for studies in fields such as imperfections, microstructure, diffusion and phase diagram.
- Develop intuitive understanding of the subject to present a wealth of real world engineering examples to give students a feel of how material science is useful in engineering practices.

UNIT I STRUCTURE AND PROPERTY


UNIT II IMPERFECTIONS

Point imperfections – vacancies, interstitials, point imperfections in molecular crystals, mobility of point imperfections, solid solutions, point imperfections in ionic crystals – Line imperfections – dislocations characteristics, slip systems, dislocation motion, dislocation loops, critical resolved shear stress, surface imperfections – surface tension and surface free energy, geometry of grain structures, structure of crystalline interfaces – stacking fault, amiphase boundaries, grain boundaries, interface grain boundaries, magnetic domain walls, walls in liquid crystals, imperfections and symmetry breaking.

UNIT III MICROSTRUCTURE

Structural hierarchies – Metal forging, semi-crystalline polymers, microstructure arising from special processing – deformation microstructure – deformation processing and crystallographic structure, microstructure of deformed polycrystalline material, characterization of textures, transformation microstructure – solidification microstructures, solid-solid Transformation microstructures, Composite microstructure, Experimental techniques for identification of microstructure and defects – microscopic techniques, grain size determination.

UNIT IV DIFFUSION

UNIT V PHASE DIAGRAMS

Introduction - Basic concepts – solubility limit, Phase, Microstructure, Phase Equillibria, One component system – iron, water, Carbon, Binary system - isomorphous system, Eutectic, Peritectic diagrams – Interpretation and microstructure developments, Basic Concepts of Phase transformation.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the students are expected to

CO1. Analyze the structure of the materials
CO2. Identify the effect of imperfections in a structure
CO3. Understand and Identify the microstructures in a material
CO4. Understand the process of diffusion and its mechanism
CO5. Identify phase diagrams and reactions.

TEXTBOOKS:


REFERENCES:

### Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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<th>Program Outcome</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Analyze the structure of the materials</td>
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</tr>
<tr>
<td>CO2</td>
<td>Identify the effect of imperfections in a structure</td>
<td>3 3 1 1 1 - - - - - - 3 - - - 3</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand and Identify the microstructures in a material</td>
<td>3 3 2 2 1 - - - - - - 3 - - - 3</td>
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<tr>
<td>CO4</td>
<td>Understand the process of diffusion and its mechanism</td>
<td>3 3 2 2 2 - - - - - - 3 - - - 3</td>
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<tr>
<td>CO5</td>
<td>Identify phase diagrams and reactions.</td>
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<td>MATERIALS SCIENCE - I</td>
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<td>3 3 2 2 2 - - - - - - 3 - - - 3</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- Enable students to learn purification of different raw materials
- Make students understand the effect of various parameters on size reduction
- Teach various size separation and mixing techniques

EXPERIMENTS:
1. Clay purification
2. Non-plastic Raw material purification by froath flotation
3. Size reduction by Jaw Crusher
4. Size reduction in ball milling with respect to time, speed and grinding media size
5. Size separation by Sieves
6. Calculating screen effectiveness of sieves
7. Separation of solids by sedimentation method
8. Separation of solid from liquid by filter press
9. Granule formation by spray drying
10. Separating magnetic particles by magnetic separator
11. Solid mixing by pan mixer
12. Liquid mixing by agitators

TOTAL :60 PERIODS

OUTCOMES:
On completion of this Laboratory Course, the students are expected to
CO1. purify various raw materials and reduce them to required size using appropriate technique.
CO2. evaluate screen effectiveness of sieves.
CO3. be able to separate solid from other solids or liquids using suitable method

EQUIPMENTS REQUIRED:
1. Blunger
2. Froath flotation equipment
3. Jaw Crusher
4. Ball mill
5. Sieve set
6. Sieve shaker
7. Magnetic separator
8. Filter press
9. Pan mixer
10. Agitator
11. Spray drier
### Course Articulation Matrix:

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<td>CO1</td>
<td>purify various raw materials and reduce them to required size using appropriate technique.</td>
<td>PO1</td>
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<tr>
<td>CO2</td>
<td>evaluate screen effectiveness of sieves.</td>
<td>−</td>
</tr>
<tr>
<td>CO3</td>
<td>be able to separate solid from other solids or liquids using suitable method</td>
<td>−</td>
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<tr>
<td>PROCESSING OF CERAMIC RAW MATERIALS LABORATORY</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVE:
The course is aimed to
- Enable students to analyze the given ceramic raw material for its chemical composition and estimate its physical properties

EXPERIMENTS:
1. Determination of moisture content
2. Determination of loss on ignition
3. Determination of SiO$_2$ content by gravimetric method
4. Determination of SiO$_2$ content by hydrofluoric acid
5. Determination of Al$_2$O$_3$ by EDTA method
6. Determination of Na, K and Li by flame photometry
7. Determination of CaO, MgO by complexometry
8. Determination of particle size by Hydrometer
9. Determination of particle size by Andreasen Pipette
10. Determination of plasticity of ceramic materials by Pfefferkorn test
11. Determination of plasticity of ceramic materials by Atterberg test
12. Determination of rheological properties like fluidity and thixotropy by torsion viscometer
13. Determination of setting time of Plaster of Paris
14. Determination of setting temperature of Plaster of Paris

TOTAL: 60 PERIODS

OUTCOMES:
On completion of this Laboratory Course, the students are expected to
- CO1. qualitatively determine the chemical components in the given ceramic raw material.
- CO2. evaluate plasticity of clay and rheological properties of clay slurry.
- CO3. evaluate setting time and temperature of plaster of Paris

EQUIPMENTS REQUIRED:
1. Flame Photometer
2. Hot Plate
3. Hot Air Oven
4. Electronic Balance
5. Furnace
6. Atterberg Apparatus
7. Pfefferkorn Apparatus
8. Torsion Viscometer
9. Vickat's apparatus
### Course Articulation Matrix:

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</tr>
<tr>
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<td>evaluate setting time and temperature of plaster of Paris</td>
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<td>CERAMIC RAW MATERIALS ANALYSIS LABORATORY</td>
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</tr>
</tbody>
</table>

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

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

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

UNIT II  TQM PRINCIPLES  9

UNIT III  TQM TOOLS & TECHNIQUES I  9

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

UNIT V  QUALITY MANAGEMENT SYSTEM  9

TOTAL: 45 PERIODS
OUTCOMES:
CO1: Ability to apply TQM concepts in a selected enterprise.
CO2: Ability to apply TQM principles in a selected enterprise.
CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.
CO5: Ability to apply QMS and EMS in any organization.

TEXT BOOK:

REFERENCES:
OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and non-renewable resources, causes of their degradation and measures to preserve them.
- To familiarize the influence of societal use of resources on the environment and introduce the legal provisions, National and International laws and conventions for environmental protection.
- To inculcate the effect of population dynamics on human and environmental health and inform about human right, value education and role of technology in monitoring human and environmental issues.

UNIT I ENVIROMENT, ECOSYSTEMS AND BIODIVERSITY

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – bio geographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies – Land resources: Land as a resource, land 47 degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.
UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT


UNIT V HUMAN POPULATION AND THE ENVIRONMENT


TOTAL: 45 PERIODS

OUTCOMES:

- To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- To identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.
- To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
- To recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development.
- To demonstrate the knowledge of societal activity on the long and short term environmental issues and abide by the legal provisions, National and International laws and conventions in professional and personal activities and to identify and analyse effect of population dynamics on human value education, consumerism and role of technology in environmental issues.

TEXT BOOKS:


REFERENCE BOOKS:

OBJECTIVES:
The course is aimed to

- explain the composition and types of various traditional ceramic bodies.
- introduce design body compositions and formulate bodies
- describe the testing and properties of traditional ceramic bodies

UNIT I DESIGNING OF BODY COMPOSITION


UNIT II BODY FORMULATIONS

Body composition – porcelain, earthenware, bone china, sanitary ware, hotel china, terracotta, majolica, steatite bodies, cordierite bodies, rutile bodies, titanate bodies, zircon bodies, lava bodies - Industries - Market Scenario - Demand.

UNIT III WHITEWARE PRODUCTS

Manufacturing process and properties – whitewares at home – tableware, kitchenware, flame resistant ware, art ware, containers, whitewares in construction – floor tile, wall tiles, sanitary ware, whitewares in electrical applications – low tension insulators, high tension insulators, high frequency low loss insulators, whitewares in industrial use – abrasion resistance, chemical resistance, heat resistance - Industries - Market Scenario - Demand.

UNIT IV HEAVY CLAYWARE PRODUCTS

Introduction – classification- body composition – properties and applications of heavy clayware products – face bricks, paving bricks, hollow bricks, roofing tiles, sewer pipes, stoneware pipes, floor tiles, vitrified tiles, fireclay sanitaryware - Industries - Market Scenario - Demand.

UNIT V PROPERTIES and TESTING

Tests on unfired body – bulk density, green MOR, Shrinkage. Tests on fired body - strength, density, porosity, moisture absorption, abrasion resistance, chemical durability, thermal expansion, thermal shock resistance and electrical properties - dielectric strength, dielectric constant, power and loss factor, volume resistivity.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course the students are expected to

- CO1. Have a basic knowledge about whiteware and heavy clayware, their classification and formulation.
- CO2. Be capable of classifying the various whiteware and heavy clayware products and know the body formulation and properties.
- CO3. Be able to test ceramic bodies and glazes

TOTAL: 45 PERIODS
TEXT BOOKS:

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### Course Articulation Matrix:

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<tr>
<td></td>
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<tr>
<td>CO1</td>
<td>Have a basic knowledge about whiteware and heavy clayware, their classification and formulation.</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Be capable of classifying the various whiteware and heavy clayware products and know the body formulation and properties.</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>Be able to test ceramic bodies and glazes</td>
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<tr>
<td>TRADITIONAL CERAMICS</td>
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</table>

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

The course is aimed to

- discuss the basics of materials science with the objective of rationalizing, predicting, modifying and describing the mechanical, electrical, magnetic, thermal, optical and environmental behavior of materials.
- correlate between structure-property-performance of materials.

UNIT I  MECHANICAL PROPERTIES


UNIT II ELECTRICAL PROPERTIES


UNIT III MAGNETIC PROPERTIES


UNIT IV THERMAL AND OPTICAL PROPERTIES


UNIT V CORROSION AND DEGRADATION


TOTAL: 45 PERIODS
OUTCOMES:

On completion of the course, the students are expected to

CO1. Understand and evaluate the mechanical properties of the material
      Predict the electrical properties of the materials

CO2. Interpret the behavior of the materials when subjected to magnetic
      field

CO3. Evaluate the property changes of the materials with respect to
      temperature and light interactions

CO4. Analyze the degradation of the materials due to environmental
      changes.

TEXTBOOKS:


REFERENCES:

   Sons.
2. Upadhyaya G.S., Anish Upadhyaya, “Materials Science and Engineering”, Viva
   Sons, 1999.
   PHI Learning Pvt. Ltd., 2011
<table>
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<td>Understand and evaluate the mechanical properties of the materials.</td>
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<tr>
<td>CO2</td>
<td>Predict the electrical properties of the materials</td>
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<tr>
<td>CO3</td>
<td>Interpret the behavior of the materials when subjected to magnetic field</td>
<td>3</td>
<td>3</td>
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<tr>
<td>CO4</td>
<td>Evaluate the property changes of the materials with respect to temperature and light interactions</td>
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<td>CO5</td>
<td>Analyze the degradation of the materials due to environmental changes.</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES:
The course is aimed to
- Outline the basics concepts of thermodynamics.
- Impart knowledge about thermodynamic relations, phase equilibria and Ideal gas mixtures.

UNIT I LAWS OF THERMODYNAMICS
Zeroth law of thermodynamics; concepts of heat and work, different modes of work, and various forms of energy, concept of temperature, internal energy, enthalpy; specific heats; first law applied to elementary processes, Limitations of the first law of thermodynamics, concepts of heat engines and heat pumps/refrigerators, Kelvin-Planck and Clausius statements and their equivalence; reversible and irreversible processes; Carnot cycle and Carnot principles/theorems; thermodynamic temperature scale; Clausius inequality and concept of entropy; T-s diagrams; third law of thermodynamics.

UNIT II PROPERTIES OF PURE SUBSTANCES
Thermodynamic properties of pure substances in solid, liquid and vapor phases; P-v-T behaviour of simple compressible substances, phase rule, ideal and real gases, ideal gas equation of state and van der Waals equation of state; law of corresponding states, compressibility factor and generalized compressibility chart, Joule-Thomson coefficient.

UNIT III FUNDAMENTAL EQUATION AND THEIR RELATIONS
Molar heat capacities at constant volume and pressure, theoretical calculation of heat capacity, entropy and disorder on an atomic scale, statistical interpretation of entropy. T-ds relations, Enthalpy, Helmholtz free energy, Gibbs free energy, Chemical potential, the fundamental equation for a closed system, Thermodynamical relations, Maxwell relations, Examples of the applications of Maxwell relations.

UNIT IV PHASE EQUILIBRIUM IN ONE COMPONENT SYSTEM
Variation of Gibbs free energy with temperature at constant pressure, Gibbs free energy as a function of temperature and pressure, Equilibrium between the vapour phase and condensed phase, Graphical representation of vapour phase and condensed phase equilibria, solid-solid equilibria, Gibbs Phase Rule and Phase diagram of Unary system.

UNIT V IDEAL GAS MIXTURES
Dalton’s and Amagat’s laws, properties of ideal gas mixtures, air-water vapor mixtures and simple thermodynamic processes involving them; specific and relative humidities, dew point and wet bulb temperature, adiabatic saturation temperature, psychrometric chart.

TOTAL : 45 PERIODS

OUTCOMES:
On completion of the course, the students are expected to
- CO1. be clear with the basic concepts and laws of thermodynamics
- CO2. recall the properties of pure substances
- CO3. formulate relations between thermodynamic variables
- CO4. have clear knowledge on ideal gas mixtures
TEXT BOOKS:

REFERENCES:
## Course Articulation Matrix:

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<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
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<td>recall the properties of pure substances</td>
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<td>formulate relations between thermodynamic variables</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES:

The course is aimed to

- enable the students to have a thorough knowledge about the different ceramic fabrication process and the other final operations involved after the fabrication of the product.

UNIT I  SLIP PREPARATION  
General Ceramic Forming Techniques and Additives. Slip- selection of materials, preparation, slip properties – density, fluidity, particle size measurement, viscosity, thixotrophy, surfactant concentration, binders, pH, zeta potential, settling, solid recovery, slip recovery, slip conditioning and storage.

UNIT II  SLIP CASTING PROCESS  

UNIT III  PLASTIC FORMING PROCESS  

UNIT IV  PRESSING  

UNIT V  DRYING AND FIRING  

TOTAL: 45 PERIODS
OUTCOMES:

On completion of the course, the students are expected to

CO1. be thorough with the additives and process of slip preparation
CO2. differentiate the different consistencies and identify corresponding shaping methods
CO3. know the possible defects and their remedies during shaping
CO4. discern the methods to dry and fire the prepared articles
CO5. discuss the changes that happen in articles during drying and firing

TEXT BOOKS:

REFERENCES:
**Course Articulation Matrix:**

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<tr>
<th>Course Outcomes</th>
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<td>be thorough with the additives and process of slip preparation</td>
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<td>differentiate the different consistencies and identify corresponding shaping methods</td>
<td>PO1 PSO1</td>
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<td>know the possible defects and their remedies during shaping</td>
<td>PO1 PSO1</td>
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<td>discern the methods to dry and fire the prepared articles</td>
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<td>discuss the changes that happen in articles during drying and firing</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES:
The course is aimed to
- Enable students to prepare casting slip and analyze its various properties
- Prepare articles through different shaping methods
- Teach various physical property estimation techniques

EXPERIMENTS:
1. Plaster Mould Making
2. Preparation of Ceramic Slip with variable raw materials in a Pot Mill
3. Determination of Slip specific gravity
4. Effect of Deflocculant on Viscosity of Slip.
5. Determination of Residue in a Slip.
6. Determination of rheological properties of slip.
9. Forming of Ceramic Article by Potter Wheel
10. Forming of Ceramic Article by Jigger and jolly
11. Preparation of ceramic article by extrusion
12. Biscuit Firing
13. Determination of green and fired shrinkage
14. Determination of bulk density, apparent porosity and water absorption

TOTAL: 60 PERIODS

OUTCOMES:
On completion of this Laboratory Course, the students are expected to
- prepare ceramic casting slip and analyse its properties
- prepare ceramic articles using slip and plastic mass
- evaluate physical properties of the prepared ware

EQUIPMENTS REQUIRED:
1. Electronic weighing balance
2. Pot Mill
3. Hot Air Oven
4. Sieves
5. Moulds
6. Gibbs Viscometer
7. Furnace
8. Jiggering Machine
### Course Articulation Matrix:

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<td>CO1</td>
<td>prepare ceramic casting slip and analyse its properties</td>
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</tr>
<tr>
<td>CO2</td>
<td>prepare ceramic articles using slip and plastic mass</td>
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<td>evaluate physical properties of the prepared ware</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:

The course is aimed to

- Enable students to understand various crystal structures and imperfections
- Teach various mechanical and thermal property estimation techniques
- Enable students to construct simple phase diagrams

EXPERIMENTS:

1. Determination of Crystal Structure and Imperfections using ball models
2. Identification of Crystalline and Non-Crystalline Materials
3. Construction of Phase Diagrams
4. Analyze the microstructure of materials by various sample preparation methods.
5. Analyze the microstructure of materials by various processing techniques
6. Determination of grain size using microstructural analysis
7. Determination of tensile properties using UTM
8. Determination of compressive strength using UTM
9. Determination of hardness of the material.
10. Determination of band gap in semiconductor materials
11. Determination of B-H curve of materials
12. Determination of glass transition temperature of material.

TOTAL: 60 PERIODS

OUTCOMES:

On completion of this Laboratory Course, the students are expected to

CO1. understand various crystal structures and imperfections
CO2. analyze microstructure of materials
CO3. determine mechanical and thermal properties of materials
CO4. construct simple phase diagram

EQUIPMENTS REQUIRED:

1. B-H Curve unit
2. Universal Testing Machine
3. LCR meter
4. Optical microscope
5. Vicker's hardness tester
6. Melting Furnace
7. Band Gap Apparatus
## Course Articulation Matrix:

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<td>CO2</td>
<td>analyze microstructure of materials</td>
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<td>CO3</td>
<td>determine mechanical and thermal properties of materials</td>
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<td>CO4</td>
<td>construct simple phase diagram</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- Outline the basics about refractories and its demand.
- Impart knowledge about various refractory materials
- Discuss the properties and applications of various refractory materials

UNIT I  INTRODUCTION
Definition, Demand and growth of refractories in India, Layout of a refractory plant, Classification of refractory, Fundamental properties of refractories and their testing – physical properties, mechanical properties, thermal properties, chemical properties; Importance of aggregate size, pore size and glassy phase content on refractory properties, Factors for selection and use of refractories.

UNIT II  SILICA AND ALUMINA - SILICA REFRACTORIES
Silica refractories - Raw materials and composition – manufacturing process steps – phase transformation of quartzite - properties and applications – types. \( \text{Al}_2\text{O}_3 - \text{SiO}_2 \) phase diagram, - types of raw materials - different alumino silicate refractories – manufacturing steps – properties and applications - Market Scenario - Demand.

UNIT III  BASIC REFRACTORIES
Raw materials, manufacturing process, properties and applications of magnesite, forsterite, dolomite, chrome based and spinel refractories - Manufacturing Sectors - Market Scenario - Demand.

UNIT IV  SPECIAL REFRACTORIES
Manufacture, properties and applications of different Carbide and nitride refractories, carbonaceous and carbon based refractory, zirconia, beryllia, thoria refractory, fused cast refractories, cermets- Manufacturing Sectors - Market Scenario - Demand.

UNIT V  INSULATING REFRACTORIES
Types of insulating materials – preparation of insulating refractories, ceramic fibers, ceramic fibre products – purpose of insulation – ceramic coatings to minimize heat loss.

TOTAL : 45 PERIODS

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

CO1. Comprehend different refractory properties and their inter relations
CO2. Garner knowledge on the types of refractories and their significance
CO3. Recall the steps involved in the preparation of various refractory materials
CO4. Interpret the properties and applications of the refractory materials
CO5. Acquire awareness on the purpose on insulation and insulating materials
TEXT BOOKS:


REFERENCES:

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<td>Comprehend different refractory properties and their inter relations</td>
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<td>CO2</td>
<td>Garner knowledge on the types of refractories and their significance</td>
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<td>CO3</td>
<td>Recall the steps involved in the preparation of various refractory materials</td>
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<td>CO4</td>
<td>Interpret the properties and applications of the refractory materials</td>
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<td>Acquire awareness on the purpose on insulation and insulating materials</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- Describe the principle behind glass formation and structures of different glasses.
- List about the raw materials for glass making and describe formation of glass
- Explain about the thermo-dynamical, thermal, mechanical, electrical and other properties of glass.
- Describe the defects found in a flat ware and a hollow ware, and the quality control procedure for a coated glass.

UNIT I PRINCIPLES OF GLASS FORMATION 10
Definition. Difference between a glass and crystalline material. Glass Formation – atomistic hypothesis of glass formation, kinetic approach to glass formation. Structures of glasses – fundamental laws, elements of structural models for glasses, structural models for silicate glasses. Phase diagrams of glass forming oxide systems – CaO-Al₂O₃-SiO₂, Na₂O-CaO-SiO₂ etc.

UNIT II RAW MATERIALS AND PREPARATION OF GLASS BATCH 10
Raw materials – Glass formers, intermediates and modifiers, cullet, minor ingredients like oxidizing/reducing agents, refining agents, decolourisers, colouring oxides – description and importance. Selection of glass composition, change in properties in relation to change in composition, Glass batch calculation.

UNIT III GLASS MELTING PROCESS 10

UNIT IV PROPERTIES AND TESTING OF GLASS 8

UNIT V QUALITY CONTROL OF GLASS 7

OUTCOMES:
On completion of the course, the students are expected to
CO1. Have thoroughly understood the science behind glass formation
CO2. Enumerate the various raw materials used for glass preparation and the purpose of its usage
CO3. Formulate glass compositions from batch composition and vice versa.
CO4. Explain various glass properties and their testing methods
CO5. Know the defects that occurs in glass and quality control in different glasses.

TOTAL: 45 PERIODS
TEXT BOOKS:

REFERENCES:
### Course Articulation Matrix:

<table>
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<th>Course Outcomes</th>
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<td>Have thoroughly understood the science behind glass formation</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PO12  PSO1  PSO2  PSO3  PSO4</td>
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<td>Enumerate the various raw materials used for glass preparation and the purpose of its usage</td>
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<td>CO3</td>
<td>Formulate glass compositions from batch composition and vice versa.</td>
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<td>CO4</td>
<td>Explain various glass properties and their testing methods</td>
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<td>CO5</td>
<td>Know the defects that occurs in glass and quality control in different glasses.</td>
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</table>

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

- Enable students to prepare different glass compositions and products
- Enable students to prepare and apply glaze and enamel over wares
- Teach techniques for estimation of glass properties

EXPERIMENTS:
1. Preparation of Soda Lime Glass with varying Cullet Percentage
2. Preparation of Amber Glass
3. Determination of Density, Thermal Expansion, Refractive Index and Chemical Durability of glass
4. Preparation of laminated glass
5. Determination of hardness of a toughened glass
6. Glass fusion and shaping
7. Glaze application over ware by spraying, dipping and pouring
8. Glost firing
9. Sheet metal preparation
10. Ground and cover coat application on metal
11. Design application on glass
12. Glaze crazing test using autoclave
13. Chemical Treatment on glass and glaze
14. Thermo-mechanical treatment on glass and glaze

OUTCOMES:
On completion of this Laboratory Course, the students are expected to

- CO1. prepare and fabricate different glasses
- CO2. prepare and apply glaze over articles
- CO3. prepare and apply enamel over articles
- CO4. evaluate properties of glass and glaze

EQUIPMENTS REQUIRED:
1. Sieve Shaker
2. Hot Plate
3. Hot Air Oven
4. Furnace
5. Electronic balance
6. Dilatometer
7. Spectrometer
8. Optical microscope
9. Vicker’s hardness tester
10. Autoclave
11. Pneumatic Spray gun
12. Three point bending test apparatus

TOTAL: 60 PERIODS
### Course Articulation Matrix:

<table>
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<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
  • impart CAD modelling and design of Ceramic components using CAD software.
  • model and analyse simple Ceramic components using Finite Element Analysis Software.

EXERCISES:
1. Basic Training on CAD Software Tools.
4. Modelling of Cup and Saucer using Assembly Design.
5. Modelling of Vase with handles using shell and Rib command.
7. Stress Analysis of beams with point load.
8. Stress Analysis of beams with varying load.
9. 1-D Conduction problem with single wall.
10. 1-D Conduction problem with multi wall.
12. Fatigue Problems.

TOTAL: 30 PERIODS

OUTCOMES:
On completion of this Laboratory Course, the students are expected to
  CO1. develop CAD Model of Ceramic Products.
  CO2. evaluate Stress Analysis on modelled Ceramic components.
  CO3. evaluate Thermal studies on simple Ceramic components.

FACILITIES REQUIRED:
15No’s of higher end Pentium PC with minimum 64bit,
4GB RAM with Suitable Finite Element Analysis and CAD Software.
### Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
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<tr>
<td>CO1</td>
<td>develop CAD Model of Ceramic Products.</td>
<td>PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PSO1 PSO2 PSO3 PSO4</td>
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<td>CO2</td>
<td>evaluate Stress Analysis on modelled Ceramic components.</td>
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<tr>
<td>CO3</td>
<td>evaluate Thermal studies on simple Ceramic components.</td>
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</table>

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

The course is aimed to

- help students to identify innovative projects that promotes and imbibe creativity.
- enable students to be familiar with current thinking in their field, and able to apply the concepts to relevant research problems or practical applications related to Ceramic Technology.

Each batch comprising of a maximum of 3 students will choose problem related to research or industrial task that has been difficult for them to “solve.” Batch is expected to solve the task by fabricating or developing suitable working model / process / product. At the end of the semester, each student or group of students have to submit a report for evaluation.

OUTCOMES:

On completion of the course, the students are expected to

CO1. learn concepts, models, frameworks, and tools that a Ceramic Engineer need in a world where creativity and innovation is fast becoming a pre- condition for competitive advantage.

CO2. develop a working model using the knowledge they have gained theoretically

TOTAL: 60 PERIODS
### Course Articulation Matrix:

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<tr>
<td>CO1</td>
<td>learn concepts, models, frameworks, and tools that a Ceramic Engineer need in a world where creativity and innovation is fast becoming a pre-condition for competitive advantage.</td>
<td>PO1</td>
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| CO2             | develop a working model using the knowledge they have gained theoretically |                |                |                |                |                |                |                |                |                |                |                |                |                |                |                |                |
|                 |                                                                           | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   |

| CREATIVE PROJECT AND INNOVATIVE PROJECT |                | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   |

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- Describe different furnaces used for glass melting, their design and operation.
- Elaborate the fabrication methods of glass flat ware and hollow ware.
- Discuss the importance and process of annealing of glass products.
- Define the different value adding processes done to glass.

UNIT I  GLASS MELTING FURNACES  8
Construction and operation of pot furnace and day tank furnace. Tank furnace – types, design and construction. Electric tank furnace – design and operation, electrodes used, electric boosting in tank furnace. Forehearth and Feeder section in tank furnace.

UNIT II  OPERATION OF TANK FURNACE  10

UNIT III  FABRICATION PROCESS  9

UNIT IV  ANNEALING  9
Introduction, nature of generation and release of strain, temporary and permanent strain, dependence of strain on cooling rate, detection and measurement of strain, annealing equation, problems in annealing, annealing glass plate, optical glass, ideal annealing cycle.

UNIT V  VALUE ADDING PROCESSES IN GLASS  9
Mirror, chemical vapour deposition, physical vapour deposition process, laminated glass, tempered glass, decorated glasses, vycor and micro porous glass, sealing glass, neutral glass, photosensitive glass, glass ceramic, glass fibers - Manufacturing Sector.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students are expected to
- CO1. Describe different glass melting furnaces
- CO2. Explain the operation of tank furnace with the means to control its operation
- CO3. Recall different fabrication processes of glass
- CO4. Recognize the importance of annealing a glassware
- CO5. State various value adding processes in glass

TEXT BOOKS:

REFERENCES:
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<tr>
<td>CO1</td>
<td>Describe different glass melting furnace</td>
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<tr>
<td>CO2</td>
<td>Explain the operation of tank furnace with the means to control its operation</td>
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<tr>
<td>CO3</td>
<td>Recall different fabrication processes of glass</td>
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<tr>
<td>CO4</td>
<td>Recognize the importance of annealing a glassware</td>
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<tr>
<td>CO5</td>
<td>State various value adding processes in glass</td>
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<td>GLASS ENGINEERING – II</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- Explain the application of refractories in different industries
- Describe the design and installation of refractories

UNIT I  REFRACTORIES FOR IRON and STEEL INDUSTRY

UNIT II  REFRACTORIES FOR NON-FERROUS and NON-METALLIC INDUSTRIES
Refractories for non-ferrous industries – copper, aluminum, zinc, lead. Refractories for non-metallic industries – hydrocarbon industry, fertilizer industry, cement industry.

UNIT III  REFRACTORIES FOR GLASS AND CERAMIC INDUSTRY
Refractories for glass industry – refractory practices in sidewall, basin, throat, forehearth and roof of glass tank, regenerator systems. Refractories for ceramic industry – kiln design – LTM concept, fast firing technology, kiln furnitures – types, properties, requirements – applications in different ceramic industry.

UNIT IV  REFRACTORIES FOR SPACE and NUCLEAR APPLICATIONS
Ceramics for space – materials used in space satellite, missiles, rockets nozzles. Ceramics for nuclear reactors – types of reactors, structural ceramic materials, ceramic fuel elements, control rod elements.

UNIT V  REFRACTORY LINING DESIGN AND INSTALLATION
Design with shaped dense and heat-insulating materials – standard shapes, holding anchors, joints, some examples of design. Design with monolithic refractory material – general, anchors, joints, some examples of design. Example for heat flux calculation through multilayer refractory wall and subsequent wall design. Installation of shaped and unshaped refractory materials, and ceramic fiber products – industries, market scenario.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students are expected to
- CO1. Cognize the design and refractory usage in various furnaces
- CO2. Know the refractory usage in space and nuclear applications
- CO3. Reason out the purpose of using a particular refractory in its application area
- CO4. Design refractory linings and develop installation methods

TEXT BOOKS:

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<td>Cognize the design and refractory usage in various furnaces</td>
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<td>CO2</td>
<td>Know the refractory usage in space and nuclear applications</td>
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<td>CO3</td>
<td>Reason out the purpose of using a particular refractory in its application area</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:

This course is aimed to impart knowledge in

- Preparation of ceramic powders
- Surface interaction between powders
- Consolidation and fabrication of final ceramic products

UNIT I  POWDER SYNTHESIS

Powder Characteristics – Powder Preparation – Mechanical, Chemical – Solid state, Liquid state and Vapour Phase reactions – Nano scale powders: SiO₂, TiO₂, Al₂O₃, BaTiO₃, ZrO₂, CeO₂, Si₃N₄, MoSi₂, SiC.

UNIT II  COLLOIDAL PROCESSING

Colloids – Types – Surface forces – Stabilisation – Colloidal suspension – Electrostatic, steric and electrosteric – structure and Rheology of colloidal suspensions

UNIT III  FORMING


UNIT IV  SINTERING


UNIT V  CERAMIC FABRICATION AND APPLICATIONS

Film, Monoliths, Fibers – CVD, Directed Metal Oxidation, Reaction Bonding, sol-gel Processing. Fabrication of Cutting tools, Ceramic Liners, bearings, Turbine blade, Biological implants, Ceramic capacitors - case studies - Industries

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course, students are expected to

CO1. evaluate suitable method for ceramic powder preparation
CO2. identify science of interaction between colloidal state of powders
CO3. select suitable forming and sintering method
CO4. identify fabrication method of ceramic components
TEXT BOOKS:

REFERENCES:
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<td>identify science of interaction between colloidal state of powders</td>
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<td>identify fabrication method of ceramic components</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- Enable students to prepare different refractories
- Teach estimation of properties of refractories

EXPERIMENTS:
1. Preparation of silica refractory with different additives
2. Preparation of fire clay refractory with different additives
3. Preparation of high alumina refractory with different additives.
4. Estimation of PLC of silica, fire clay, high alumina refractories.
5. Estimation of TEC of silica, fire clay, high alumina refractories.
6. Estimation of PCE of silica, fire clay, high alumina refractories.
7. Estimation of RUL of silica, fire clay, high alumina refractories.
8. Estimation of chemical attack resistance of silica, fire clay, high alumina refractories.
9. Comparison of density, porosity and strength of refractory prepared by powder pressing and extrusion.
10. Comparison of density, porosity and strength of silica, fire clay, and high alumina refractories.
11. Preparation of porous refractory for insulation with different pore formers and comparison of their characteristics.
12. Comparing the characteristics of a dense and porous refractory.

TOTAL : 60 PERIODS

OUTCOMES:
On completion of this Laboratory Course, the students are expected to
- CO1. design composition and prepare different refractories
- CO2. estimation of properties of different refractories
- CO3. compare properties of different refractories

EQUIPMENTS REQUIRED:
1. Universal Testing Machine
2. HotPlate
3. Extruder
4. Electronic balance
5. Uniaxial pressing machine
6. Hot air oven
7. Furnace
8. Dilatometer
9. Optical microscope
## Course Articulation Matrix:

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</tbody>
</table>

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

- Enable students to prepare ceramic powders by different methods and consolidate them through various techniques
- Teach various sintering techniques and surface treatment methods

EXPERIMENTS:
1. Powder synthesis by Communition / High Energy Ball milling
2. Powder preparation by Sol - Gel process
3. Powder preparation by Precipitation process
4. Powder preparation by Spray Drying
5. Forming by Gel Casting
6. Forming by Tape Casting
7. Role of additives in compaction by Pressing
8. Porous body making by Foaming
9. Porous body making by Intrusion / Replication
10. Microwave Sintering
11. Hot Pressing
12. Coating over substrate by Spray Pyrolysis
13. Surface Grinding and Roughness estimation

TOTAL: 60 PERIODS

OUTCOMES:
On completion of this Laboratory Course, the students are expected to

CO1. prepare ceramic powders by top-down and bottom up approaches
CO2. prepare ceramic articles by advanced casting and other shaping methods
CO3. fire ceramic articles by advanced sintering techniques
CO4. modify and study the surface of ceramic articles by coatings or grinding

EQUIPMENTS REQUIRED:
1. High energy ball mill
2. Hot Press
3. Spray Pyrolyser
4. Hot Air Oven
5. Uniaxial pressing Machine
6. Hot plate
7. Microwave Furnace
8. Spray Dryer
9. Magnetic stirrer
10. Tape casting Equipment
11. Surface Grinding Machine
12. Surface Roughness Tester Machine
<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>prepare ceramic powders by top-down and bottom up approaches</td>
<td>PO1 3 3 3 3 3 3 3 3 3 3 3 3 PSO1 3 3 3 3</td>
</tr>
<tr>
<td>CO2</td>
<td>prepare ceramic articles by advanced casting and other shaping methods</td>
<td>PO1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3</td>
</tr>
<tr>
<td>CO3</td>
<td>fire ceramic articles by advanced sintering techniques</td>
<td>PO1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3</td>
</tr>
<tr>
<td>CO4</td>
<td>modify and study the surface of ceramic articles by coatings or grinding</td>
<td>PO1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3</td>
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<tr>
<td>ADVANCED CERAMIC PROCESSING LABORATORY</td>
<td>-</td>
<td>PSO1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES:
The course is aimed to
- Enable students to be thorough in different materials characterizations techniques which are dependent on their composition, phase, crystal, particulate and microstructure properties and applications.

UNIT I THERMAL ANALYSIS
Principles of Differential thermal analysis (DTA), Thermogravimetric analysis (TGA) and Differential scanning calorimetry (DSC), Dilatometer - their applications in processing and Characterization of ceramics, glasses, and glass Ceramics.

UNIT II X–RAY DIFFRACTION
Characteristics X – rays, Fundamental principles of X-ray diffraction (XRD); Brag’s Law, Determination of Crystal Structure and particle size from XRD, Atomic Scattering and geometrical structure factors and their application in intensity calculation. Single crystal and powder diffraction.

UNIT III SPECTROSCOPY

UNIT IV SURFACE CHARACTERIZATIONS

UNIT V ELECTRICAL, MAGNETIC CHARACTERIZATIONS
Electrical resistivity in bulk and thin films(2-probe method and 4-probe method), Hall effect, Impedance spectroscopy, Vibrating sample magnetometer(VSM), Magnetic PE loop.

TOTAL: 45 PERIODS
OUTCOMES:
On completion of the course, the students are expected to
   CO1. Know the techniques to characterize a material right from raw material stage to final product stage
   CO2. Explain the principle of various characterization techniques
   CO3. Select a suitable characterization technique to analyze a property
   CO4. Be able to design a material with required properties with the aid of characterization techniques

TEXT BOOKS:

REFERENCES:
4. https://nptel.ac.in/courses/113106034/
5. https://nptel.ac.in/courses/115103030/
6. https://chem.libretexts.org/
## Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Know the techniques to characterize a material right from raw material stage to final product stage</td>
<td>PO1 3 2 2 2 2 2 1 3 3 3 3 - - - - 3 3 3 3 3 3 3 3</td>
</tr>
<tr>
<td>CO2</td>
<td>Explain the principle of various characterization techniques</td>
<td>PO2 2 2 2 3 3 1 - - - - 3 3 3 3 3 3 3 3 3 3 3 3 3</td>
</tr>
<tr>
<td>CO3</td>
<td>Select a suitable characterization technique to analyze a property</td>
<td>PO3 3 1 2 2 2 2 - - - - 3 3 3 3 3 3 3 3 3 3 3 3 3</td>
</tr>
<tr>
<td>CO4</td>
<td>Be able to design a material with required properties with the aid of characterization techniques</td>
<td>PO4 2 2 1 3 3 2 - - - - 3 3 3 3 3 3 3 3 3 3 3 3 3</td>
</tr>
<tr>
<td>CERAMIC CHARACTERIZATION</td>
<td>3 2 2 3 3 2 - - - - 3 3 3 3 3 3 3 3 3 3 3 3 3 3</td>
<td>1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively</td>
</tr>
</tbody>
</table>
OBJECTIVES:
The course is aimed to
- Enable students to characterize ceramic powders and products for various properties

EXPERIMENTS:
1. Elemental analysis using atomic emission spectrometer - Flame Photometer
2. Thermal Analysis of ceramic and glass materials by TGA, DTA, DSC.
3. Determination of Viscosity of slip by Brookfield Viscometer.
4. Particle Size Analysis of ceramic powders by Laser Diffraction technique.
5. Study the surface morphology of ceramic systems by microscopy techniques – Optical Microscopy and SEM.
8. Study the thermal expansion behaviour of ceramic material using dilatometer.
10. Temperature and frequency dependence of dielectric constant of ferroelectric material by impedance spectroscopy.
11. Indexing the X ray diffraction pattern of ceramic system.
12. B-H loop
13. Construction of phase diagram of ceramic material.

TOTAL : 60 PERIODS

OUTCOMES:
On completion of this Laboratory Course, the students are expected to
- CO1. analyze ceramic raw materials for their particle size and other properties
- CO2. estimate various mechanical, thermal, electronic and magnetic properties of ceramic products

EQUIPMENTS REQUIRED:
1. Flame photometer
2. Thermo gravimetric analyzer
3. Brookfield viscometer
4. Laser particle size analyser
5. Optical microscope
6. Scanning electron microscope
7. Vicker’s hardness tester / Nano Indenter
8. Pin on disc wear tester
9. Dilatometer
10. Impedence spectroscopy
11. LCR meter
12. B-H Loop equipment
13. X-ray diffractometer
## Course Articulation Matrix:

<table>
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<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO1</th>
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<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
<th>PSO4</th>
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<tbody>
<tr>
<td>CO1</td>
<td>analyze ceramic raw materials for their particle size and other properties</td>
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<tr>
<td>CO2</td>
<td>estimate various mechanical, thermal, electronic and magnetic properties of ceramic products</td>
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</tbody>
</table>

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

The course is aimed to

- enable students to revise and recollect the courses completed by them earlier

In this course, comprehension test on the courses completed by the students till their Sixth Semester will be conducted twice a week. This will serve to recollect and rectify the doubts in those courses. The marks obtained by the students during the periodic tests will be considered to award the grade to the students.

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course, the students are expected to

CO1. recollect the courses completed by them till their sixth semester
CO2. rectify any doubts they happen to have in those courses
CO3. have better understanding of the courses
<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO1</th>
<th>PO2</th>
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<th>PSO3</th>
<th>PSO4</th>
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<tbody>
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<td>recollect the courses completed by them till their sixth semester</td>
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<tr>
<td>CO2</td>
<td>rectify any doubts they happen to have in those courses</td>
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<tr>
<td>CO3</td>
<td>have better understanding of the courses</td>
<td>3</td>
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</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to design and fabrication of ceramic product and to develop a pilot system design of Ceramic Machineries

The students should carryout following assignments and have to submit project report as per University norms.

(1) Design and Construction of Kilns/ Muffle furnace/Vacuum furnace/ceramic furniture/Ceramic liners
(2) Design and Construction of Spray drier/Cyclone separator/Filter press/Pug Mill
(3) Fabrication ceramic components such as Ceramic Sheath/Ceramic Burner/crucible/grinding media/feed through/container

TOTAL: 90 PERIODS

OUTCOMES:
On completion of the course the students are expected

CO1. to make newer ceramic components
CO2. to have experience on principle of ceramic machineries
CO3. to develop a custom built ceramic machinery
### Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
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<td>to make newer ceramic components</td>
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<tr>
<td>CO2</td>
<td>to have experience on principle of ceramic machineries</td>
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<tr>
<td>CO3</td>
<td>to develop a custom built ceramic machinery</td>
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<td>PROJECT - I</td>
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</tr>
</tbody>
</table>

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

The course is aimed to

- Give practical exposure to students in industries or in research institute
- Enable students to relate their theoretical knowledge to practical situation
- Train students to the industry / research environment

All the students have to undergo practical industrial training / internship of minimum four week (total) duration in recognized establishments during vacations in their third year (vacation during V semester and / or VI Semester), at the end of which they have to submit a report.

OUTCOMES:

On completion of the course, the students are expected to

- CO1. Employ their theoretical skills
- CO2. Be clarified with the components and working of industry / research institute.
- CO3. Be trained in the different divisions of the industry / institute
- CO4. Face the real life situation in industry / institute with ease on placement.
## Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Employ their theoretical skills</td>
<td>PO1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Be clarified with the components and working of industry / research institute.</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>Be trained in the different divisions of the industry / institute</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Face the real life situation in industry / institute with ease on placement.</td>
<td>3</td>
</tr>
<tr>
<td>INTERNSHIP / INDUSTRIAL TRAINING</td>
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<td>3</td>
</tr>
</tbody>
</table>

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

The course is aimed to

- train the students on systematic analysis of a problem
- enable students to bring out a solution to the problem

Each student / batch with a maximum of 3 students are required to use concepts of ceramic engineering and technology to develop a pilot model or to suggest a suitable process to solve industrial and/or societal related problems. At the end of the course, they have to submit a report on the project assigned to him/her by the department. The report should be based on the literature collected from the many sources, the actual analysis and the development done by the student on the given project.

TOTAL: 240 PERIODS

OUTCOMES:

On completion of the course, the students are expected to

- CO1. analyze a given problem systematically
- CO2. make use of the knowledge gained at various stages of the degree course to bring out solution to the problem
- CO3. be trained in methodical approach to problem solving
### Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>analyze a given problem systematically</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PSO1  PSO2  PSO3  PSO4</td>
</tr>
<tr>
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<td></td>
<td>3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3</td>
</tr>
<tr>
<td>CO2</td>
<td>make use of the knowledge gained at various stages of the degree course to bring out solution to the problem</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PSO1  PSO2  PSO3  PSO4</td>
</tr>
<tr>
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<td></td>
<td>3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3</td>
</tr>
<tr>
<td>CO3</td>
<td>be trained in methodical approach to problem solving</td>
<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PSO1  PSO2  PSO3  PSO4</td>
</tr>
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<tr>
<td>PROJECT - II</td>
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<td>PO1  PO2  PO3  PO4  PO5  PO6  PO7  PO8  PO9  PO10  PO11  PSO1  PSO2  PSO3  PSO4</td>
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<td>3   3   3   3   3   3   3   3   3   3   3   3   3   3   3   3</td>
</tr>
</tbody>
</table>

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

- Describe various types of monolithic materials
- Discuss the installation methods of different monolithic materials
- Deliberate the wear mechanisms of the installed materials and their testing methods

UNIT I CASTABLES

UNIT II PLASTIC REFRACTORIES, RAMMING AND GUNNING MIXES

UNIT III MORTARS, COATINGS AND DRY VIBRATABLES

UNIT IV MONOLITHIC INSTALLATION
Methods of installations of castables, plastic refractories, ramming mix and gunning mix. Drying and heating up of installed monolithic lining. Application designs – blast furnace trough design, trough lining, and form design, tundish, steel ladle, electric arc furnace. Linings in installation – anchors, steel fibre reinforcements.

UNIT V WEAR MECHANISMS AND TESTING
Wear mechanisms – introduction, abrasion, penetration, corrosion, spalling. Tests done on monolithics – chemical analysis, density, porosity, strength, high temperature properties, corrosion, erosion.

TOTAL: 45 PERIODS

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

CO1. Recall the types of unshaped / monolithic refractory materials, their composition and characteristics.
CO2. Prepare monolithic materials with appropriate bond systems
CO3. Discern the methods of installing different monolithic materials, the application design and the lining materials used while laying monolithics.
CO4. Have studied the wear mechanisms that cause failure in a monolithic lining and the methods to test a monolithic.

TEXT BOOKS:
REFERENCES:
<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
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<th>PSO1</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Recall the types of unshaped / monolithic refractory materials, their composition and characteristics.</td>
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</tr>
<tr>
<td>CO2</td>
<td>Prepare monolithic materials with appropriate bond systems</td>
<td>-</td>
<td>2</td>
<td>2</td>
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</tr>
<tr>
<td>CO3</td>
<td>Discern the methods of installing different monolithic materials, the application design and the lining materials used while laying monolithics.</td>
<td>-</td>
<td>3</td>
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<td>2</td>
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<tr>
<td>CO4</td>
<td>Have studied the wear mechanisms that cause failure in a monolithic lining and the methods to test a monolithic.</td>
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</tbody>
</table>

UNSHAPED REFRACTORIES: - 3  2  2  2  -  -  -  -  -  -  -  -  -  -  3  3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- List out the various types of fuels and their characteristics
- Describe about the combustion of different fuels
- Discuss the modes of heat transfer and means of heat recovery

UNIT I  SOLID FUEL  9

UNIT II  LIQUID FUEL  9

UNIT III  GASEOUS FUELS  9

UNIT IV  COMBUSTION PROCESS  9
Air requirement, combustion processes of solid, liquid, gaseous fuels, control of combustion process, combustion stoichiometry.

UNIT V  HEAT TRANSFER  9
Heat transfer to charge by conduction, convection and radiation in a kiln, heat loss through kiln wall, opening, cooling etc., heat balance and thermal efficiency, heat recovery – recuperator and regenerator, co-generator – importance. Methods to protect environment from heat

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students are expected to
CO1. Recall various types of fuels, their advantages and disadvantages
CO2. Calculate air requirement for combustion process and know how to control combustion
CO3. Explain modes of heat transfer
CO4. Describe methods of heat recovery

TEXT BOOKS:

REFERENCES:
## Course Articulation Matrix:

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<td>Recall various types of fuels, their advantages &amp; disadvantages</td>
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<td>Calculate air requirement for combustion process and know how to control combustion</td>
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<td>CO3</td>
<td>Explain modes of heat transfer</td>
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<td>Describe methods of heat recovery</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:

The course is aimed to
- Discuss the factors for selection of a plant layout.
- Describe the ways of assembling the various sections in the plant for proper functioning.
- List the principles of designing equipments and furnaces.
- Enable the construction of furnaces.

UNIT I  PLANT DESIGN  9
Proper location of the plant - factors to be considered, factory buildings - layouts with necessary details. Feasibility study, market survey, Raw material, Manpower, Power and water availability. Economy of plant design, Electrical, Diagram for movement of flow, Gangways for material handling, Exhaust and powder waste management.

UNIT II  EQUIPMENT DESIGN  9
Design principles - crushers, filter press, sieves, pugmill and different types of pug mill die design, Design of Jiggering and Jolley machine, Roller machines, Hydraulic power pack design for presses, Bearings and drives for linear motion, Tonnage calculation for hydraulic press, Simple Electrical circuit for automation.

UNIT III  DRIER DESIGN  9

UNIT IV  FURNACE DESIGN  9

UNIT V  FURNACE CONSTRUCTION  9
Construction of Chamber kiln, Tunnel kiln, Roller kiln, Blast furnace, Glass tank furnace, Shuttle kiln - Manufacturers.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the students are expected to
- CO1. Recall the parameters for setting up the plant
- CO2. Fabricate the machinery
- CO3. Design a drier and a furnace
- CO4. Construct a furnace

TEXT BOOKS:

REFERENCES:

### Course Articulation Matrix:

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<td>Recall the parameters for setting up the plant</td>
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<td>Fabricate the machinery</td>
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<td>Design a drier and a furnace</td>
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<td>Construct a furnace</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- Describe the process of cement clinker manufacture and its testing
- Elaborate on preparation and properties of Portland cement
- Discuss different blended and special cements
- Familiarize the environmental impact and the testing methods of cement

UNIT I PRODUCTION OF CEMENT CLINKER

UNIT II CLINKER STUDY
Solid state reactions, Sintering and Clinkering, Constitution of Portland Cement clinker, Study of important system in phase formation, Effect of impurities and role of minor components, Quality control of clinker- Litre weight test, Characterization of clinker-Chemical analysis, Optical microscopy, electron Microscopy, XRD.

UNIT III PORTLAND CEMENT

UNIT IV BLENDED CEMENTS AND SPECIAL CEMENTS
Introduction, Type I – Type V Portland Cements; Cement with mineral constituents – pozzolanic materials, Blast furnace slag and fly ash; Problem in of blended cements. Composition, Properties and Applications of Special cements - high alumina cement, white and coloured cement, oil well cement, hydrophobic cement, water proof cement, super sulphate cement, sulphate resisting cement - Manufacturers.

UNIT V ENVIRONMENTAL IMPACT AND CEMENT TESTING

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students are expected to
CO1. Know the process of cement clinker manufacture
CO2. Recall the various tests done on clinker
CO3. Describe Portland cement manufacturing process
CO4. Discern the types of cements
CO5. Test the cement for its properties
TEXT BOOKS:

REFERENCES:
## Course Articulation Matrix:

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<thead>
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<td>CO1</td>
<td>Know the process of cement clinker manufacture</td>
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<td>Recall the various tests done on clinker</td>
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<td>Describe Portland cement manufacturing process</td>
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<td>CO4</td>
<td>Discern the types of cements</td>
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<td>CO5</td>
<td>Test the cement for its properties</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- Discuss basics on abrasives, backings and adhesives
- Describe manufacturing process of coated and bonded abrasives
- Explain the fundamentals of grinding operation, grinding aids and aboutpolishing

UNIT I ABRASIVES, ADHESIVES and BACKINGS 9

UNIT II MANUFACTURE OF COATED ABRASIVES 10

UNIT III BACKUPS 10
Contact wheels – cloth contact wheels, rubber contact wheels, hardness, face serrations, shape, wheel diameter, speed, belt tension, dressing and protection of contact wheels – their characteristics. Drum, rolls, pads and platens – types, characteristics, choice and uses. Working principle of coated abrasive.

UNIT IV MANUFACTURE OF BONDED ABRASIVES 8
Abrasive grain type and characteristics required for bonded abrasives. Types of bonds – vitrified, silicate, resinoid, shellac, rubber and oxychloride. Bonded wheel manufacture with different bonds and their characteristics. Shapes and sizes of wheels. Factors determining grinding action – characteristics of abrasive grain, bond type, structure. Other types of wheels – Diamond wheels, reinforced wheels, mounted wheels. Selection of appropriate abrasive wheels for grinding metals - Industries.

UNIT V BASICS OF GRINDING AND POLISHING 8

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course the students are expected to
- CO1. Recall different types of abrasive grains, backings, adhesives and their characteristics.
- CO2. Know the stages involved in the manufacturing of coated and bonded abrasives.
- CO3. Describe the effect of different back ups on the grinding characteristics of coated belts.
- CO4. Choose a specific bonded wheels for a given grinding operations.
- CO5. Identify different grinding fluids and wheel wear
- CO6. Discuss types of grinding and polishing operations.
TEXT BOOKS:

1. Coated Abrasives – Modern Tool of Industry, Coated Abrasive Manufacturer’s Institute, Cleaveland, Ohio,1982.

REFERENCES:

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<tr>
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<td>Recall different types of abrasive grains, backings, adhesives and their characteristics.</td>
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<td>Know the stages involved in the manufacturing of coated and bonded abrasives</td>
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<td>Describe the effect of different back ups on the grinding characteristics of coated belts</td>
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<td>CO4</td>
<td>Identify different grinding fluids and wheel wear</td>
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<td>CO5</td>
<td>Discuss types of grinding and polishing operations</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- Introduce the science of glass-ceramics formation.
- Describe glass ceramic material preparation.
- Discuss about various composition system for glass ceramics
- Elaborate properties of glass ceramic materials.
- List different applications of glass ceramics.

UNIT I  INTRODUCTION
8
Glass ceramic materials – characteristics; phase equilibria in glass forming system; Glass formation; Glass crystallization – nucleation and crystal growth in glass, overall glass crystallization kinetics.

UNIT II  PREPARATION OF GLASS CERAMIC MATERIALS
8
Raw materials, preparation of the glass batch, melting, forming, heat treatment, special methods for preparing glass ceramic materials.

UNIT III  VARIOUS COMPOSITION SYSTEMS FOR GLASS CERAMICS
11
Alkali and alkaline earth silicates – SiO<sub>2</sub>-Li<sub>2</sub>O;Aluminosilicates - SiO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub>-Li<sub>2</sub>O,SiO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub>-Na<sub>2</sub>O, SiO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub>-CaO; Flurosilicates - SiO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub>-MgO-CaO-ZrO<sub>2</sub>-F;Silicophosphates - SiO<sub>2</sub>-CaO-Na<sub>2</sub>O-P<sub>2</sub>O<sub>5</sub>; Iron silicates - SiO<sub>2</sub>-Fe<sub>2</sub>O<sub>3</sub>-CaO;Phosphates – P<sub>2</sub>O<sub>5</sub>-Al<sub>2</sub>O<sub>3</sub>-CaO.

UNIT IV  PROPERTIES OF GLASS CERAMIC MATERIALS
9
Density; mechanical properties – strength and elasticity, hardness and abrasion resistance; thermal properties; electrical property.

UNIT V  APPLICATIONS
9
Medical – CERABONE, CERAVITAL, BIOVERIT and dental applications; electrical and electronic applications – insulator, electronic packaging; energy applications – components for lithium batteries joining materials for solid oxide fuel cell components; consumer and technical applications - Industries - Market Demand.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course the students are expected to
CO1. Know phase equilibria in glass forming system, nucleation, crystal growth and overall glass crystallization kinetics.
CO2. Recognize the process involved in the preparation of glass ceramic materials.
CO3. Recall various composition systems for glass ceramics.
CO4. Discern the properties of glass ceramic materials.
CO5. Identify the application of glass ceramics in various fields.

TEXT BOOKS:
1. Z. Strnad, Glass Ceramics materials, Glass Science and Technology 8, Elsevier 1986
REFERENCES:
Course Articulation Matrix:

<table>
<thead>
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<th>Course Outcomes</th>
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<td>Know phase equilibria in glass forming system, nucleation, crystal growth and overall glass crystallization kinetics.</td>
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<td>Recognize the process involved in the preparation of glass ceramic materials.</td>
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<tr>
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<td>Recall various composition systems for glass ceramics.</td>
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<tr>
<td>CO4</td>
<td>Discern the properties of glass ceramic materials.</td>
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<tr>
<td>CO5</td>
<td>Identify the application of glass ceramics in various fields.</td>
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</table>

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

- Introduce the use of ceramic materials as insulators and capacitors and their properties.
- Describe the processing, properties and various applications of ferroelectric and magnetic ceramics and its applications.
- Provide basic knowledge about the manufacture, characteristics and properties of varistors and fuel cells.

UNIT I  CERAMIC INSULATORS  9

UNIT II  CERAMIC CAPACITORS  7

UNIT III  FERROELECTRIC CERAMICS  11

UNIT IV  MAGNETIC CERAMICS  9

UNIT V  VARISTORS AND FUEL CELLS  9
Introduction- ZnO varistors – PN junction diode– electrical characteristics, fabrication of ZnO varistor behavior- microstructure – gas sensors fuel cells – types, principle, working, solid oxide fuel cells –applications- structure and operation principle of oxygen sensors, NOx sensors, thermistor.

TOTAL: 45 PERIODS

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

CO1. Recall the science of dielectric, ferroelectric and magnetic systems in ceramics

CO2. Describe the preparations of ferroelectric and magnetic materials by various method

CO3. Identify applications of various electronic ceramic materials
TEXT BOOKS:

REFERENCES:
Course Articulation Matrix:

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<tr>
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<td>Recall the science of dielectric, ferroelectric and magnetic systems in ceramics</td>
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<td>CO2</td>
<td>Describe the preparations of ferroelectric and magnetic materials by various method</td>
<td>PO1</td>
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<td>Identify applications of various electronic ceramic materials</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- Enable the students to have a basic knowledge about the various types of fuel cells and their characterization
- Describe the different sensors and their applications.

UNIT I FUEL CELLS

UNIT II REACTION KINETICS

UNIT III SOLID OXIDE FUEL CELLS

UNIT IV FUEL CELL CHARACTERIZATION
Ex situ characterizations – Porosity determination, surface area measurements, gas permeability, structure determination, chemical determination. In situ characterizations (electrochemical) - current - voltage measurement, current interrupt measurement, electrochemical impedance spectroscopy, cyclic voltammetry.

UNIT V SENSORS

TOTAL : 45 PERIODS

OUTCOMES:
On completion of the course, the students are expected to
CO1. Have learnt the basics about fuel cells and sensors.
CO2. Have knowledge about fuel cell kinetics.
CO3. Have a sound knowledge about solid oxide fuel cells.
CO4. Have learnt about characterization techniques to characterize Fuel cells.
CO5. Have learnt about the various basic sensors.
TEXT BOOKS:

REFERENCES:
Course Articulation Matrix:

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<tr>
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<td>Have knowledge about fuel cell kinetics.</td>
<td>−</td>
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<td>2</td>
<td>2</td>
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<td>CO3</td>
<td>Have a sound knowledge about solid oxide fuel cells.</td>
<td>−</td>
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<td>CO5</td>
<td>Have learnt about the various basic sensors.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES:
The course is aimed to
- list out various energy materials.
- discuss about fabrication and performance of various energy storage devices

UNIT I  ENERGY MATERIALS  9

UNIT II  SOLAR ENERGY MATERIALS  9

UNIT III  ENERGY TRANSPORT AND STORAGE MATERIALS  9

UNIT IV  FUEL CELL MATERIALS  9

UNIT V  FERROELECTRIC BASED ENERGY MATERIALS  9
Introduction to ferroelectrics, anti ferroelectric and piezoelectric, pyroelectric systems, materials. Electromechanical coupling, figures of merit, piezoelectric energy harvesting system, electrocaloric effect, energy storage capacitors

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students are expected to
CO1. Have learnt the basics about energy materials.
CO2. Have knowledge about solar energy materials.
CO3. Have a sound knowledge about energy transport and storage materials.
CO4. Have learnt about the fuel cell materials.
CO5. Have learnt about ferroelectric materials for energy application.
TEXT BOOKS:

REFERENCES:
1. Arumugam. M, “Physics II” Anuradha agencies, 2005
## Course Articulation Matrix:

<table>
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<td>Have learnt the basics about energy materials.</td>
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<td>CO2</td>
<td>Have knowledge about solar energy materials.</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>Have a sound knowledge about energy transport and storage materials.</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Have learnt about the fuel cell materials.</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>Have learnt about ferroelectric materials for energy application</td>
<td>3</td>
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<td>MATERIALS FOR ENERGY DEVICES</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- Introduce the various parameters influencing sol gel process
- Describe the chemistry of precursor solution
- Impart knowledge on different types of gels and processing from gel
- Discuss different material preparation by sol gel process

UNIT I  INTRODUCTION TO SOL GEL PROCESS  9
Introduction to sol, gel. Gel formation, various parameters involved in sol gel process, hydrolysis, condensation, gelation, pH, aging, drying, densification, processing. Types of gel - aero gel, xerogel.

UNIT II  CHEMISTRY OF PRECURSOR SOLUTION  9
Solvent- basic of precursor’s transformation solution- metal salt solution- Alkoxides solution- other precursor-precursor mixing-non oxide solution.

UNIT III  APPROACHES IN PARTICULATE AND POLYMERIC GEL  9
Introduction to particulate gel- Single component system- steps involved in single component systems multi component systems-steps involved in multi component system, Introduction to polymeric gel, approaches of polymeric gel.

UNIT IV  RHEOLOGICAL PROPERTIES OF GEL  9

UNIT V  PREPARATION OF MATERIAL  9

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students are expected to
- CO1. Recall the parameters influencing sol gel process
- CO2. State the chemistry of precursor solution
- CO3. Interpret the gel formation, its types and properties
- CO4. Prepare different materials through sol gel process
- CO5. Identify suitable application areas for sol gel process

TEXT BOOKS:

REFERENCES:
1. Alain C.Pierre ,"Introduction to solgel processing --springer1990
<table>
<thead>
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<th>Statement</th>
<th>Program Outcome</th>
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<td>Recall the parameters influencing sol gel process</td>
<td>PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PSO1 PSO2 PSO3 PSO4</td>
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<tr>
<td>CO2</td>
<td>State the chemistry of precursor solution</td>
<td>3 2 2 1 2 - - - - - - - - 3 3</td>
</tr>
<tr>
<td>CO3</td>
<td>Interpret the gel formation, its types and properties</td>
<td>3 3 1 1 2 - - - - - - - - 3 3</td>
</tr>
<tr>
<td>CO4</td>
<td>Prepare different materials through sol gel process</td>
<td>3 2 2 2 2 - - - - - - - - 3 3</td>
</tr>
<tr>
<td>CO5</td>
<td>Identify suitable application areas for sol gel process</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to introduce the students to the basic concepts of ceramic materials used for nuclear and space applications.

UNIT I FUNDAMENTALS OF NUCLEAR CERAMICS
Atomic structure- atomic number- mass number- isotopes- nuclear energy and nuclear forces, binding energy- nuclear stability- radio activity- nuclear reactions- nuclear fission, nuclear fusion.

UNIT II NUCLEAR REACTORS
Types of reactors- ordinary water moderated reactors- heavy water cooled and moderated reactors- design, construction and control of nuclear reactors- moderators- coolants, reflectors and structural materials - Manufacturers.

UNIT III FUELS
Methods of production and properties, uranium oxide, thorium oxide, beryllium oxides encapsulation, nuclear fuel cycle, spent fuel characteristics, reprocessing techniques.

UNIT IV RADIATION PROTECTION
Types of waste- disposal- ICRP recommendations- radiation hazards and prevention, radiation dose units.

UNIT V SPACE CERAMICS
Materials aspects of missile and satellite re entry- aerospace nuclear propulsion technology, auxiliary space powder devices- rocket nozzle technology- the space environment and its effects- Manufacturers.

OUTCOMES:
On completion of the course the students are expected to
CO1. Have studied the basic concepts of nuclear physics.
CO2. Have learnt about the nuclear reactors.
CO3. Have studied in detail about the production and properties of various fuels.
CO4. Have studied about the radiation protection.
CO5. Have studied the basics about space ceramics.

TEXT BOOKS:

REFERENCES:
# Course Articulation Matrix:

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<th>Course Outcomes</th>
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<td>Have studied the basic concepts of nuclear physics.</td>
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<td>CO2</td>
<td>Have learnt about the nuclear reactors.</td>
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<td>2</td>
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<tr>
<td>CO3</td>
<td>Have studied in detail about the production and properties of various fuels.</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
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<tr>
<td>CO4</td>
<td>Have studied about the radiation protection.</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
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<td>CO5</td>
<td>Have studied the basics about space ceramics.</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- Discuss the fundamentals of coatings.
- Elaborate on various thin film forming techniques
- Describe the interfacial adhesion of thin films.
- List the different properties and applications of Thin film coatings.

UNIT I COATINGS – FUNDAMENTALS 8
Definition of thin film and coatings, preparation of substrate- Role of substrate- substrate selection nucleation and thin film growth- residual stress, thickness measurements.

UNIT II VAPOUR PHASE and LIQUID PHASE TECHNIQUES 10

UNIT III GLOW DISCHARGE TECHNIQUES 9
Sputtering – diode sputtering, reactive sputtering, bias sputtering (ion plating), magnetron sputtering, ion beam sputter deposition, reactive ion plating. Plasma process – plasma enhanced CVD.

UNIT IV INTERFACIAL ADHESION AND STRENGTH 9

UNIT V APPLICATIONS 9

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the students are expected to
- CO1. Know the fundamentals of coatings, substrate selection and film growth.
- CO2. Have knowledge on thin film forming techniques.
- CO3. Assess interfacial adhesion of films through adhesion measurement techniques.
- CO4. Explain the properties and applications thin films.
TEXT BOOKS:

REFERENCES:
# Course Articulation Matrix:

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<td>Know the fundamentals of coatings, substrate selection and film growth.</td>
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<td>CO2</td>
<td>Have knowledge on thin film forming techniques.</td>
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<td>CO3</td>
<td>Assess interfacial adhesion of films through adhesion measurement techniques.</td>
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<td>CO4</td>
<td>Explain the properties and applications thin films.</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- Introduce various materials used as implants and the importance of ceramics
- Describe various compositions of ceramics used as implants
- Discuss about Material Shaping.

UNIT I  INTRODUCTION  9

UNIT II  INERT BIOCERAMICS  9

UNIT III  CALCIUM PHOSPHATE BIOCERAMICS  9
Preparation, properties and biological performance of hydroxyapatite, Tricalcium Phosphate, Biphasic Calcium phosphate, Calcium phosphate nano particles. Invivo response of calcium phosphate ceramics and clinical applications of Calcium phosphate ceramics.

UNIT IV  SILICA BASED CERAMICS  9
Glass as Bio materials, increasing bio activity of glasses, Strengthening and adding new capabilities to bioactive glasses. Non silicate glasses, Clinical application of glass. Mesoporous silica - Synthesis and Functionalization.

UNIT V  MATERIAL SHAPING  9

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students are expected to
CO1. State various implant materials
CO2. Know the fabrication, application and biological response of inert bioceramics.
CO3. Appraise the importance of calcium phosphate based bioceramic materials
CO4. Examine the usage of silica based ceramics in clinical applications
CO5. Recognize the usage of ceramics in implant as coatings, cements and scaffolds
TEXT BOOKS:

REFERENCES:
### Course Articulation Matrix:

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<td>CO1</td>
<td>State various implant materials</td>
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<tr>
<td>CO2</td>
<td>Know the fabrication, application and biological response of inert bioceramics.</td>
<td>PO1</td>
</tr>
<tr>
<td>CO3</td>
<td>Appraise the importance of calcium phosphate based bioceramic materials</td>
<td>PO1</td>
</tr>
<tr>
<td>CO4</td>
<td>Examine the usage of silica based ceramics in clinical applications</td>
<td>PO1</td>
</tr>
<tr>
<td>CO5</td>
<td>Recognize the usage of ceramics in implant as coatings, cements and scaffolds</td>
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</table>

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

The course is aimed to

- teach the fundamentals of nanomaterial science and technology.
- explain the basis of nanomaterial preparation methods.
- familiarize the applications of nanomaterials.

UNIT I  INTRODUCTION  8


UNIT II  GENERAL METHODS OF PREPARATION  9

Bottom-up approach -Top-down Approach, Sol-Gel Method, Co-Precipitation, Hydrothermal route, Ultrasonication, Mechanical Milling, Colloidal routes, Thin film growth - physics-vapour deposition(PVD), Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMB. Chemical vapourdeposition(CVD), MOCVD,

UNIT III  NANOMATERIALS  12


UNIT IV  CHARACTERIZATION TECHNIQUES  9


UNIT V  APPLICATIONS  7


TOTAL : 45 PERIODS

OUTCOMES:

On completion of the course, the students are expected to

CO1. be familiar with the science of nanomaterials
CO2. demonstrate the preparation of nanomaterials
CO3. have gained knowledge in characteristic nanomaterial
TEXT BOOKS:

REFERENCES:
### Course Articulation Matrix:

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<th>Statement</th>
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<th>PSO3</th>
<th>PSO 4</th>
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<td>CO1</td>
<td>be familiar with the science of nanomaterials</td>
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<tr>
<td>CO2</td>
<td>demonstrate the preparation of nanomaterials</td>
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<tr>
<td>CO3</td>
<td>have gained knowledge in characteristic nanomaterial</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- Explain various functional applications of ceramics
- Discuss the significance of ceramics in the functional applications

UNIT I  FUNCTIONAL CERAMIC

UNIT II  CERAMICS IN LOCOMOTIVE

UNIT III  MEDICAL APPLICATIONS OF CERAMIC

UNIT IV  CERAMIC IN NUCLEAR, SPACE AND DEFENCE APPLICATION
Types of reactor-structure-preparation and properties of oxides, carbides, nitride and composites used in fission and fusion nuclear reactor. Ceramic used in space shuttle-rocket engine. Military application- Armor applications - Manufacturers.

UNIT V  FUNCTIONAL GLASSES

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students are expected to
- CO1. Know the functional characteristics of ceramics
- CO2. Select a ceramic material for specific application
- CO3. Appraise the significance of using ceramics in a specific application
- CO4. Describe different functional glasses

TEXT BOOKS:
REFERENCES:
1. Barycartor C and Grant Norton “Ceramic Materials and Engineering” Springer 2013
2. Narottam P. Bansal and Jacques Iamon Ceramic matrix composite material modeling and technology, Johan Wiley sons 2014
## Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
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<td>CO1</td>
<td>Know the functional characteristics of ceramics</td>
<td>PO1  PO 2 PO 3 PO 4 PO 5 PO 6 PO 7 PO 8 PO 9 PO1 0 PO1 1 PO1 2 PSO 1 PSO 2 PSO3 PSO 4</td>
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<td>3 3</td>
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<tr>
<td>CO2</td>
<td>Select a ceramic material for specific application</td>
<td>PO1  PO 2 PO 3 PO 4 PO 5 PO 6 PO 7 PO 8 PO 9 PO1 0 PO1 1 PO1 2 PSO 1 PSO 2 PSO3 PSO 4</td>
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<td>3 3</td>
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<td>CO3</td>
<td>Appraise the significance of using ceramics in a specific application</td>
<td>PO1  PO 2 PO 3 PO 4 PO 5 PO 6 PO 7 PO 8 PO 9 PO1 0 PO1 1 PO1 2 PSO 1 PSO 2 PSO3 PSO 4</td>
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<td>- 3 2 2 2 - - - - - - - - - - - - - - - - - -</td>
<td>3 3</td>
</tr>
<tr>
<td>CO4</td>
<td>Describe different functional glasses</td>
<td>PO1  PO 2 PO 3 PO 4 PO 5 PO 6 PO 7 PO 8 PO 9 PO1 0 PO1 1 PO1 2 PSO 1 PSO 2 PSO3 PSO 4</td>
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<td>3 3</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES:
The course is aimed to
- Introduce about types of composites, reinforcement and matrix.
- Describe the different types of reinforcement, its manufacturing techniques and properties.
- Give knowledge on PMC, MMC, CMC, C/C composites, manufacturing process, properties and applications.

UNIT I INTRODUCTION 7

UNIT II REINFORCEMENT 10
Fibre definition, fibre flexibility; Glass fibres – types, manufacturing process, properties, glass wool forming process; Alumina fibres, mullitefibres, zirconia fibres, boron fibres, carbon fibres and graphite fibres – manufacturing techniques, properties and applications, Background of whisker growth, composite processing, fiber/powder/whisker with matrix powder mixing, SiC and Si₃N₄ whiskers, VLC synthesis, properties.

UNIT III POLYMER MATRIX COMPOSITES (PMC) 10
Polymer matrix materials – Thermoset, thermoplastic, elastomer, mechanical behaviour of polymers, melting and glass transition temperature, polymerization, processing methods of polymeric matrix composites: hand lay-up, autoclaving, filament winding, pultrusion, compression molding, pre-pegging, sheet molding compounds, process capability and application of PMC.

UNIT IV METAL MATRIX COMPOSITES (MMC) 9
Metallic matrix materials – Aluminum alloys, Titanium alloys, Magnesium alloys, selection of reinforcements, processing of MMC- liquid state process- solid state process, secondary processing, properties of MMC-Modulus, strength, toughness, thermal characteristics, applications of MMC.

UNIT V CERAMIC MATRIX COMPOSITES (CMC) 9
Crystalline oxides – Alumina, Zirconia, Silicon Nitrate, Glasses ceramics – Magnesium Alumino-silicates, processing of CMC – ceramic particle based process, In Situ ceramic composite processing, chemical vapor infiltration, mechanical properties of CMC-strength and modulus, fracture toughness, applications of CMC, processing of Carbon-Carbon (C/C) composites, applications of C/C composites

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students are expected to
- CO1. Be familiar with the composite materials and its applications.
- CO2. Recall different matrix and reinforcement
- CO3. Prepare of PMC, MMC and CMC by various methods
- CO4. Adjudge applications of PMC, MMC and CMC materials.

TEXT BOOKS:
REFERENCES:
5. https://nptel.ac.in/courses/112104221/21
## Course Articulation Matrix:

<table>
<thead>
<tr>
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<tr>
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<td>CO1</td>
<td>Be familiar with the composite materials and its applications.</td>
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</tr>
<tr>
<td>CO2</td>
<td>Recall different matrix and reinforcements</td>
<td>-   3   2   1   2   -   -   -   -   -   -   -   -   -   3   3</td>
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<tr>
<td>CO3</td>
<td>Prepare of PMC, MMC and CMC by various methods</td>
<td>-   3   2   2   2   -   -   -   -   -   -   -   -   -   3   3</td>
</tr>
<tr>
<td>CO4</td>
<td>Adjudge applications of PMC, MMC and CMC materials.</td>
<td>-   3   2   2   2   -   -   -   -   -   -   -   -   -   3   3</td>
</tr>
<tr>
<td>FIBRES AND COMPOSITES</td>
<td></td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to impart knowledge about
- various machining processes
- Advanced machining processes
- Surface finishing methods
- conventional and advanced joining techniques of ceramics with other materials

UNIT I  BASIC MACHINING METHODS  9

UNIT II  ADVANCED MACHINING  9

UNIT III  SURFACE FINISHING  9
Super polishing, chemical compound polishing, Ultrasonic Lapping, Abrasive flow finishing, Magneto rheological abrasive finishing, Polycrystalline Diamond lapping of ceramics, Flame polishing–Annealing–Healing of surface cracks– Electrolytic In-Process Dressing Grinding of Ceramic materials –UV bonded grinding wheel

UNIT IV  JOINING METHODS  9
Mechanical Joints - Adhesive joints –testing of joint strength, wettability, reactivity, thermodynamic stability- Filler materials - High temperature Brazing – Brazing of diamonds, CBN, Oxides, carbides, composites – metal and ceramic joints -Active brazing of advanced ceramic composites to metallic systems - applications

UNIT V  ADVANCED JOINING METHODS  9

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students are expected to
CO1. Have a basic understanding about various basic machining and advanced methods
CO2. Have understanding about the surface finishing methods.
CO3. Have basic knowledge about Joining of ceramics with other materials
CO4. have knowledge about surface preparation and testing of joint

TEXT BOOKS:
1. IoanD.Marinesar, Handbook of Advanced Ceramics Machining, CRC press. 2006
REFERENCES:
## Course Articulation Matrix:

<table>
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<tr>
<td>CO1</td>
<td>Have a basic understanding about various basic machining and advanced methods</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>Have understanding about the surface finishing methods.</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>Have basic knowledge about Joining of ceramics with other materials</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>Have knowledge about surface preparation and testing of joint</td>
<td>3</td>
</tr>
<tr>
<td>MACHINING AND JOINING OF CERAMIC</td>
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</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- introduce the basics of microwave
- describe the usage of microwave for industrial heating and the necessary set ups
- discuss the hazards and safety measures to be taken for microwave usage

UNIT I INTRODUCTION
Dielectric Behavior of materials- power dissipation- propagation factor and skin depth-heat and mass transfer phenomena- temperature distribution- wall loss.

UNIT II MICROWAVE HEATING CIRCUIT
Power sources- klystron and magnetron- operating characteristics- protection system- high frequency breakdown phenomena- automatic control of the process- automation, tuning and machining.

UNIT III APPLICATION TYPES
Travelling wave applicators- multimode applications- power transfer- uniformity of heating.

UNIT IV INDUSTRIAL APPLICATIONS
Microwave drying- microwave sintering- application to laboratory models and pilot system comparison with pilot heating.

UNIT V HAZARDS AND SAFETY
Exposure standards- industrial- frequency band- leakage from industrial equipment- batch system- continuous flow system- safety precautions.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course the students are expected to
- CO1. Have learnt the introduction about microwave processing.
- CO2. Have learnt the concepts of microwave heating circuit.
- CO3. Have learnt the applicator types of microwave.
- CO4. Have studied the industrial applications of microwave processing.
- CO5. Have studied the hazard and safety of microwave processing.

TEXT BOOKS:

REFERENCES:
## Course Articulation Matrix:

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<th>PSO3</th>
<th>PSO4</th>
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<td>Have learnt the introduction about microwave processing.</td>
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<tr>
<td>CO2</td>
<td>Have learnt the concepts of microwave heating circuit.</td>
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<td>CO3</td>
<td>Have learnt the applicator types of microwave.</td>
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<td>CO4</td>
<td>Have studied the industrial applications of microwave processing.</td>
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<tr>
<td>CO5</td>
<td>Have studied the hazard and safety of microwave processing.</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to enable the students to have a basic knowledge about the various nondestructive methods of testing.

UNIT I  INTRODUCTION
Non destructive Test and Evaluation Technology – an overview, Materials, Manufacturing Process and Non destructive testing methods, Designs and Non Destructive Testing, Industrial applications of non destructive evaluation – railways, nuclear, non nuclear and chemical industries, automotive industries.

UNIT II  RADIOGRAPHIC TESTING
Sources of –ray and gamma rays and their interaction with matter, equipment, general radiographic procedure, radiographic technique and acceptance standard, special radiographic techniques, safety aspects of industrial radiography.

UNIT III  ULTRASONIC TESTING
Principles of wave propagation, Reflection, Refraction, Diffraction, Mode conversion and Attenuation, Sound field, Piezoelectric effect, Ultrasonic transducers and their characteristics, Ultrasonic equipment, A, B,C scan presentation of Test Indications and Interpretations, Ultrasonic Testing, Effective applications and Limitations of Ultrasonic Testing.

UNIT IV  EDDY CURRENT TESTING
Introduction- principles of eddy current, Eddy current test system, Applications of Eddy Current Testing, Effectiveness of eddy current testing.

UNIT V  OTHER METHODS
Liquid Penetrant Test basic concepts, liquid penetrant system, Test Procedure, effective applications and Limitations, Magnetic Particle Test – Magnetic Materials, Magnetic Particle Test – Principle, Equipment, Procedure, Interpretation and Evaluation, Effective applications and limitations, other methods – thermal infrared testing, acoustic emission.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course the students are expected to
CO1. Have studied the basic concepts of non-destructive testing and surface NDT methods
CO2. Have learnt about small business and preparation of feasibility chart.
CO3. Have a basic knowledge about establishment of a business.
CO4. Have learnt about how to manage a business unit.
CO5. Have some basic concepts about promotion of entrepreneurship and practical knowledge about some case studies.
TEXT BOOKS:

REFERENCES:
**Course Articulation Matrix:**

<table>
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<tr>
<th>Course Outcomes</th>
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<th>PSO  2</th>
<th>PSO  3</th>
<th>PSO  4</th>
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<td>CO2</td>
<td>Have learnt about small business and preparation of feasibility chart.</td>
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<td>CO3</td>
<td>Have a basic knowledge about establishment of a business.</td>
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<tr>
<td>CO4</td>
<td>Have learnt about how to manage a business unit.</td>
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<tr>
<td>CO5</td>
<td>Have some basic concepts about promotion of entrepreneurship and practical knowledge about some case studies.</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- cover the concepts of metallic and non-metallic materials,
- discuss physical metallurgy, high temperature reactions and processing methods.

UNIT I  FERROUS AND NON-FERROUS MATERIALS  9

UNIT II  NON-METALLIC MATERIALS  9
Polymers - types of polymer, commodity and engineering polymers - Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PAI, PPS, PEEK, PTFE, Thermo set polymers - Urea and Phenol, formaldehydes.

UNIT III  BASICS OF METALLURGY  9
Introduction - classification - metals, metallic ores, sampling, identification, extraction - copper, aluminum, lead, iron and steel - iron carbon diagram - heat treatment process - annealing, normalizing, hardening, tempering, surface hardening process - carburizing, nitriding, cyaniding, carbonitriding, flame hardening, metallography - sampling, grinding, polishing, microscope - metallurgical, electron, testing - hardness, impact, creep, non-destructive testing.

UNIT IV  HIGH TEMPERATURE METALLURGICAL PROCESS  9

UNIT V  MANUFACTURING PROCESS  9
Metal Casting - Pattern and Moulds, Sand Casting, Permanent Mould Casting, Investment Casting, Shell Molding, Hot warm and cold working of metals, Metal forming, rolling, forging, extrusion, wire drawing, sheet metal forming, metal joining - soldering, brazing, welding, Powder metallurgy - production of powders, compaction and sintering.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students are expected to
- CO1. Classify and distinguish different types of cast irons, steels and non-ferrous alloys
- CO2. Classify and distinguish the different types of non-metallic materials.
CO3. Describe the concept of heat treatment of steels and strengthening mechanisms.

CO4. Analyze the various high temperature metallurgical reactions.

CO5. Be able to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

TEXT BOOKS:


REFERENCES:

<table>
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<tr>
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<tr>
<td>CO1</td>
<td>Classify and distinguish different types of cast irons, steels and non ferrous alloys</td>
<td>3 3 2 2 2 - - - - - - 3 - - - 3</td>
</tr>
<tr>
<td>CO2</td>
<td>Classify and distinguish the different types of non metallic materials</td>
<td>3 3 2 2 2 - - - - - - 3 - - - 3</td>
</tr>
<tr>
<td>CO3</td>
<td>Describe the concept of heat treatment of steels &amp; strengthening mechanisms</td>
<td>3 3 2 2 2 - - - - - - 3 - - - 3</td>
</tr>
<tr>
<td>CO4</td>
<td>Analyze the various high temperature metallurgical reactions.</td>
<td>3 3 2 2 2 - - - - - - 3 - - - 3</td>
</tr>
<tr>
<td>CO5</td>
<td>Be able to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability</td>
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<td>MATERIALS AND METALLURY</td>
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</table>

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

The course is aimed to

- provide the necessary tools to apply the principles and concepts of phase equilibria and evaluate in various systems.

UNIT I INTRODUCTION
Introduction, phase, component, variable, Gibb’s phase rule, single component system – \( \text{H}_2\text{O}, \text{SiO}_2, \) iron, \( \text{ZrO}_2, \) Carbon, Hume Rothery’s rule; binary phase diagrams – solid solutions, eutectic, peritectic, liquid immiscibility, decomposition, polymorphism, exsolution, lever rule, ternary diagrams - single phase equilibrium, two phase equilibrium, three phase equilibrium.

UNIT II THERMODYNAMICS OF PHASE EQUILIBRIA
Introduction, criteria of phase equilibrium, criterion of stability, phase equilibria in single and multi component system; binary solutions – constant pressure system, constant temperature system, partially miscible and immiscible system, liquid-liquid and ternary equilibrium diagrams.

UNIT III PHASE DIAGRAMS
\( \text{Al}_2\text{O}_3 - \text{SiO}_2, \) \( \text{MgO} - \text{Al}_2\text{O}_3, \) \( \text{MgO} - \text{SiO}_2, \) \( \text{Al}_2\text{O}_3 - \text{ZrO}_2, \) \( \text{K}_2\text{O} - \text{Al}_2\text{O}_3 - \text{SiO}_2, \) \( \text{MgO} - \text{Al}_2\text{O}_3 - \text{SiO}_2, \) \( \text{Na}_2\text{O} - \text{Al}_2\text{O}_3 - \text{SiO}_2. \) Prediction of alkali corrosion of alumino silicate refractories using phasediagrams.

UNIT IV PHASE TRANSFORMATIONS

UNIT V CONSTRUCTION AND DETERMINATION OF PHASE DIAGRAMS
Construction of phase diagrams - cooling curves, thermal analysis, techniques - introduction, ex-situ methods - sample preparation and non equilibration, phase and compositional analysis, identification of new phases, in-situ methods - thermal analysis, coulometric titration, high temperature XRD, thermo-microscopy, optical methods, oscillation method of phase analysis - in-situ electric, dielectric and magnetic measurements

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the students are expected to

CO1. interpret phase diagrams, and calculate phase stability diagrams in unary, binary and ternary phase diagrams.

CO2. understand the relation between thermodynamics and phase equilibria
CO3. Interpret and know applications of binary and ternary phase diagrams (unary systems, binary systems, ternary effects on microstructures, phase calculations, drawing isothermal and vertical sections of real ternary systems).

CO4. analyze the phase transformation and microstructural development

CO5. construct and evaluate phase diagrams

TEXT BOOKS:

REFERENCES:
# Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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<tr>
<td>CO1</td>
<td>interpret phase diagrams, and calculate phase stability diagrams in unary, binary and ternary phase diagrams.</td>
<td>PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO1 PO1 PO1 PSO1 PSO2 PSO3 PSO4</td>
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<td>CO2</td>
<td>understand the relation between thermodynamics and phase equilibria</td>
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<tr>
<td>CO3</td>
<td>Interpret and know applications of binary and ternary phase diagrams</td>
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<tr>
<td>CO4</td>
<td>analyze the phase transformation and microstructural development</td>
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<tr>
<td>CO5</td>
<td>construct and evaluate phase diagrams</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
OBJECTIVES:
The course is aimed to
- Introduce basics of sintering like the driving force for sintering
- Discuss the mechanisms of solid phase and viscous sintering
- Describe the changes on liquid phase sintering and its types.
- Cover topics on advanced and novel sintering techniques.

UNIT I INTRODUCTION
Introduction to Sintering Techniques, Measurement—heating schedule, multistage—Physical properties, Microstructure, Thermal, Electrical and Magnetic Properties—Sintering atmosphere, Driving force – Mechanisms of sintering– Grain growth, Oswald Ripening – Topological and Interfacial tension requirements – Controlling the boundary Mobility – Controlled Microstructure

UNIT II SOLID PHASE AND VISCOUS SINTERING

UNIT III LIQUID PHASE SINTERING

UNIT IV SPECIAL TOPICS IN SINTERING

UNIT V NOVEL SINTERING TECHNIQUES

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students are expected to,
CO1. Know the driving force for sintering.
CO2. Explain the mechanisms of solid, liquid and viscous phase sintering.
CO3. Have knowledge on the applications of different sintering techniques.
CO4. Appreciate the advanced and novel sintering techniques.

TEXT BOOKS:

REFERENCES:
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<td>Know the driving force for sintering.</td>
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<td>Explain the mechanisms of solid, liquid &amp; viscous phase sintering.</td>
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<td>CO3</td>
<td>Have knowledge on the applications of different sintering techniques.</td>
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<td>CO4</td>
<td>Appreciate the advanced &amp; novel sintering techniques.</td>
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</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
- Introduce factors for elimination and reduction of wastage
- Describe the ways to reuse the wastage.
- Discuss ways to calculate the loss in wastage
- Familiarize the various wastages that is available from other industries and the ways of using them in ceramic Industry

UNIT I  SOLID WASTE FROM CERAMIC PLANTS  9
Body scrap, Scrap from cast ware during finishing, Scrap from handling, Property variation due to scrap addition, Method of scrap storage, Handling of scrap, Testing of scrap. Calculation of scrap addition
Scrap from broken wares, Addition of broken wares in the ball mill

UNIT II  LIQUID WASTE FROM CERAMIC PLANT  9
Design of settling tanks, Adjustment of water pH, Filter pressing of slurry. Testing and adjustment of recovery materials, Reclaimed glaze usage, Methods to eliminate contamination in reclaimed glazes. Testing of outlet water

UNIT III  HEAT RECOVERY FROM CERAMIC PLANT  9
Waste heat generation from kilns, Duct design for hot gas transport, Heat recovery - Regeneration, Recuperator, Energy transfer efficiency

UNIT IV  SOLID WASTE FROM OTHER PLANTS  9
Clay scrap from mineral Industries, Blast furnace slag powder, Silica fumes, Flyash, Scrap refractory bricks, Reuse of glass tank refractory bricks, Reuse of scrap Iron oxide powder for Ferrite component making, Red mud from bauxite purification

UNIT V  CASE STUDY  9
Use of sanitary scrap for road building, Use of sanitary ware for concrete structure, Use of glass waste for making fusion glass tiles, glass powder for cement replacement, Conversion of waste to useful product.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students are expected to
- CO1. Classify the types of solid waste generated in ceramic plant
- CO2. Recognize the types of liquid waste generated in ceramic plant
- CO3. Know the means of waste heat recovery from ceramic plant
- CO4. Discuss the types of solid waste generated from other plants
- CO5. Develop ways to convert waste to useful product

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<td>Classify the types of solid waste generated in ceramic plant</td>
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<td>CO2</td>
<td>Recognize the types of liquid waste generated in ceramic plant</td>
<td>Core Outcome</td>
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<tr>
<td>CO3</td>
<td>Know the means of waste heat recovery from ceramic plant</td>
<td>Core Outcome</td>
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<tr>
<td>CO4</td>
<td>Discuss the types of solid waste generated from other plants</td>
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<td>CO5</td>
<td>Develop ways to convert waste to useful product</td>
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<td>CERAMIC WASTE RECOVERY AND MANAGEMENT</td>
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<td>Core Outcome</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to impart basic knowledge about
- Elastic behaviour of Ceramic Materials
- Fracture behaviour, strength and creep behaviour of ceramic materials
- Toughening techniques and thermal shock behaviour of ceramic materials.

UNIT I  ELASTIC BEHAVIOUR  9

UNIT II  FRACTURE  9

UNIT III  STRENGTH  9

UNIT IV  THERMAL BEHAVIOUR  9

UNIT V  TOUGHENING AND MECHANICAL PROPERTIES OF CERAMICS  9
Toughening mechanisms – crack deflection, crack bowing, crack branching, crack tip shielding by process zone and bridging effect, transformation toughening
Mechanical properties of Alumina, Silicon Nitride, Silicon Carbide and Porous ceramics

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course the students are expected to
- CO1. Have a basic understanding about elasticity, deformation point of isotropic and crystalline materials.
- CO2. Have learnt about various fractures, fracture testing techniques, strength behaviour, thermal shock resistance and creep behaviour
- CO3. Design ceramic components for safe life and identify suitable ceramic material for intended application
TEXT BOOKS:

REFERENCES:
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<td>Have a basic understanding about elasticity, deformation point of isotropic and crystalline materials.</td>
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<td>CO2</td>
<td>Have learnt about various fractures, fracture testing techniques, strength behaviour, thermal shock resistance and creep behaviour</td>
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<td>CO3</td>
<td>Design ceramic components for safe life and identify suitable ceramic material for intended application</td>
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<td>MECHANICAL BEHAVIOR OF CERAMICS</td>
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</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:
The course is aimed to
• introduce the students to importance of glazing and glaze raw materials
• describe various glazing techniques and defects formed in glaze
• analyze various glaze properties and their testing methods
• familiarize the students with decoration techniques in glaze and enamels

UNIT I INTRODUCTION TO GLAZE

UNIT II GLAZING TECHNIQUES AND DEFECTS
Glazing techniques - dipping, pouring, spraying, brushing, painting and other techniques - Glaze bodyreactions- interface layers- glaze defects and remedies- crazing, peeling, crawling, rolling, blisters, pinholes, dunting.

UNIT III DECORATION
Classification of decoration methods- advantages- different decorating techniques- painting, spraying, stencilling, stamping, lithographic transferring, printing-silk screen printing, digital printing - dusting,decalcomania- liquid gold decoration and decoration techniques - protective care - restoration.

UNIT IV ENAMEL

UNIT V PROPERTIES AND TESTING
Thermal, mechanical, optical and chemical properties of glazes – Testing of glazes - Particle size distribution, Slip density, Viscosity, Fluidity , coherence parameter, glaze pick up, solubility of leadfrits, glaze fit, thermal expansion, chemical durability , colour measurement, thermal shock measurement.

TOTAL: 45 PERIOD

OUTCOMES:
On completion of the course the students are expected to
CO1. Have learnt the definition of glazes and classification of glazes and Enamel.
CO2. Have a thorough knowledge about the raw materials and properties of the glaze raw materials.
CO3. Have a thorough knowledge about the various glazing techniques.
CO4. Have learnt the properties and defects produced by glazing.
CO5. Have complete understanding about the various methods of decorating the glazed and Enamel articles.

TEXT BOOKS:

REFERENCES:
1. The Art of Enameling Techniques Projects and Inspiration Barnes andNobles, 28 Aug 2006
## Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
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<td>Have learnt the definition of glazes and classification of glazes and Enamel.</td>
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<td>CO2</td>
<td>Have a thorough knowledge about the raw materials and properties of the glaze raw materials.</td>
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<td>CO3</td>
<td>Have a thorough knowledge about the various glazing techniques.</td>
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<td>CO4</td>
<td>Have learnt the properties and defects produced by glazing.</td>
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<td>CO5</td>
<td>Have complete understanding about the various methods of decorating the glazed and Enamel articles.</td>
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
OBJECTIVES:

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I  INTRODUCTION

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features

UNIT II  CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES


UNIT III  ORGANS OF GOVERNANCE

Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions

UNIT IV  EMERGENCY PROVISIONS


UNIT V  LOCAL ADMINISTRATION

District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat-Elected officials and their roles- CEO ZilaPachayat- Position and role-Block level-Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Able to understand history and philosophy of Indian Constitution.
CO2: Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3: Able to understand powers and functions of Indian government.
CO4: Able to understand emergency rule.
CO5: Able to understand structure and functions of local administration.

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TEXTBOOKS:

4. The Constitution of India (Bare Act), Government Publication, 1950
OBJECTIVES:
- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self-destructive habits with value education
- Interpret social empowerment with value education

UNIT I           INTRODUCTION TO VALUE EDUCATION  9
Values and self-development – Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non-moral valuation, Standards and principles, Value judgements

UNIT II          IMPORTANCE OF VALUES  9
Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline

UNIT III         INFLUENCE OF VALUE EDUCATION  9
Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth.

UNIT IV          REINCARNATION THROUGH VALUE EDUCATION  9

UNIT V           VALUE EDUCATION IN SOCIAL EMPOWERMENT  9
Equality, Non violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively

TOTAL: 45 PERIODS

OUTCOMES:
CO1 – Gain knowledge of self-development
CO2 – Learn the importance of Human values
CO3 – Develop the overall personality through value education
CO4 – Overcome the self-destructive habits with value education
CO5 – Interpret social empowerment with value education

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REFERENCES:
OBJECTIVES:
- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I INTRODUCTION AND METHODOLOGY:
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 45 PERIODS

OUTCOMES:
- Understand the methodology of pedagogy.
- Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Know the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

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REFERENCES:
OBJECTIVES:
- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do’s and Don’t’s in life through Yam
- Categorize Do’s and Don’t’s in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I INTRODUCTION TO YOGA
Definitions of Eight parts of yog.( Ashtanga )

UNIT II YAM
Do’s and Don’t’s in life.
Shaucha, santosh, tapa, swadhyay, ishwarpnanidhan

UNIT III NIYAM
Do’s and Don’t’s in life.
Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT IV ASAN
Various yog poses and their benefits for mind & body

UNIT V PRANAYAM
Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 45 PERIODS

OUTCOMES:
CO1 – Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2 – Learn Do’s and Don’t’s in life through Yam
CO3 – Learn Do’s and Don’t’s in life through Niyam
CO4 – Develop a healthy mind and body through Yog Asans
CO5 – Learn breathing techniques through Pranayam

REFERENCE:
1. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. ‘Yogic Asanas for Group Tarining-Part-I” : Janardan Swami Yogabhyasi Mandal, Nagpur
OBJECTIVES:
- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind, pleasing personality and determination
- Discover wisdom in students

UNIT I NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I 9
Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)

UNIT II NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II 9
Verses- 52,53,59 (don’ts) - Verses- 71,73,75,78 (do’s)

UNIT III APPROACH TO DAY TO DAY WORK AND DUTIES 9
Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-
Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48

UNIT IV STATEMENTS OF BASIC KNOWLEDGE – I 9
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter-
12 -Verses 13, 14, 15, 16,17, 18

UNIT V PERSONALITY OF ROLE MODEL - SHRIMAD BHAGWADGEETA 9
Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses-
37,38,63

TOTAL: 45PERIODS

OUTCOMES:
CO1: To develop basic personality skills holistically
CO2: To develop deep personality skills holistically to achieve happy goals
CO3: To rewrite the responsibilities
CO4: To reframe a person with stable mind, pleasing personality and determination
CO5: To awaken wisdom in students

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REFERENCES:
1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari’s ThreeSatakam , Niti-sringar-
vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016
COURSE OBJECTIVES
The course will introduce the students to
- get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I INTRODUCTION TO CULTURE 9
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

UNIT II INDIAN LANGUAGES AND LITERATURE 9
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature

UNIT III RELIGION AND PHILOSOPHY 9
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)

UNIT IV FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING) 9
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT V EDUCATION SYSTEM IN INDIA 9
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

TOTAL: 45PERIODS

COURSE OUTCOMES
After successful completion of the course the students will be able to
- Understand philosophy of Indian culture.
- Distinguish the Indian languages and literature.
- Learn the philosophy of ancient, medieval and modern India.
- Acquire the information about the fine arts in India.
- Know the contribution of scientists of different eras.
- Understand education systems in India

REFERENCES:
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
Course Objectives: The main learning objective of this course is to make the students an appreciation for:

1. Introduction to Sanga Tamil Literature.
2. ‘Agathamai’ and ‘Purathamai’ in Sanga Tamil Literature.
3. ‘Attruppadai’ in Sanga Tamil Literature.
4. ‘Puranaanuru’ in Sanga Tamil Literature.
5. ‘Pathitrupaththu’ in Sanga Tamil Literature.

UNIT I  SANGA TAMIL LITERATURE AN INTRODUCTION 9
Introduction to Tamil Sangam—History of Tamil Three Sangams—Introduction to Tamil Sangam Literature—Special Branches in Tamil Sangam Literature- Tamil Sangam Literature’s Grammar-Tamil Sangam Literature’s parables.

UNIT II  ‘AGATHINAI’ AND ‘PURATHINAI’ 9
Tholkappiyar’s Meaningful Verses—Three literature materials—Agathamai’s message- History of Culture from Agathamai— Purathamai—Classification—Message to Society from Purathamai.

UNIT III  ‘ATTRUPPADAI’. 9
Attruppadai Literature—Attruppadaiin’Puranaanuru’—Attruppadaiin’Pathitrupaththu’—Attruppadai in ‘Paththupaattu’.

UNIT IV  ‘PURANAANURU’ 9
Puranaanuru on Good Administration, Ruler and Subjects—Emotion & its Effect in Puranaanuru.

UNIT V  ‘PATHITRUPATHTHU’ 9
Pathitrupaththu in ‘Etthugai’—Pathitrupaththu’s Parables—Tamil dynasty: Valor, Administration, Charity in Pathitrupaththu— Message to Society from Pathitrupaththu.

Total (L:45) = 45 PERIODS

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

1. Appreciate and apply the messages in Sanga Tamil Literature in their life.
2. Differentiate ‘Agathamai’ and ‘Purathamai’ in their personal and societal life.
3. Appreciate and apply the messages in ‘Attruppadai’ in their personal and societal life.
4. Appreciate and apply the messages in ‘Puranaanuru’ in their personal and societal life.
5. Appreciate and apply the messages in ‘Pathitrupaththu’ in their personal and societal life.

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COURSE DESCRIPTION

This course offers an introduction to language and communication. The primary goal of this course is to familiarize students with key ideas related to communication using language as well as non-verbal means. Ideas related to the use of language and the underlying power structures are also examined. The course also examines the role of media in communication and in the dissemination of ideas as well as opinions.

Objectives

✓ To familiarize students with the concept of communication using linguistic and non-linguistic resources.
✓ To help students ask critical questions regarding facts and opinions.
✓ To provide students with the material to discuss issues such as language and power structures.
✓ To help students think critically about false propaganda and fake news.

Learning Outcomes

➢ Students will be able to use linguistic and non-linguistic resources of language in an integrated manner for communication.
➢ Students will be able to analyse communication in terms of facts and opinions.
➢ Students will be able to discuss, analyse and argue about issues related to language and power.

UNIT I  LINGUISTIC AND NON-LINGUISTIC RESOURCE OF COMMUNICATION: 9
a) Writing and Speech
b) Distinction between language structure and language use, form and function, acceptability and grammaticality
c) Gestures and Body language, pictures and symbols, cultural appropriacy
d) Communicative Competency, context and situation, combination of linguistic and non-linguistic elements of communication

UNIT II  STRUCTURE OF WRITING/CONVERSATION: 9
a) Language skills and the communication cycle; speaking and listening, writing and reading
b) Initiating and closing conversations, intervention, turn taking
c) Writing for target reader, rhetorical devices and strategies
d) Coherence and Cohesion in speech and writing

UNIT III  POWER STRUCTURE AND LANGUAGE USE: 9
a) Gender and language use
b) Politeness expressions and their use
c) Ethical dimensions of language use
d) Language rights as part of human rights
UNIT IV MEDIA COMMUNICATION: 9
a) Print media, electronic media, social media
b) Power of media
c) Manufacturing of opinion, fake news and hidden agendas

UNIT V PERSUASIVE COMMUNICATION AND MISCOMMUNICATION: 9
a) Fundamentals of persuasive communication
b) Persuasive strategies
c) Communication barriers

TOTAL: 45 PERIODS

TEXT BOOKS:


HU5172 VALUES AND ETHICS L T P C 3 0 0 3

OBJECTIVES:
- Teach definition and classification of values.
- Explain Purusartha.
- Describe Sarvodaya idea.
- Summarize sustenance of life.
- Conclude views of hierarchy of values.

UNIT I DEFINITION AND CLASSIFICATION OF VALUES 9
Extrinsic values- Universal and Situational values- Physical- Environmental-Sensuous- Economic-Social-Aesthetic-Moral and Religious values

UNIT II CONCEPTS RELATED TO VALUES 9
Purusartha-Virtue- Right- duty- justice- Equality- Love and Good

UNIT III IDEOLOGY OF SARVODAYA 9
Egoism- Altruism and universalism- The Ideal of Sarvodaya and Vasudhaiva Kutumbakam

UNIT IV SUSTENANCE OF LIFE 9
The Problem of Sustenance of value in the process of Social, Political and Technological Changes

UNIT V VIEWS ON HIERARCHY OF VALUES 9
The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi

TOTAL: 45 PERIODS
OUTCOMES:

CO1: Able to understand definition and classification of values.
CO2: Able to understand purusartha.
CO3: Able to understand sarvodaya idea.
CO4: Able to understand sustenance of life.
CO5: Able to understand views of hierarchy of values.

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TEXTBOOKS:

2. Little, William, : An Introduction of Ethics (Allied Publisher, Indian Reprint 1955)

HU5173 HUMAN RELATIONS AT WORK L T P C 3 0 0 3

OBJECTIVES:

- Illustrate human relations at work its relationship with self.
- Explain the importance of interacting with people at work to develop teamwork.
- Infer the importance of physical health in maintaining human relations at work.
- Describe the importance of staying psychologically healthy.
- Identify the essential qualities for progressing in career.

UNIT I UNDERSTANDING AND MANAGING YOURSELF 9
Human Relations and You: Self-Esteem and Self-Confidence: Self-Motivation and Goal Setting; Emotional Intelligence, Attitudes, and Happiness; Values and Ethics and Problem Solving and Creativity.

UNIT II DEALING EFFECTIVELY WITH PEOPLE 9
Communication in the Workplace; Specialized Tactics for Getting Along with Others in the Workplace; Managing Conflict; Becoming an Effective Leader; Motivating Others and Developing Teamwork; Diversity and Cross-Cultural Competence.

UNIT III STAYING PHYSICALLY HEALTHY 9
Yoga, Pranayam and Exercise: Aerobic and anaerobic.
UNIT IV   STAYING PSYCHOLOGICALLY HEALTHY   9
Managing Stress and Personal Problems, Meditation.

UNIT V   DEVELOPING CAREER THRUST   9

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to
CO1: Understand the importance of self-management.
CO2: Know how to deal with people to develop teamwork.
CO3: Know the importance of staying healthy.
CO4: Know how to manage stress and personal problems.
CO5: Develop the personal qualities essential for career growth.

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TEXT BOOK:

REFERENCES:

HU5174   PSYCHOLOGICAL PROCESSES   L T P C
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COURSE DESCRIPTION
Psychological Processes course is designed for students to be aware of the basic principles of psychology for the better understanding of people’s psyche and behaviour around them. This course enables learners to use the optimal use of different forms of thinking skills and thereby results in effective communication in diverse situations. Every unit of the syllabus highlights the psychological process of people, the most powerful and constructive use of perceptions.
OBJECTIVES

The major objectives of this course is

- To develop students’ awareness – on psychology, learning behavior and usage of perception effectively.
- To learn to use the various kinds of thinking in a formal context.
- To critically evaluate content and comprehend the message on the bases of perception, personality and intelligence.

UNIT 1: INTRODUCTION


UNIT 2: SENSORY & PERCEPTUAL PROCESSES

Some general properties of Senses: Visual system – the eye, colour vision – Auditory system – Hearing, listening, Sounds - Other senses - Selective attention; physiological correlates of attention; Internal influences on perception learning – set - motivation & emotion - cognitive styles; External influences on perception figure and ground separation – movement – organization – illusion; Internal- external interactions: Constancy - Depth Perception- Binocular & Monocular Perception; Perceptual defense & Perceptual vigilance; Sensory deprivation -Sensory bombardment; ESP - Social Perception.

UNIT 3: COGNITION & AFFECT


UNIT 4: THINKING, PROBLEM-SOLVING & DECISION MAKING


UNIT 5: PERSONALITY & INTELLIGENCE

Psychological phenomena & Attributes of humans - cognition, motivation, and behavior - thoughts, feelings, perceptions, and actions – personality dimensions, traits, patterns - Specialized knowledge, performance accomplishments, automaticity or ease of functioning, skilled performance under challenge - generative flexibility, and speed of learning or behavior change.

References

HU5175 EDUCATION, TECHNOLOGY AND SOCIETY  

COURSE DESCRIPTION

This course introduces students to multidisciplinary studies in Education, Technology and Society. Students will get an understanding of the relationship between education, technology and society. They will also learn about the long lasting impact of good education in a technologically advanced society.

COURSE OBJECTIVES:

The course aims

- To help learners understand the basics of different types of technology utilised in the field of education
- To make them realize the impact of education in society
- To make them evolve as responsible citizen in a technologically advanced society

LEARNING OUTCOMES

By the end of the course, learners will be able to

- Understand the various apps of technology apps and use them to access, generate and present information effectively.
- Apply technology based resources and other media formats equitably, ethically and legally.
- Integrate their technical education for betterment of society as well as their personal life.

UNIT I INDIAN EDUCATION SYSTEM

Gurukul to ICT education – Teacher as facilitator – Macaulay’s Minutes – English medium vs Regional medium – Importance of Education in Modern India - Challenges in Education

UNIT II LEARNING THEORIES


UNIT III TECHNOLOGICAL ADVANCEMENTS

Web tools – Social media in education – elearning – MOOCs – Mobile assisted learning – Learning Apps – Blended learning - Self-directed learning

UNIT IV EDUCATIONAL TECHNOLOGY

Technological implications on Education – Teaching, Learning & Testing with Technology - Advantages and drawbacks – Critical analysis on the use of technology

UNIT V ETHICAL IMPLICATIONS

Plagiarism – Online Copyright issues – Ethical and value implications of education and technology on individual and society.

TOTAL: 45 PERIODS
TEACHING METHODS

Teaching modes include guest lectures, discussion groups, presentations, visual media, and a practicum style of learning.

EVALUATION

As this is course is not a content based course, it focuses more on the ethical use of technology in education and society, and so, evaluation can be based on assignments and discussions. So there is no need for an end semester examination. Internals marks can be taken for the total marks.

INTERNAL (100 % WEIGHTAGE)

(a) Written Test (40 marks)
(b) Assignment: Write a real time report of the technology use in any school / college (15 marks)
(c) Presentation: Students choose any one of the technological tools and present its relevance to education and society (15 marks)
(d) Group discussion: Students discuss in groups on case studies relating to various challenges in education and technology use in society (20 marks)
(e) Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others’ posts. (10 marks)

REFERENCES

1) Education and Social order by Bertrand Russel
2) Theories of learning by Bower and Hilgard
3) Technology and Society by Jan L Harrington

HU5176 PHILOSOPHY

OBJECTIVES

- To create a new understanding by teaching philosophy through a comparison of Indian and Western traditions.
- To Fosters critical thinking and imagination by dealing with inter-related concepts in literature and science.
- To bridge the gap between the sciences and humanities through introspective analyses.
- To nurture an understanding of the self and elucidates ways to progress towards a higher understanding of one’s self and others.

UNIT I KNOWLEDGE


UNIT II ORIGIN

UNIT III WORD

UNIT IV KNOWLEDGE AS POWER/OPPRESSION

UNIT V SELF KNOWLEDGE/BRAHMAN

TOTAL : 45 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

1. Think sceptically, ask questions and to arrive at deductions.
2. Connect and relate different branches of thought.
3. Comprehends the relation between language, thought and action.
4. Arrive at a better understanding of self and others and forms a new outlook.

REFERENCES:

7. Bacon, Francis: Power as Knowledge
UNITI	INTRODUCTION
Nature and fields.

UNITII	PSYCHOLOGY IN INDUSTRIES AND ORGANIZATIONS
Job analysis; fatigue and accidents; consumer behavior.

UNITIII	PSYCHOLOGY AND MENTAL HEALTH
Abnormality, symptoms and causes psychological disorders

UNITIV	PSYCHOLOGY AND COUNSELING
Need of Counseling, Counselor and the Counselee, Counseling Process, Areas of Counseling.

UNITV	PSYCHOLOGY AND SOCIAL BEHAVIOUR
Group, group dynamics, team building, Prejudice and stereotypes; Effective Communication, conflict and negotiation.

TOTAL: 45PERIODS

TEXTBOOKS