### SEMESTER III

<table>
<thead>
<tr>
<th>CODE</th>
<th>COURSE TITLE</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA 9211</td>
<td>Mathematics – III</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>CT 9201</td>
<td>Materials Science for Ceramics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9202</td>
<td>Unit Operations</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CY 9213</td>
<td>Instrumental Methods of Analysis</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>EE 9213</td>
<td>Electrical Drives and Controls</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CH 9204</td>
<td>Basic Mechanical Engineering</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CE 9215</td>
<td>Mechanics of Solids</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

**PRACTICALS**

<table>
<thead>
<tr>
<th>CODE</th>
<th>COURSE TITLE</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT 9207</td>
<td>Ceramic Science Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>EE 9214</td>
<td>Electrical Engineering Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CH 9257</td>
<td>Mechanical Engineering Lab</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

**TOTAL** 21 1 10 27

### SEMESTER IV

<table>
<thead>
<tr>
<th>CODE</th>
<th>COURSE TITLE</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA 9267</td>
<td>Statistics and Linear Programming</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>CT 9251</td>
<td>Metallurgy</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9252</td>
<td>Ceramic Raw Materials</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9253</td>
<td>Processing of Ceramic Raw Materials</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9254</td>
<td>White ware &amp; Heavy Clayware</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective – I</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective – II</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

**PRACTICALS**

<table>
<thead>
<tr>
<th>CODE</th>
<th>COURSE TITLE</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT 9257</td>
<td>Ceramic Powder Processing Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CT 9258</td>
<td>White ware &amp; Heavy Clayware Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**TOTAL** 21 1 4 24
### SEMESTER V

<table>
<thead>
<tr>
<th>CODE NO</th>
<th>COURSE TITLE</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT 9301</td>
<td>Thermodynamics for Ceramics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9302</td>
<td>Fuels &amp; Energy Engineering</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9303</td>
<td>Ceramic Fabrication Processes</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9304</td>
<td>Glass Engineering – I</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9305</td>
<td>Refractories – I</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective – III</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective – IV</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>PRACTICALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT 9307</td>
<td>Refractories Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CT 9308</td>
<td>Chemical Analysis of Ceramic Raw Materials Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CT 9306</td>
<td>Technical Seminar</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CT 9309</td>
<td>Industrial Training*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>21</td>
<td>0</td>
<td>6</td>
<td>25</td>
</tr>
</tbody>
</table>

* Industrial Training for four weeks during the 4th Semester vacation

### SEMESTER VI

<table>
<thead>
<tr>
<th>CODE NO</th>
<th>COURSE TITLE</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT 9351</td>
<td>Kilns, Furnaces &amp; Pyrometry</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9352</td>
<td>Glaze Technology</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9353</td>
<td>Phase Equilibria in Ceramics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9354</td>
<td>Glass Engineering – II</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9355</td>
<td>Refractories – II</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective – V</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective – VI</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PRACTICALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT 9357</td>
<td>Glaze Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CT 9358</td>
<td>Glass Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>GE 9371</td>
<td>Communication Skills and Soft Skills Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>21</td>
<td>0</td>
<td>6</td>
<td>24</td>
</tr>
</tbody>
</table>

### SEMESTER VII

<table>
<thead>
<tr>
<th>CODE NO</th>
<th>COURSE TITLE</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT 9401</td>
<td>Advanced Structural Ceramic Materials</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9402</td>
<td>Advanced Ceramic Processing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9403</td>
<td>Calculations in Ceramics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9404</td>
<td>Electronic Ceramics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9405</td>
<td>Cement &amp; Concrete</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective – VII</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective – VIII</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>PRACTICALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT 9407</td>
<td>Advanced Instrumental Methods of Analysis Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CT 9408</td>
<td>Advanced Ceramic Processing Lab</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>21</td>
<td></td>
<td>0</td>
<td>4</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>
### SEMESTER VIII

<table>
<thead>
<tr>
<th>CODE NO</th>
<th>COURSE TITLE</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>THEORY</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elective – IX</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective – X</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PRACTICALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT 9451</td>
<td>Project Work</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>0</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>TOTAL CREDITS: 190</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### LIST OF ELECTIVES FOR B.TECH. CERAMIC TECHNOLOGY

<table>
<thead>
<tr>
<th>CODE NO</th>
<th>COURSE TITLE</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT 9021</td>
<td>Properties of Ceramics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9022</td>
<td>Ceramic Testing &amp; Quality Control</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9023</td>
<td>Adhesive</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9024</td>
<td>Process Automation</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9025</td>
<td>Materials Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9026</td>
<td>Monolithics &amp; Castables</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9027</td>
<td>Heat Recovery Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9028</td>
<td>Quality Control in Ceramic Industries</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9029</td>
<td>Abrasives</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9030</td>
<td>Bioceramics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9031</td>
<td>Special Glasses</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9032</td>
<td>Advanced Coating Technologies</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9033</td>
<td>Fundamentals of Nano science</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>GE 9023</td>
<td>Fibres &amp; Composites</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9034</td>
<td>Plant Equipment &amp; Furnace Design</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9035</td>
<td>Nanoceramics &amp; Nanocomposites</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9036</td>
<td>Mechanical Behaviour of Ceramics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9037</td>
<td>Non Destructive Testing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9038</td>
<td>Microwave Processing of Ceramics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9039</td>
<td>Nuclear &amp; Space Ceramics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9040</td>
<td>Entrepreneurship Development</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CT 9041</td>
<td>Computer Aided Design</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>GE 9021</td>
<td>Professional Ethics in Engineering</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>GE 9022</td>
<td>Total Quality Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>GE 9261</td>
<td>Environmental Science &amp; Engineering</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>IB 9309</td>
<td>Process Economics &amp; Industrial Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>
AIM
To facilitate the understanding of the principles and to cultivate the art of formulating
physical problems in the language of mathematics.

OBJECTIVES

- To introduce Fourier series analysis which is central to many applications in
  engineering apart from its use in solving boundary value problems
- To acquaint the student with Fourier transform techniques used in wide variety of
  situations in which the functions used are not periodic
- To introduce the effective mathematical tools for the solutions of partial differential
  equations that model physical processes
- To develop Z-transform techniques which will perform the same task for discrete
time systems as Laplace Transform, a valuable aid in analysis of continuous time
  systems

UNIT I   FOURIER SERIES
Dirichlet’s conditions – General Fourier series – Odd and even functions – Half-range
  Sine and Cosine series – Complex form of Fourier series – Parseval’s identity – Harmonic
  Analysis.

UNIT II   FOURIER TRANSFORM
Fourier integral theorem – Fourier transform pair–Sine and Cosine transforms – Properties –
  Transform of elementary functions – Convolution theorem – Parseval’s identity.

UNIT III   PARTIAL DIFFERENTIAL EQUATIONS
Formation – Solutions of first order equations – Standard types and Equations reducible to
  standard types – Singular solutions – Lagrange’s Linear equation – Integral surface passing
  through a given curve – Solution of linear equations of higher order with constant
  coefficients.

UNIT IV   APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS
Method of separation of Variables – Solutions of one dimensional wave equation and one-
  dimensional heat equation – Steady state solution of two-dimensional heat equation –
  Fourier series solutions in Cartesian coordinates.

UNIT V   Z–TRANSFORM AND DIFFERENCE EQUATIONS
Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial
  and Final value theorems – Formation of difference equation – Solution of difference
  equation using Z-transform.

L: 45, T: 15, TOTAL: 60 PERIODS

TEXT BOOK

REFERENCES
  Publications (P) Limited, New Delhi.
AIM
The course is aimed to enable the students to have a basic knowledge about crystal systems, microstructure and dependence on various properties.

OBJECTIVES
On completion of the course the students are expected to
- Have learnt about the atomic structure and bonding.
- Have studied about the structure of solids and various imperfections.
- Have learnt the basics about phase diagrams and phase transformations.
- Have learnt the basic concepts of diffusion in solids.
- Have studied the general properties of the solids.

UNIT I CHARACTERIZATION OF CERAMIC SOLIDS 10

UNIT II STRUCTURE OF SOLIDS AND IMPERFECTIONS 9

UNIT III PHASE DIAGRAMS AND PHASE TRANSFORMATIONS 9

UNIT IV DIFFUSION 8

UNIT V PROPERTIES 9

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
The course is aimed to enable the students to have a better understanding on the principles of unit operations like fluid mechanics, heat transfer and mass transfer.

OBJECTIVES
On completion of the course the students are expected to
- Have a thorough knowledge on the fluid statics and the fluid flow phenomena.
- Have studied the different equations involved in fluid flow and the changes that occur in a fluid flowing past immersed solids.
- Have understood the concepts involved in transfer of heat by conduction and convection.
- Have a clear idea on principle of heat transfer by radiation and radiative heat transfer between different surfaces.
- Have studied the 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 SOLIDS  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  7
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  11

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
To know the principle and importance of various analytical instruments used for the characterization of various materials

OBJECTIVES
- To have thorough understanding of theory, instrumentation and applications of analytical equipments used in industries for testing quality of raw materials, intermediates and finished products
- To know the importance of analytical instrumentation during the purification, compounding and formulating the finished product

UNIT I  INTRODUCTION TO SPECTROSCOPICAL METHODS OF ANALYSIS  12
ELECTROMAGNETIC RADIATION: Various ranges, Dual properties, Various energy levels, Interaction of photons with matter, absorbance & transmittance and their relationship, Permitted energy levels for the electrons of an atom and simple molecules, Classification of instrumental methods based on physical properties
QUANTITATIVE SPECTROSCOPY: Beer -Lambert's law, Limitations, Deviations (Real, Chemical, Instrumental), Estimation of inorganic ions such as Fe, Ni and estimation of Nitrite using Beer -Lambert's Law

UNIT II  UV AND VISIBLE SPECTROSCOPY  12
Various electronic transitions in organic and inorganic compounds effected by UV, and Visible radiations, Various energy level diagrams of saturated, unsaturated and carbonyl compounds, excitation by UV and Visible radiations, Choice of solvents, cut off wavelengths for solvents, Lamda max and epsilon max rules, Woodward -Fieser rules for the calculation of absorption maxima ( Lamda max) for dienes and carbonyl compounds, Effects of auxochromes and effects of conjugation on the absorption maxima, Different shifts of absorption peaks ( Batho chromic, hypsochromic, hypochromic), Multicomponent analysis ( no overlap, single way overlap and two way overlap), Instrumentation for UV and VISIBLE spectrophotometers (source, optical parts and detectors), Photometric titration ( Experimental set -up and various types of titrations and their corresponding curves), Applications of UV and VISIBLE spectroscopies

UNIT III  IR, RAMAN AND ATOMIC SPECTROSCOPY  10
Theory of IR spectroscopy, Various stretching and vibration modes for diatomic and triatomic molecules (both linear and nonlinear), various ranges of IR (Near, Mid, Finger print and Far) and their usefulness, Instrumentation (Only the sources and detectors used in different regions), sample preparation techniques, Applications.Raman spectroscopy: Theory, Differences between IR and Raman. Atomic absorption spectrophotometry: Principle, Instrumentation (Types of burners, Types of fuels, Hollow cathode lamp, Chopper only) and Applications, Various interferences observed in AAS (Chemical, radiation and excitation) Flame photometry: Principle, Instrumentation, quantitative analysis (Standard addition method and internal standard method) and applications Differences between AAS and FES.

UNIT IV  THERMAL METHODS  5
Thermogravimetry: Theory and Instrumentation, factors affecting the shapes of thermograms (Sample Characteristics and instrumental characteristics), thermograms of some important compounds (CuSO4. 5H2O, CaC2O4. 2H2O, MgC2O4, Ag2CrO4, Hg2CrO4, AgNO3 etc), applications. Differential thermal analysis: Principle, Instrumentation and applications, differences between DSC and DTA. Applications of DSC (Inorganic and Polymer samples)
UNIT V  CHROMATOGRAPHIC METHODS  6
Classification of chromatographic methods, Column, Thin layer, Paper, Gas, High
Performance Liquid Chromatographical methods (Principle, mode of separation and
Technique). Separation of organic compounds by column and Thin layer, mixture of Cu, Co
and Ni by Paper, separation of amino acids by paper, estimation of organic compounds by
GC and HPLC

TOTAL: 45 PERIODS

REFERENCES
1. Willard, H.H., Merritt.I.I., Dean J.a., and Settle,F.A., Instrumental methods of analysis,
Sixth edition, CBS publishers,1986
5. Day R.A Underwood A.L Qualitative Inorganic analysis ( A. I. Vogel).
V Edition, Prentice-Hall of India ( P) Ltd, NewDelhi
6. Sharma, B.K., Instrumental Methods of Analysis, Goel publishing House,1995
Publishers,2006
New Age International publishers.

EE9213  ELECTRICAL DRIVES AND CONTROLS  L T P C  3 0 0 3

UNIT I  INTRODUCTION  9
Fundamentals of Electrical Drives, advantages of Electrical Drives. Choice of an Electric
Drive – characteristics of loads. Components of an Electric Drive: Electrical Motors – power
converters (AC to DC, DC to DC, DC to AC, AC to AC) – Control units (Fuses, Switches,
Circuit breakers, contactors and relays). Equations governing motor load dynamics –
equilibrium operating point and its steady state stability.

UNIT II  HEATING AND POWER RATING OF MOTOR DRIVE  9
Load diagram, heating and cooling of motors – classes of motor duty. Determination of
rating for continuous, intermittent and short time duty cycles.

UNIT III  POWER CONVERTERS  9
Control rectifiers – single phase and three phase circuits – choppers – step up and step
down choppers – A.C. Voltage controllers. Single phase and three phase A.C. Voltage
controllers, Inverters: Voltage source and current source inverters (Elementary Treatment
only).

UNIT IV  D.C. MOTOR DRIVE  9
D.C. Motor: Types, speed – torque characteristics. Starting – braking – speed control:
Converter fed separately excited D.C. motor drive – chopper fed D.C. motor drive
(Continuous current operation only).
UNIT V  A.C. DRIVES

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
2. S.K. Bhattacharya and Brijinder Singh, Control of Electrical Machines, New Age International Publishers.

CH9204  BASIC MECHANICAL ENGINEERING  L T P C  3 0 0 3

AIM
To impart knowledge on thermodynamics and thermal engineering power generating units such as engines and theory of machines

OBJECTIVE
- Students should learn thermodynamics and thermal engineering to understand the principles behind the operation of thermal equipments like IC engines and turbines etc.,
- Students should be able to appreciate the theory behind operation of machinery and be able to design simple mechanisms

UNIT I  LAWS OF THERMODYNAMICS  10
Basic concepts and hints; Zeroth law; First Law of Thermodynamics - Statement and application; Steady flow energy equation-problems; Second law of Thermodynamics – Kelvin - Plank statement and Clausius statement- problems; Limitations; Heat Engine, Refrigerator and Heat Pump, Available energy, Equivalence entropy; Reversibility: Entropy charts; Third law of Thermodynamics - Statement.

UNIT II  HEATING AND EXPANSION OF GASES  6
Expressions for work done, Internal energy and heat transfer for Constant Pressure, Constant Volume, Isothermal, Adiabatic and Polytropic processes-Derivations and problems; Free expansion and Throttling process.

UNIT III  AIR STANDARD CYCLES  6
Carnot cycle; Stirlings cycle; Joule cycle; Otto cycle; Diesel cycle; Dual combustion Cycle- Derivations and problems.

UNIT IV  I.C. ENGINES, STEAM AND ITS PROPERTIES AND STEAMTURBINES  12
Engine nomenclature and classification; SI Engine; CI Engine; Four Stroke cycle, Two stroke cycle; Performance of I.C.Engine; Brake thermal efficiency; Indicated Thermal Efficiency, Specific fuel consumption.
- Steam - Properties of steam; Dryness fraction; latent heat; Total heat of wet steam; Dry steam; Superheated steam. Use of steam tables; volume of wet steam, volume of superheated steam; External work of evaporation; Internal energy; Entropy of vapour, Expansion of vapour, Rankine cycle.
- Steam turbines – Impulse and Reaction types - Principles of operation.
UNIT V  SIMPLE MECHANISM, FLY WHEEL, DRIVES AND BALANCING
Definition of Kinematic Links, Pairs and Kinematic Chains; Working principle of Slider Crank mechanism and inversions; Double slider crank mechanism and inversions. Flywheel-Turning moment Diagram; Fluctuation of Energy. Belt and rope drives; Velocity ratio; slip; Creep; Ratio of tensions; Length of belt; Power Transmitted; gear trains-types. Balancing of rotating masses in same plane; Balancing of masses rotating in different planes.

TEXT BOOKS

REFERENCES
5. Kothandaraman and Dhomkundwar,”: A course in Thermal Engineering (SI Units)", Dhanpat Rai and Sons, Delhi (2001)

CE9215  MECHANICS OF SOLIDS  L T P C  3 0 0 3

AIM
To given them knowledge on structural, Mechanical properties of Beams, columns.

OBJECTIVES
• The students will be able to design the support column, beams, pipelines, storage tanks and reaction columns and tanks after undergoing this course. This is precursor for the study on process equipment design and drawing.

UNIT I  STRESS, STRAIN AND DEFORMATION OF SOLIDS  9

UNIT II  TRANSVERSE LOADING  ON BEAMS  9

UNIT III  DEFLECTIONS OF BEAMS AND STRESSES IN BEAMS  9
UNIT IV       TORSION
Torsion of circular shafts – derivation of torsion equation \( T/J = C/R = G0/L \) – stress and deformation in circular and hollow shafts – stresses and deformation in circular and hollow shafts – stepped shafts – shafts fixed at both ends – stresses in helical springs – deflection of springs – spring constant

UNIT V       COLUMNS
Axially loaded short columns – columns of unsymmetrical sections – Euler’s theory of long columns – critical loads for prismatic columns with different end conditions – effect of eccentricity.

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCE

CT9207       CERAMIC SCIENCE LAB
L T P C
[Minimum of 10 experiments] 0 0 2 1

PART - A
1. Determination of Thermal Conductivity
2. Determination of Thermal Expansion
3. Determination of Dielectric Constant and Dielectric Loss
4. Determination of Dielectric Breakdown
5. Determination of Electrical Conductivity of Insulating Materials

PART – B
1. Physical Properties of Ceramic Raw Materials
   - Determination of Moisture Content
   - Determination of Loss on Ignition
2. Physical Properties of Ceramic Body
   - Pressing of Ceramic Raw Material
   - Determination of Shrinkage of Ceramic Body – Dry & Fired, Volume & Linear
   - Determination of Density - True & Bulk
   - Determination of Porosity
   - Determination of Water Absorption

Equipments Required:
1. Hot Air Oven
2. Hot Plate
3. LCR Meter
4. Dilatometer

TOTAL: 30 PERIODS
AIM
To provide the practical knowledge and control methods of electrical machines

OBJECTIVE
To impart practical knowledge on
I. Characteristic of different machines
II. Method of speed control of machines
III. Measurement of various electrical parameters
   1. Study of DC & AC Starters
   2. Study of Transducers
   3. Wheatstone Bridge and Schering Bridge
   4. ADC and DAC Converters
   5. Speed Control of DC Shunt Motor
   6. Load Test on DC Shunt Motor
   7. OCC & Load Characteristics of DC Shunt Generator
   8. Load Test on Single-Phase Transformer
   9. Load Test on Three-Phase Induction Motor
  10. Load Test on Single-Phase Induction Motor.

TOTAL: 60 PERIODS

CH9257 MECHANICAL ENGINEERING LAB

AIM:
To impart practical knowledge in operating IC engines and conduct experiments. To understand test procedures in testing material for engineering applications

OBJECTIVES:
Students will be able to understand Power-generating units such as engines and operate IC engines and conduct tests. They will be able to appreciate the theory behind the functioning of engines. Material properties, their behavior under different kinds of loading and testing can be visualized.

LIST OF EXPERIMENTS *
   1. Port timing diagram
   2. Valve timing diagram
   3. Study of 2,4 stroke I C Engines
   4. Load test on 4-stroke petrol engine
   5. Performance test on 4-stroke single cylinder diesel engine
   6. Performance test on 4-stroke twin cylinder diesel engine
   7. Heat balance test on diesel engines
   8. Tension test
   9. Compression test
  10. Deflection test
  11. Hardness test (Rockwell and Brinell)
  12. Spring test
  13. Torsion test
  14. Impact test

* Minimum 10 experiments shall be offered

TOTAL: 60 PERIODS
MA9267  STATISTICS AND LINEAR PROGRAMMING          L T P C
                                                3 1 0 4

AIM
This course aims at providing the required skill to apply the statistical and Linear
Programming tools for engineering problems.

OBJECTIVES
- The students will have a fundamental knowledge of the concepts of statistical
  inference
- Have the knowledge of applying Linear programming tools in management problems.

UNIT I     TESTING OF HYPOTHESIS  9 + 3
Sampling distributions - Tests for single mean, proportion and difference of means (large
 and small samples) – Tests for single variance and equality of variances – \( \chi^2 \)-test for
goodness of fit – Independence of attributes – Non-parametric tests: Test for Randomness
and Rank-sum test (Wilcoxon test).

UNIT II    DESIGN OF EXPERIMENTS  9 + 3
Completely randomized design – Randomized block design – Latin square design - \( 2^2 \) -
factorial design.

UNIT III   STATISTICAL QUALITY CONTROL  9 + 3
Control charts for measurements (\( \bar{X} \) and R charts) – Control charts for attributes (p, c and
np charts) – Tolerance limits - Acceptance sampling

UNIT IV    LINEAR PROGRAMMING     9 + 3
Formulation – Graphical solution – Simplex method – Big-M method - Transportation and
Assignment models

UNIT V     ADVANCED LINEAR PROGRAMMING  9 + 3
Duality – Dual simplex method – Integer programming – Cutting-plane method.

L: 45, T: 15, TOTAL: 60 PERIODS

TEXT BOOKS

REFERENCES
1. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K., “Probability and Statistics for
AIM
The course is aimed to enable the students to have a basic knowledge about the basics of metallurgy, the various operations in the metallurgical process and in specific about steel making.

OBJECTIVES
On completion of the course the students are expected to
- Have learnt the basics about metals, ores and its extraction.
- Have learnt the various metallurgical processes that take place during the high temperature operation.
- Have learnt to measure and estimate the physical properties of metals.
- Have an immense knowledge about steelmaking.
- Have a basic knowledge about powder metallurgy.

UNIT I    BASICS OF METALLURGY 10

UNIT II    HIGH TEMPERATURE METALLURGICAL PROCESS 9

UNIT III    MEASUREMENT & ESTIMATION OF PHYSICAL PROPERTIES 9
Introduction – factors affecting physical properties and their measurements – microstructure, thermal expansion coefficient, electrical resistivity, diffusion coefficient, yield strength, fracture toughness and hardness.

UNIT IV    STEEL MAKING 9

UNIT V    POWDER METALLURGY 8

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
The course is aimed to enable the students to have a complete knowledge on the basics of geology, mineralogy and different raw materials used commonly in ceramic industries.

OBJECTIVES
On completion of the course the students are expected to
- Have studied the basics of rock formation, its types, and mineral formation and its physical and optical properties.
- Have learnt about clay formation, clay minerals and types of clays.
- Have studied the different types of fluxes and their characteristics.
- Have learnt the types of silicate minerals, their properties and uses.
- Have an understanding on other ceramic raw materials, their properties and uses.

UNIT I GENERAL GEOLOGY AND MINEREOLOGY 9
Rocks – formation, characteristics, classification into igneous, sedimentary and metamorphic. Minerals – formation, relation of mineral deposit to igneous activity, chemical and physical properties like composition, colour, streak, luster, fracture, cleavage, hardness, density and tenacity, elements of optical mineralogy.

UNIT II PLASTIC MATERIALS 10

UNIT III FLUXES 7
Occurrence, properties and uses of natural fluxes – feldspar group, nepheline syenite, Cornish stone, lithium containing minerals. Bone ash – preparation, properties and uses.

UNIT IV SILICA AND SILICATE MATERIALS 9
Silica – occurrence, structure, polymorphic transformation, physical and chemical properties. Silicate minerals – quartz, sillimanite, kyanite, andalusite – properties and uses.

UNIT V OTHER RAW MATERIALS 10
Bauxite, magnesite, dolomite, chromite, limestone, rutile, zircon, beryllia minerals, alumina, slag and ashes, cullet – occurrence, properties and uses.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
The course is aimed to enable the students to have a complete knowledge on the steps involved in the processing of ceramic raw materials and the equipments used for those processes.

OBJECTIVES
On completion of the course the students are expected to
- Have a thorough knowledge on the quarrying of different plastic and non-plastic raw materials.
- Have a better understanding on the different equipments used for size reduction of raw materials and the laws involved in size reduction.
- Have a clear understanding on the mechanical separation operations like screening, filtration, sedimentary separation and magnetic separation.
- Have studied the principle and working of various equipments used for mixing, conveying and storage of ceramic raw materials.
- Have a clear knowledge on methods for characterizing the ceramic powder for its shape and size.

UNIT I QUARRYING 7

UNIT II SIZE REDUCTION 9

UNIT III MECHANICAL SEPARATION 10

UNIT IV MIXING, CONVEYING AND STORAGE OF MATERIALS 9

UNIT V POWDER CHARACTERIZATION 10

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
The course is aimed to enable the students to have a sound knowledge about the whiteware and heavy clayware products and their manufacturing processes, their properties and quality control.

OBJECTIVES
On completion of the course the students are expected to
- Have a basic knowledge about whiteware and heavy clayware, their classification and formulation.
- Be capable of classifying the various whiteware products and know the body formulation and properties.
- Have learnt in detail about the manufacturing process of various whiteware products.
- Have a better understanding about the heavy clayware products and their applications.
- Have learnt about the properties and the various properties methods.

UNIT I INTRODUCTION

UNIT II WHITEWARE BODY FORMULATIONS
Body composition – porcelain, earthenware, bone china, sanitary ware, hotel china, terracotta, majolica, steatite bodies, corderite bodies, rutile bodies, titanate bodies, zircon bodies, lava bodies.

UNIT III WHITEWARE PRODUCTS
Manufacturing process & properties – whitewares at home – tableware, kitchenware, flame resistant ware, art ware, containers, construction – floor tile, wall tiles, sanitary ware, electrical – low tension insulators, high tension insulators, high frequency low loss insulators, industrial use – abrasion resistance, chemical resistance, heat resistance.

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.

UNIT V PROPERTIES & TESTING

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
CT9257 CERAMIC POWDER PROCESSING LAB  L T P C  0 0 2 1

[Minimum of 10 experiments]

1. Size reduction with Jaw Crusher and calculation of efficiency.
2. Grinding with ball mill and calculation of efficiency.
4. Filtration of slurry by Filter Press.
5. Particle separation from slurry by Gravity Sedimentation.
6. Mixing of powders in tumbling mixers and testing the homogeneity with mixing time and particle size.
7. Blunging of slurries and testing the homogeneity with mixing time and viscosity.
8. Particle shape and size identification with Microscope.
9. Particle size determination by Hydrometer Method.
10. Particle size determination by Andreason Pipette Method.

Equipments Required:
1. Jaw Crusher
2. Ball Mill
3. Sieve Shaker
4. Filter Press
5. Blunger
6. Hydrometer
7. Andreason Pipette
8. Particle Size Analyser
9. Mixers
10. Centriguge

TOTAL: 30 PERIODS

CT9258 WHITEWARE AND HEAVY CLAYWARE LAB  L T P C  0 0 2 1

[Minimum of 10 experiments]

1. Preparation of Ceramic Slip in a Pot Mill
2. Determination of Slip Specific Gravity.
3. Determination of Slip Viscosity.
4. Effect of Water on Viscosity of Slip.
5. Effect of Deflocculant on Viscosity of Slip.

Equipments Required:
1. Pot Mill
2. Gibbs Viscometer
3. Hot Air Oven
4. Sieves
5. Moulds
6. Furnace

TOTAL: 30 PERIODS
AIM
The course is aimed to enable the students to have a basic knowledge about thermodynamics and the applications of thermodynamic laws of various systems.

OBJECTIVES
On completion of the course the students are expected to
- Have an understanding about the basic concepts of thermodynamics and the thermodynamic laws.
- Have an idea about the behavior of gases under conditions of temperature, pressure and volume.
- Have a basic knowledge about concepts of heat capacity.
- Have learnt the various applications of thermodynamics and solve some thermodynamic problems.
- Have a knowledge about solution thermodynamics.

UNIT I BASIC CONCEPTS
Fundamental concepts – system, process, state, properties, force, work, pressure, energy, equilibrium state, phase rule. Thermodynamic laws – zeroth law, internal energy, first law for flow process, non flow process, enthalpy, limitations, second law, entropy, Clausius inequality, third law.

UNIT II PVT BEHAVIOUR
PVT behavior – equation of state – concept of ideal gas – constant volume constant pressure, constant temperature, adiabatic process, isotropic process – equation of state for real gases – compressibility chart – heat effects accompanying a chemical reaction.

UNIT III CONCEPTS OF HEAT CAPACITY

UNIT IV APPLICATIONS OF THERMODYNAMICS

UNIT V SOLUTION THERMODYNAMICS

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
The course is aimed to enable the students to have a thorough knowledge about different types of fuels used in industries and the mechanism involved in converting the fuel into a useful source of energy.

OBJECTIVES
On completion of the course the students are expected to
- Have a complete knowledge idea about the occurrence and characteristics of the different types of solid fuels.
- Have a better knowledge about the different types of liquid fuels and their properties.
- Have a complete understanding about the different liquid fuels and their properties.
- Have a basic knowledge about the combustion process involved in the fuels.
- Have an idea about the ways of heat transfer and the different heat recovery systems.

UNIT I SOLID FUEL

UNIT II LIQUID FUEL

UNIT III GASEOUS FUELS

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

UNIT V HEAT TRANSFER
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.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
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.

OBJECTIVES
On completion of the course the students are expected to
- Have complete knowledge about the slip casting process.
- Have a complete knowledge about the various plastic forming process.
- Have a complete knowledge about the various dry forming process.
- Have a sound understanding on the mechanism of drying and the construction and working of the various drying equipments.
- Understand effectively the importance of firing and the mechanism and types of firing equipments.

UNIT I SLIP FORMING PROCESS

UNIT II PLASTIC FORMING PROCESS

UNIT III DRY FORMING PROCESS

UNIT IV DRYING AND FINISHING

UNIT V FIRING
Action of heat on ceramic bodies – physical changes, chemical changes. Firing equipments, firing schedules – fast firing, firing range. Problems, defects. Liquid phase sintering, vitrification, microstructure control.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
The course is aimed to enable the students to have a complete knowledge on the principle behind glass formation, raw materials and melting of glass batch, glass properties and quality control in glass.

OBJECTIVE
On completion of the course the students are expected to
- Have understood the principle behind glass formation and structures of different glasses.
- Have studied about the raw materials for glass making and calculation of a glass batch for a given composition.
- Have learnt about the reactions involved in the conversion of solid glass batch into a liquid glass melt.
- Have studied about the thermo-dynamical, thermal, mechanical, electrical and other properties of glass.
- Have learnt 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 OF GLASS  8

UNIT V  TESTING AND QUALITY CONTROL  7
Flat glass defects – origin, characteristics. Container glass defects – origin, remedies. Test procedures for normal glass and coated glass.

TOTAL: 45 PERIODS

TEXT BOOKS
REFERENCES

CT9305 REFRACTORIES- I

AIM
The course is aimed to enable the students to have a basic knowledge about the various types of refractories used in the industries.

OBJECTIVES
On completion of the course the students are expected to
- Have learnt the basics about refractories and its demand.
- Have a sound knowledge about silica refractories.
- Have learnt about properties and applications of alumino silicate refractories.
- Have learnt about the various basic refractories.
- Have a knowledge about special refractories.

UNIT I INTRODUCTION

UNIT II SILICA REFRACTORIES

UNIT III ALUMINOSILICATE REFRACTORIES
Al₂O₃ – SiO₂ phase diagram, - types of raw materials - different alumino silicate refractories – manufacturing steps – properties & applications.

UNIT IV BASIC REFRACTORIES
Manufacturing process - properties and uses of magnesite, magnesia carbon, forsterite, dolomite and chrome based refractories.

UNIT V SPECIAL REFRACTORIES

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
1. Preparation of silica refractory of various compositions
2. Preparation of fire clay refractory of various compositions
3. Preparation of high alumina refractory of various compositions.
4. Comparison of Properties of various compositions of silica refractories
5. Comparison of Properties of various compositions of fireclay refractories
6. Comparison of Properties of various compositions of high alumina refractories
7. Permanent Linear Change of silica, fire clay and high alumina refractory.
8. Comparison of density, porosity and strength of refractory prepared by powder pressing and extrusion.
9. Comparison of density, porosity and strength of silica, fire clay and high alumina refractories.
10. Preparation of insulating refractory with different pore formers and comparison of their characteristics.
11. Comparing the characteristics of a dense and porous refractory.

Equipments Required:
1. Universal Testing Machine
2. Hot Plate
3. Extruder

TOTAL: 30 PERIODS

1. Alumino Silicate Materials
   - Silica
   - Alumina
   - Iron Oxide
   - Alkali Oxides
   - Alkaline Earth Oxides
2. High Silica Materials
   - Silica
   - Alumina
   - Iron Oxide
   - Alkali Oxides
   - Alkaline Earth Oxides
3. Feldspathic Materials
   - Silica
   - Alumina
   - Iron Oxide
   - Alkali Oxides
   - Alkaline Earth Oxides

TOTAL: 30 PERIODS
AIM
The course is aimed to enable the students to have a thorough knowledge on the equipments involved in firing of a ceramic article and the temperature measurement methods.

OBJECTIVES
On completion of the course the students are expected to
- Have a thorough knowledge on the different burners used based on the fuel type and the types of flame produced from burners.
- Have studied the different types of furnaces and their operation.
- Have an understanding on the different factors involved in designing a furnace.
- Have a better knowledge on different types of kilns, their construction and working.
- Have a clear understanding on the temperature and heat measurement techniques in kilns and furnaces.

UNIT I  BURNERS AND FLAMES

UNIT II  FURNACES
Introduction, definition, classification – metal heating furnaces, reheating furnace, continuous furnace, sintering furnace, crucible furnaces, electric furnace, unit melters and smelters, muffle furnace, glass tank furnace.

UNIT III  FURNACE DESIGN
Factors for consideration, heating capacity, furnace design, heat economics, furnace atmosphere, draught establishment, chimney calculation, heat transfer, safety aspects.

UNIT IV  KILNS
Introduction, definition, classification – draught kiln, chamber kiln, tunnel kiln, roller kiln, rotary kiln, continuous kiln, shuttle kiln, top hat kiln, muffle kiln, Hoffman's kiln – principle, materials used in foundation and construction, working.

UNIT V  PYROMETRY
Introduction and thermometry, thermocouples, radiation pyrometers, low temperature measurement, temperature control, heat work recorders – Segar cone, Holdcroft's bar, Buller rings, Watkin recorders.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
aim
The course is aimed to enable the students to have a complete knowledge about the importance of glazing and the processing and application of glazes.

objectives
On completion of the course the students are expected to
- Have learnt the definition of glazes and classification of glazes.
- Have a thorough knowledge about the raw materials and properties of the glaze raw materials.
- Have a thorough knowledge about the various glazing techniques.
- Have learnt the properties and defects produced by glazing.
- Have complete understanding about the various methods of decorating the glazed article.

unit i  introduction to glaze  9

unit ii  raw materials and processing  9

unit iii  glazing techniques and special glazes  9
Glazing techniques – dipping, pouring, spraying, brushing, dusting and other techniques – special glazes – matt glazes, snake skin glazes, cracked glazes, salt glazes and other glazes.

unit iv  properties and defects  9
Glaze body reactions- interface layers- thermal characteristics- glaze defects and remedies- crazing, peeling, crawling, rolling, blisters, pin holes, dunting- mechanical, optical and chemical properties of glazes.

unit v  decoration  9
Classification of decoration methods- advantages- different decorating techniques- painting, spraying, stenciling, stamping, printing, lithographic transferring, silk screen printing, dusting, engobing, liquid gold decoration and decoration techniques.

total: 45 periods

text books

references
AIM
The course is aimed to enable the students to have a thorough knowledge about the
importance of phase equilibrium and analyzing different systems.

OBJECTIVES
On completion of the course the students are expected to
1. Have learnt the basics of phase equilibrium and phase diagrams.
2. Have studied the thermodynamics behind phase equilibria.
3. Have a better understanding on the different two component and three component
   phase diagrams.
4. Have studied the types and theory behind phase transformations and also about
   nucleation and growth.
5. Have gained knowledge on the different experimental methods to determine phase
   diagrams.

UNIT I  INTRODUCTION  9
Introduction, phase, component, variable, Gibb’s phase rule, single component system –
H₂O, SiO₂, iron, Hume Rothery’s rule; binary phase diagrams – eutectic, incongruent, solid
solutions, complex diagrams.

UNIT II  THERMODYNAMICS OF PHASE EQUILIBRIA  9
Introduction, criteria of phase equilibrium, criterion of stability, phase equilibria in single
component system and multi component system; binary solutions – constant pressure
system, constant temperature system, partially miscible system, immiscible system, liquid-
liquid equilibrium diagrams, ternary equilibrium diagrams.

UNIT III  PHASE DIAGRAMS  9
Al₂O₃ – SiO₂, MgO – Al₂O₃, MgO – SiO₂, Al₂O₃ – ZrO₂, K₂O – Al₂O₃ – SiO₂, MgO – Al₂O₃ –
SiO₂, Na₂O – Al₂O₃ – SiO₂. Prediction of alkali corrosion of alumino silicate refractories using
phase diagrams.

UNIT IV  PHASE TRANSFORMATIONS  9
Introduction, Time Scale for phase transformations, types of transformations – spinoidal,
nucleation & growth, theory of transformation kinetics; nucleation and growth – nucleation
kinetics, homogeneous nucleation, heterogeneous nucleation, growth and overall
transformation kinetics.

UNIT V  EXPERIMENTAL METHODS  9
Techniques for determining phase diagrams – dynamic, static, microscopic methods –
optical, electron microscopy, X-ray methods, thermal analysis.

TOTAL: 45 PERIODS

TEXT BOOKS
1. Kingery W.D, Yet Ming Chiang and Dunbar P.Birnie III, Physical Ceramics – Principles

REFERENCES
1. Kingery W.D, Bowen H.K and Uhlmann D.Rm Introduction to Ceramics, 2nd Edn., John
AIM
The course is aimed to enable the students to have a thorough knowledge on furnaces used for glass melting, fabrication of glass and the treatments to the final glass article.

OBJECTIVES
On completion of the course the students are expected to
- Have learnt the different furnaces used for glass melting, their design and operation.
- Have a better understanding on the heating process in tank furnace and the measurement and control of parameters in tank furnace.
- Have studied the fabrication methods of glass flat ware and hollow ware.
- Have a clear understanding on the purpose and process of annealing of glass products.
- Have learnt 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 & construction, refractories used. Electric tank furnace – design & operation, electrodes used, electric boosting in tank furnace.

UNIT II  OPERATION OF TANK FURNACE  10

UNIT III  FABRICATION PROCESS  9

UNIT IV  ANNEALING  9
Introduction, nature of generation & release of strain, temporary & permanent strain, dependence of strain on cooling rate, detection & 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 & micro porous glass, sealing glass, neutral glass, photosensitive glass, glass ceramic, glass fibers.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
The course is aimed to enable the students to have a sound knowledge about the various types of refractories used in the various applications.

OBJECTIVES
On completion of the course the students are expected to
- Have learnt the basics about refractories used in iron & steel industry.
- Have a sound knowledge about refractories used in non ferrous and non metallic industries.
- Have learnt about refractories used in glass and ceramic industry.
- Have learnt about the refractories used for insulation.
- Have a knowledge about special refractories used in space and atomic/nuclear energy.

UNIT I  REFRACTORIES FOR IRON & STEEL INDUSTRY  9
Refractories - coke oven, blast furnace, open hearth furnace, LD converter, THF, EAF, IF, Ladle furnace, slide plate system, nozzle, shroud, continous casting, monolithics – gunning technique, refractory slag and metal interactions.

UNIT II  REFRACTORIES FOR NON FERROUS & NON METALLIC INDUSTRIES  9
Refractories in non ferrous industries – copper, aluminum, lead - Refractories in non metal industries – hydrocarbon industry, fertilizer industry, cement industry.

UNIT III  REFRACTORIES FOR GLASS AND CERAMIC INDUSTRY  9
Refractories for glass industry – refractory practices in sidewall, 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 INSULATION  9
Purpose of insulation – types of insulating materials and preparation of insulating refractories, ceramic fibre products – design and installation – ceramic coatings.

UNIT V  REFRACTORIES FOR SPACE & NUCLEAR APPLICATIONS  9
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.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE
GLAZE LAB

1. Preparation of Glaze Slip.
2. Fusion Studies.
3. Particle Size and Particle Size Distribution of Glaze.
8. Glst Firing.
12. Crazing Analysis.
13. Determination of Acid Resistance by boiling acid.

Equipments Required:
1. Dilatometer
2. Pot Mill
3. Particle Size Analyser
4. Hot Air Oven
5. Furnace

TOTAL: 30 PERIODS

GLASS LAB

   - Borax
   - Lime
   - Quartz
   - Feldspar
2. Sieve Analysis.
3. Preparation of Soda Lime Glass
4. Preparation of Amber Glass
6. Determination of Specific Gravity.
7. Determination of Refractive Index.
8. Determination of Thermal Expansion.

Equipments Required
1. Sieve Shaker
2. Hot Plate
3. Hot Air Oven
4. Furnace

TOTAL: 30 PERIODS
AIM
To enhance the overall capability of students and to equip them with the necessary Communication Skills and Soft Skills that would help them excel in their profession.

OBJECTIVES
- To equip students of engineering and technology with effective speaking and listening skills in English.
- To help them develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment exercises.

1. PC based session

A. Career Lab  (15 periods)  Viewing and discussing audio-visual materials

1. **Resume / Report Preparation / Letter Writing:**
   - Letter writing – Job application with Resume - Project report - Email etiquette.

2. **Presentation skills:**
   - Elements of effective presentation – Structure of presentation - Presentation tools – Body language.

3. **Soft Skills:**

4. **Group Discussion:**
   - Group discussion as part of selection process, Structure of group discussion – Strategies in group discussion – Mock group discussions.

5. **Interview Skills:**
   - Kinds of interviews – Interview techniques – Corporate culture – Mock interviews.

II. Class Room Session  TOTAL: 45 PERIODS

1. **Resume / Report Preparation / Letter writing:** Students prepare their own resume and report.

2. **Presentation Skills:** Students make presentations on given topics.

3. **Group Discussion:** Students participate in group discussions.

4. **Interview Skills:** Students participate in Mock Interviews
   - Note: Classroom sessions are practice sessions.

REFERENCES:

LAB REQUIREMENT
1. Teacher console and systems for students.
2. English Language Lab Software
3. Tape recorders
AIM
The course is aimed to enable the students to have a thorough knowledge about the various ceramic materials used for structural applications.

OBJECTIVES
- On completion of the course the students are expected to have a studied the structural characteristics and properties of oxide, carbide, nitride, carbon and other ceramic materials used for structural applications.

UNIT I OXIDE CERAMICS
Structural characteristics, properties and applications of silica, alumina, zirconia, magnesia, titania, thoria, mullite, uranium oxide and plutonium oxide.

UNIT II CARBIDES
Structural characteristics, properties and applications of silicon carbide, boron carbide, tungsten carbide, titanium carbide.

UNIT III NITRIDES
Structural characteristics properties and applications of silicon nitride, boron nitride, titanium nitride, aluminum nitride.

UNIT IV ADVANCED CERAMICS
Carbon compounds, borides, silicides, Sialon and cermets, high temperature superconducting oxides.

UNIT V SINGLE CRYSTALS

TOTAL: 45 PERIODS

TEXT BOOKS
1. Mc Colm, Ceramic Science for Materials Technologists, Blackie & Sons Ltd.,Glasgow, 1983.

REFERENCES
AIM
The course is aimed to enable the students to have a thorough knowledge on the advanced processing techniques in ceramics.

OBJECTIVES
On completion of the course the students are expected to
- Have a thorough knowledge on the preparation of ceramic powder by mechanical and chemical methods.
- Have studied the additives used in ceramic forming and different ceramic forming processes in dry powder, slurry and plastic consistency.
- Have a better understanding on the mechanisms of solid state and liquid phase sintering, and crystal growth during sintering.
- Have learnt the advanced sintering processes and their mechanisms.
- Have understood the processes involved in machining and surface finishing of ceramic products.

UNIT I  
POWDER PROCESSING  9
Powder preparation by mechanical methods – comminution, mechano-chemical synthesis. 

UNIT II  
FORMING  10
Additives in ceramic forming – solvents, dispersant, binder, plasticizer, other additives. 
Forming of ceramics – dry and semidy pressng - die compaction and isostatic compaction; casting methods - slip casting, pressure casting, gel casting, electrophoretic deposition; plastic forming methods - extrusion, co-extrusion, injection molding, solid freeform fabrication - particle filled polymer methods, powder methods, suspension methods- Porous ceramic forming- foaming, intrusion, organic additives.

UNIT III  
SINTERING MECHANISMS  10

UNIT IV  
ADVANCED SINTERING  7
Pressure assisted sintering – hot pressing and hot iso-static pressing. Reaction bonded sintering, microwave sintering.

UNIT V  
MACHINING AND SURFACE FINISHING OF CERAMICS  9
Mechanism of material removal and its effect on strength, surface grinding and mechanical polishing, non abrasive finishing, ceramic surface coating, joining of ceramics – metal ceramic joints.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
The course is aimed to enable the students to have a basic knowledge about the methods of calculating the various ceramic properties.

OBJECTIVES
On completion of the course the students are expected to
- Have learnt the basic methods of calculating the properties of ceramic raw materials.
- Have learnt to calculate the properties of ceramic bodies.
- Have learnt to calculate the properties of suspensions.
- Have learnt to formulate glaze batches by varying the parameters.
- Have learnt to formulate glass batches.

UNIT I ULTIMATE & RATIONAL ANALYSIS
Ultimate analysis, proximate analysis, rational analysis of clay, stone and feldspar -mica convention – substitution of clays in body recipes – triangular plot.

UNIT II DETERMINATION OF PHYSICAL PROPERTIES

UNIT III CALCULATIONS OF BODY & SUSPENSIONS

UNIT IV GLAZE CALCULATIONS
Molecular weights – formula and use of chemical equations – oxides – percentage composition and formula – calculation of a recipe from a simple glaze formula – given the recipe of a glaze calculate the formula – synthesis of a fritted glaze – given the recipe calculate the formula for a fritted glaze – calculation of the percentage composition of the mill batch.

UNIT V GLASS CALCULATIONS
Determination of molecular formula of glass from chemical composition of the glass and from glass batch – determination of batch from molecular formula of glass – determination of batch from the given chemical composition.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
5. R.Charan, Handbook of Glass Technology.
AIM
The Course is aimed to enable the students to know the basic concepts of ceramic materials used for electronic applications and their applications in various fields.

OBJECTIVES
On completion of the course the students are expected to

- Have studied the use of ceramic materials as insulators and capacitors and their properties.
- Have learnt the processing, properties and various applications of ceramic materials in ferroelectric applications.
- Have learnt the manufacture, characteristics and properties of magnetic ceramics.
- Have a basic knowledge about superconductivity.
- Have a basic knowledge about the manufacture, characteristics and properties of varistors and fuel cells.

UNIT I CERAMIC INSULATORS

UNIT II CERAMIC CAPACITORS

UNIT III FERROELECTRIC CERAMICS

UNIT IV MAGNETIC CERAMICS

UNIT V VARISTORS AND FUEL CELLS
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.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
The course is aimed to enable the students to have a complete knowledge on the manufacture, quality control and types of cement, and preparation, properties and different types of concrete.

OBJECTIVES
On completion of the course the students are expected to
• Have studied the raw materials, manufacturing process and mechanism of hydration of cement.
• Have learnt the tests done on cement and the quality control procedures.
• Have studied the different types of cements and their characteristics.
• Have learnt the types of aggregates and admixtures used for concrete making and the preparation of a concrete mixture.
• Have understood the different properties of concrete and the testing methods of the same.

UNIT I CEMENT

UNIT II TESTING AND QUALITY CONTROL OF CEMENT

UNIT III TYPES OF CEMENT
Types of Portland cement, blast furnace slag cement, trifer cement, high alumina cement, white and coloured cement, oil well cement, hydrophobic cement, water proof cement, super sulphate cement, sulphate resisting cement.

UNIT IV CONCRETES

UNIT V PROPERTIES OF CONCRETE
Strength, permeability, creep, thermal expansion, shrinkage, moisture movement, penetration of X-ray, abrasion resistance, fire resistance, freeze-thaw resistance, electrical properties.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
CT9407 ADVANCED INSTRUMENTAL METHODS OF ANALYSIS LAB
[Minimum of 10 experiments] L T P C 0 0 2 1

2. Thermal Analysis – TGA, DTA, DSC.
3. Determination of Viscosity by Brookfield Viscometer.
5. Microscopy – Optical, SEM.
6. Vicker’s Hardness.
7. Modulus of Rupture.
8. Modulus of Elasticity.
10. Surface Area Measurement – BET.

Equipments Required:
1. Spectrophotometer
2. Atomoc absorption Spectrometer
3. Flame Photometer
4. TGA/DTA
5. Brookfield Viscometer
6. Particle Size Analyser
7. SEM
8. Vickers Hardness Tester
10. BET

TOTAL: 30 PERIODS

CT9408 ADVANCED CERAMIC PROCESSING LAB L T P C 0 0 2 1

[Minimum of 10 experiments]

5. Shaping by Gel Casting.
7. Porous body making by Foaming Method.
8. Porous body making by Replication Technique.
10. Microstructure study of sintered samples prepared from different processing routes.

Equipments Required:
1. Optical Microscope
2. Spray Drying
3. Hot Plate
4. Furnace
5. Hot Air Oven

TOTAL: 30 PERIODS
CT9451  
PROJECT WORK  
L T P C  
0 0 12 6

AIM
The project work aims to train the students on systematic analysis of a problem and to enable them to bring out a solution it.

OBJECTIVE
The objective of the project is to make use of the knowledge gained by the student at various stages of the degree course. Each student is required 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 and the actual analysis done by the student on the given project.

CT9021  
PROPERTIES OF CERAMICS  
L T P C  
3 0 0 3

AIM
The course is aimed to enable the students to have a thorough knowledge on different properties of ceramics.

OBJECTIVES
On completion of the course the students are expected to
- Have a thorough knowledge on the mechanical properties and the mechanical failure modes of ceramics.
- Have studied the thermal properties of ceramics.
- Have an understanding on the optical properties of ceramics.
- Have a better knowledge on electrical properties of ceramics.
- Have a clear understanding on the magnetic properties of ceramics.

UNIT I  
MECHANICAL PROPERTIES  
9

UNIT II  
THERMAL PROPERTIES  
10
Heat capacity, density and thermal expansion of glasses, crystals, composite bodies. Thermal conduction – phonon conductivity of single phase crystalline ceramics and glasses, photon conductivity, conductivity of multiphase ceramics, thermal stress, temperature gradients, resistance to thermal shock and thermal spalling, thermal tempering and annealing.

UNIT III  
OPTICAL PROPERTIES  
8
Introduction, refractive index and dispersion, reflection and refraction, absorption, scattering, polarisability, boundary reflectance and surface gloss, opacity and translucency, absorption and colour, application.

UNIT IV  
ELECTRICAL PROPERTIES  
9
Electrical conduction phenomena, ionic conduction in crystals and glasses, electronic conduction in crystals and glasses, non-stoichiometry and solute controlled electronic conduction, valency controlled semiconductors, mixed conduction in poor conductors, poly crystalline ceramics, electrical phenomena, dielectric loss factor for crystals and glasses, dielectric conductivity, polycrystalline and polyphase ceramics, dielectric strength.
UNIT V MAGNETIC PROPERTIES

Magnetic phenomena, origin of interactions in ferromagnetic materials, spinel ferrites, rare earth garnets, ortho ferrites and ilmenites, hexagonal ferrites, polycrystalline ferrites, susceptibility, permeability, flux density, types of magnetism and their origin, electronic structure and magnetic moment, exchange interaction and super exchange interaction, hysteresis loop and magnetic domain – domain structure.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

CT9022 CERAMIC TESTING AND QUALITY CONTROL L T P C

AIM
The course is aimed to enable the students to have a basic knowledge about the various testing methods of ceramic raw materials and samples and also the basics about quality control.

OBJECTIVES
On completion of the course the students are expected to
- Have learnt the basics about the testing methods for ceramic raw materials.
- Have learnt the various methods of testing the physical properties.
- Have learnt to test the various properties of glaze.
- Have an immense knowledge about testing of refractories.
- Have a basic knowledge about quality control.

UNIT I TESTING OF RAW MATERIALS

UNIT II TESTING OF PHYSICAL PROPERTIES

UNIT III TESTING FOR GLAZE

UNIT IV TESTING FOR REFRACTORIES
UNIT V  QUALITY CONTROL

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

CT9023  ADHESIVES  L T P C
3 0 0 3

AIM
The course aimed to enable the students to have a basic knowledge about the types, properties and applications of adhesives.

OBJECTIVES
On completion of the course the students are expected to
- Have gained knowledge on classification of adhesives and forces involved in adhesion.
- Have studied the mechanical properties, adhesion and cohesion of adhesives.
- Have understood about the types, properties and applications of thermosetting resins.
- Have learnt about the types, properties and applications of thermoplastic resins.
- Have studied about the types, properties and applications of inorganic adhesives.

UNIT I  INTRODUCTION

UNIT II  PROPERTIES
Mechanical properties – rheological models and molecular theory, glass transition and viscoelasticity, chemo-rheology, two phase systems, concepts of fracture, tough-brittle transition, rupture and tearing of rubber, nucleation and growth of cracks, controlled brittle fracture and fracture toughness, controlled cleavage of crystals, adhesive strength. Adhesion and cohesion – tack, surface treatment, wetting, spreading and shear strength, non-destructive testing, destructive testing.
UNIT III  THERMOSETTING RESIN ADHESIVES

UNIT IV  THERMOPLASTIC RESIN ADHESIVES
Introduction, types and properties of cellulose adhesives, polyvinyl adhesives, acrylic resin adhesives, polyamide resins and nylon, and miscellaneous thermoplastic adhesives.

UNIT V  NATURAL ORGANIC ADHESIVES AND INORGANIC ADHESIVES

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

CT9024  PROCESS AUTOMATION

AIM
The course is aimed to enable the students to have a basic knowledge about the control instruments and its applications in various fields.

OBJECTIVES
On completion of the course the students are expected to
- Have studied the principle and classification of process control equipments.
- Have learnt basic concepts on process control.
- Have learnt the basics about advanced control instruments.
- Have learnt about digital control instruments.
- Have learnt the optimal control instruments.

UNIT I  INTRODUCTION
Principles of measurement and classification of process control instruments; temperature, pressure fluid flow, liquid level, velocity, fluid density, viscosity, conductivity etc., instrument scaling; sensors; transmitters and control valves; instrumentation symbols and labels.
UNIT II  PROCESS AUTOMATION  9
Basic Concepts; terminology and techniques for process control; control modes; tuning process controllers.

UNIT III  ADVANCED CONTROL  9
Advanced control techniques, feed forward and ratio control; controller design; adaptive control system; statistical process control; expert system; multivariable control techniques; supervisory control.

UNIT IV  DIGITAL CONTROL  9
Digital control techniques; z transforms; sampling and filtering; response of discrete time systems; sampled data control systems; design of digital controllers.

UNIT V  OPTIMAL CONTROL  9
Optimization and simulation; optimization techniques; single and multivariable constrained optimization; dynamic simulation of distillation columns and reactors.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

CT9025  MATERIALS MANAGEMENT  L T P C  3 0 0 3

AIM
The course is aimed to enable the students to have a basic knowledge about importance of material management and its applications in various sectors.

OBJECTIVES
On completion of the course the students are expected to
- Have learnt the basic concepts about materials management.
- Have studied about the importance of purchasing.
- Have studied the importance of management in warehouse and stores.
- Have studied the importance of management in inventory.
- Have studied the concepts of different material procurement procedures.

UNIT I  INTRODUCTION  9
Introduction to material management, importance of integrated materials management, need for integrated materials management, concept, definition, scope and advantage- an overview, A-B-C analysis, codification, variety reduction, standardization.

UNIT II  PURCHASE MANAGEMENT  9
Material planning and purchase, purchase system, procedures, price forecasting, purchasing of capital equipment, vendor development, account procedure, purchasing decisions, procurement policies.
UNIT III WARE HOUSING AND STORE MANAGEMENT 9
Store keeping principles-past and latest techniques, stores-general layout, cost aspect and productivity, problems and development, store system procedures incoming material control, store accounting and stock incoming material control, store accounting and stock verification, value analysis.

UNIT IV INVENTORY MANAGEMENT 9
Introduction, basic models, definition of commonly used terms, replenishment model, choice of system etc., inventory work in progress, safety stock, computerization in materials management control, information to materials management case study, spare parts.

UNIT V MATERIAL PROCUREMENT PROCEDURES 9
Arbitration act- octroi, central and local sales tax, excise duties- custom tariff, import, control policies, procurement from government agencies and international market- insurance, DGS and D tariff.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

CT9026 MONOLITHICS AND CASTABLES L T P C
3 0 0 3

AIM
The course is aimed to enable the students to have a sound knowledge about the types, properties and applications of monolithics and castables.

OBJECTIVES
On completion of the course the students are expected to
- Have learnt the types of castables, its composition and characteristics.
- Have a better understanding on the use of plastic refractories, ramming and gunning mixes as monolithic materials.
- Have studied about the composition and characteristics of mortars, coatings and dry vibratables.
- Have a clear idea on the methods of installing different monolithic materials, the application design and the lining materials used while laying monolithics.
- Have studied the wear mechanisms that cause failure in a monolithic lining and the methods to test a monolithic.

UNIT I CASTABLES 10

UNIT II PLASTIC REFRACTORIES, RAMMING AND GUNNING MIXES 10
UNIT III  MORTARS, COATINGS AND DRY VIBRATABLES  7

UNIT IV  MONOLITHIC INSTALLATION  10
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  8
Wear mechanisms – introduction, abrasion, penetration, corrosion, spalling. Tests done on monolithics – chemical analysis, density, porosity, strength, high temperature properties, corrosion, erosion.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

CT9027  HEAT RECOVERY SYSTEMS  L T P C
3 0 0 3

AIM
The course is aimed to enable the students to have a sound knowledge about the methods to recover the waste heat from furnaces and also methods to minimize wastage of heat.

OBJECTIVES
On completion of the course the students are expected to
- Have a thorough knowledge on thermal operation of furnaces.
- Have studied the various heat exchange equipments like heat exchangers, boilers, calandrias and extended surface equipments.
- Have learnt the types, design and construction of regenerators.
- Have learnt the types, design and construction of recuperators.
- Have understood the methods of minimizing heat loss and heat consumption in furnace by proper design.

UNIT I  ENERGY BALANCE IN FURNACE  9
Temperature and thermal conditions in furnace, calculation of thermal operation of furnaces – heat balance, furnace productivity.

UNIT II  HEAT EXCHANGERS  9
UNIT III REGENERATORS
Principle of operation, types of regenerators, design and construction, materials of construction and applications.

UNIT IV RECUPERATORS
Principle of operation, types of recuperators, design, applications, comparison over regenerator.

UNIT V ENERGY CONSERVATION DESIGNS
Prevention of energy loss in furnace – insulation, coatings, low thermal mass materials – importance, design and applications.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

CT9028 QUALITY CONTROL IN CERAMIC INDUSTRIES L T P C 3 0 0 3

AIM
To impart knowledge on various quality control aspects and issues followed in ceramic industries.

OBJECTIVES
At the end of the course the students would
- Be aware on the basic concepts of standardization.
- Have a comprehensive insight in the Indian standard specifications.
- Have a basic knowledge on the concepts of quality control in ceramic industries.
- Have learnt the statistical methods of quality control.
- Have a basic knowledge about the reliability and maintainability of quality concept.

UNIT I CONCEPTS OF STANDARDISATION
Historical development of standards – aims, techniques, management, formulation, implementation of company standards- economic benefits of standardization.

UNIT II INDIAN STANDARDS FOR CERAMIC MATERIALS

UNIT III CONCEPTS OF QUALITY
Quality engineering- planning for quality and reliability- quality standards- specification of inspection methods, setting of standard quality levels- introduction to ISO 9000- design of quality experiments using statistics- analysis of variance.
UNIT IV  STATISTICAL QUALITY CONTROL  9
Introduction to taguchi methods and 6 sigma concepts- objectives of statistical quality control- inspection and its importance- difference between inspection and quality control, basic statistical methods- techniques of quality control- control charts for attributed- control charts for variables.

UNIT V  DECORATION  9
Definition of reliability, factors affecting reliability- MTTF- MTBF- evaluation of reliability, quality management- organizing for quality- economy of quality- techniques of ABC analysis- quality management education- zero defects concept-

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

CT9029  ABRASIVES  L T P C  3 0 0 3

AIM
The course aimed to enable the students to have a basic knowledge about the types, manufacturing process, properties and applications of abrasives.

OBJECTIVES
On completion of the course the students are expected to
- Have a basic understanding on the abrasives, and different raw materials and their characteristics.
- Have studied the stages involved in the manufacture of a coated abrasive.
- Have learnt about the different types of back ups used in a coated abrasive and how they affect the grinding characteristic.
- Have a good knowledge on the manufacturing of bonded abrasive, its types and characteristics.
- Have learnt the fundamentals of grinding operation, grinding aids and about polishing.

UNIT I  INTRODUCTION  6

UNIT II  MANUFACTURE OF COATED ABRASIVES  8
Raw material selection and preliminary treatments, maker coating, abrasive coating – methods and types of coating, sizer coating, drying and humidification, flexing, conversions – slitting, belt making, sheet cutting, disc cutting. Individual disc coating process. Quality control and testing.

UNIT III  BACK UPS  7
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 12
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

UNIT V BASICS OF GRINDING AND POLISHING 12
Grinding wheel – definition, abrasives chosen, grinding chips, chemical reactions, grade selection, wheel wear, chemical grinding aids. Grinding fluids – properties, types and purpose. Types of grinding – cylindrical grinding, centre less grinding, surface grinding, internal grinding. Polishing – definition, types.

TOTAL: 45 PERIODS

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

REFERENCES

CT9030 BIOCERAMICS L T P C 3 0 0 3

AIM
The course is aimed to enable the students to have a sound knowledge about the applications of ceramic materials in biological field.

OBJECTIVES
On completion of the course the students are expected to
- Have learnt the various applications of ceramic materials in the medical field.
- Have a complete knowledge about the various calcium phosphate based ceramic materials along with the preparation, properties and applications.
- Have studied about the different bioactive glasses and glass ceramic materials.
- Have studied about the different bioactive composites.
- Have studied about the different bioactive coatings.

UNIT I MATERIALS IN MEDICINE 9

UNIT II CALCIUM PHOSPHATE CERAMICS 9
UNIT III  BIOACTIVE GLASSES AND GLASS CERAMICS  9
Surface active glasses, bioactive glass – preparation, mechanical properties, bonding mechanism to living tissue – interfacial bonding. Doped bioactive glasses. High strength bioactive glass ceramics – mechanical and biological properties, bone bonding mechanism, mechanism of surface apatite formation, compositional dependence.

UNIT IV  BIOACTIVE COMPOSITES  9
Hydroxyapatite composites with zirconia, alumina and titania – preparation and properties. SiC whisker reinforced hydroxyapatite and bioactive glass ceramics, zirconia toughened and bioactive glass ceramics, bioglass-hydroxyapatite composites, carbon composites.

UNIT V  BIOACTIVE COATINGS  9
Importance of bioactive coatings. Hydroxyapatite coated metal implants – coating methods, characterization and properties. Bioglass and bioactive glass ceramics coating over metals and alloys.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

CT9031  SPECIAL GLASSES  L T P C
3 0 0 3

AIM
The course is aimed to enable the students to have a thorough knowledge about the special applications of glasses in various fields.

OBJECTIVES
On completion of the course the students are expected to
- Have a clear understanding on the types and properties of heat resistant and safety glasses.
- Have studied the manufacture, types and applications of optical glasses.
- Have studied the composition of glass fibres and optical fibres, and their applications.
- Have learnt the composition, preparation and properties of glass ceramics.
- Have a knowledge on the methods and types of coatings on glass, their applications and quality control.

UNIT I  HEAT RESISTANT AND SAFETY GLASSES  9

UNIT II  OPTICAL GLASSES  9
UNIT III GLASS FIBRES
Composition for fibre glass, glass wool, manufacturing process and applications. Optical fibres – optical properties of fibres, silica based glass fibres – applications in optical communication.

UNIT IV GLASS CERAMICS
Glass composition, heat treatment schedule, crystal nucleation in glass, nucleating agent, microstructure and properties, applications, machinable glass ceramics.

UNIT V COATED GLASS
Coating methods – physical vapour deposition, chemical vapour deposition. Types of coatings, characteristics of coated glass, applications of coated glasses, quality control of coated glass.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

CT9032 ADVANCED COATING TECHNOLOGIES

AIM
The course is aimed to enable the students to have a complete knowledge about the advanced ceramic coating technology processes, properties and applications.

OBJECTIVES
On completion of the course the students are expected to
- Have studied the classification and raw materials used for the special coatings.
- Have learnt in detail about enamel coating.
- Have studied the concept of vapour phase coatings.
- Have studied about the various special coating techniques.
- Have studied the properties and applications of special coatings.

UNIT I COATINGS – FUNDAMENTALS

UNIT II VAPOUR PHASE COATINGS
PVD - basic evaporation process - evaporation techniques - sputtering – ion plating- CVD process- CVD reactor- CVD kinetics- product and process route.

UNIT III SPECIAL COATINGS
Plasma spray- pack coating- slurry coating- sol gel coating- hot dip coating- electrophoresis-electro chemical coating- corrosion resistant coating and other coatings.

UNIT IV SURFACE ANALYTICAL METHODS
XRD – glancing incidence, x-ray diffraction- electron microscopy techniques- auger electron spectroscopy, secondary ion mass spectroscopy, photoelectron spectroscopy.

UNIT V PROPERTIES AND APPLICATIONS
Thermal, mechanical. Optical and chemical properties- hardness- wear and erosion resistance- high temperature properties- applications- defects and remedies.

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

GE9023 FUNDAMENTALS OF NANOSCIENCE

AIM
To make the students understand the importance, relevance and potentialities of this emerging field of study.

OBJECTIVES
- Study the basic nano technology and nano science.
- Understand interdisciplinary nature of this field.
- Understand the importance role of physics, chemistry, biology.
- Recognize that the rules of nano science are fundamentally different than those we experience.
- Study the basic fabrication strategies of nano science.

UNIT I INTRODUCTION
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II PREPARATION METHODS
Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES
Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma/reactive ion) etching, Etch resists-dip pen lithography

UNIT IV PREPARATION ENVIRONMENTS
Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

UNIT V CHARACTERISATION TECHNIQUES
X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

TOTAL : 45 PERIODS
TEXT BOOKS

REFERENCES

CT9033 FIBRES AND COMPOSITES L T P C
3 0 0 3

AIM
The course is aimed to enable the students to have a sound knowledge about the different types of ceramic fibres, composites, their properties and applications.

OBJECTIVES
On completion of the course the students are expected to
- Have studied the different fibre reinforcements, their manufacturing routes, properties and applications.
- Have studied the different types of matrices, its manufacturing techniques and properties.
- Have a basic knowledge about the types, manufacturing process and properties of composites.
- Have a basic knowledge about the properties of composite materials.
- Have a sound knowledge about the different types of whiskers.

UNIT I REINFORCEMENTS
Fibre definition, fibre flexibility; Glass fibres – types, manufacturing process, properties, glass wool forming process; Alumina fibres, mullite fibres, zirconia fibres, boron fibres, carbon fibres and graphite fibres – manufacturing techniques, properties and applications; Strength of reinforcements.

UNIT II TYPES OF MATRICES
Introduction, types – polymer, ceramic, metal, glass, thermosetting and thermoplastic matrices.

UNIT III COMPOSITES

UNIT IV PROPERTIES OF COMPOSITES
Elastic and strength properties – fracture behavior – fibre matrix load transfer – failure of a composite – criteria, damage of composites from physical and mechanisms to modeling, long term behavior of composite materials, high temperature stability – wear and friction.

UNIT V WHISKERS
Background of whisker growth – whisker nucleation and growth – composite processing – whisker purification, whisker / matrix poeder mixing, densification, SiC and Si₃N₄ whiskers, VLC synthesis, properties.

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

CT9034 PLANT EQUIPMENT AND FURNACE DESIGN L T P C
3 0 0 3

AIM
The course is aimed to enable the students to have a sound knowledge about designing the layout of the plant and designing of furnaces.

OBJECTIVES
On completion of the course the students are expected to
- Have learnt the factors for selection of a plant layout.
- Have studied the ways of assembling the various sections in the plant for proper functioning.
- Have studied the principles of designing equipments.
- Have studied the principle and designing of furnaces.
- Have studied the construction of furnaces.

UNIT I PLANT DESIGN 9
Proper location of the plant- factors to be considered, factory buildings- layouts with necessary details.

UNIT II ASSEMBLING 9
Assembling of economics, engineering and industrial data, calculations and data necessary for the process route- electrical, piping instruments, motors, compressors etc- flow diagrams-process, design and overall technical report.

UNIT III EQUIPMENT DESIGN 9
Design principles- crushers, filter press, sieves, pugmill and different types of pug moulds-tunnel, chamber and electrical.

UNIT IV FURNACE DESIGN 9
Design of furnaces- tank furnace, tunnel kiln, chamber kiln, rotary kiln, muffle furnace, blast furnace, open hearth furnace, stack calculations- chimney foundations. Essential operations-firing, charging, melting, preheating- air, gas, fuel, flame systems, furnace high temperature measurements and temperature control instruments.

UNIT V FURNACE CONSTRUCTION 9
Furnace life and selection of proper refractories, thermal currents and atmosphere, safe firing schedule. Basic knowledge about furnace construction, capacity, fuel and firing efficiencies- design, construction and thermal calculation of one of the furnaces.

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

CT9035 NANOCERAMICS AND NANO COMPOSITES L T P C 3 0 0 3

AIM
The course is aimed to enable the students to have a basic knowledge about the developing field on nanotechnology, nanoceramics and composites.

OBJECTIVES
- On completion of the course the students are expected to have a complete knowledge about the preparation, characterization and applications of Nano ceramics and composites.

UNIT I NANO SCIENCE AND TECHNOLOGY 9
General definition and size effects--important nano structured materials and nano particles--importance of nano materials- applications.

UNIT II SYNTHESIS & CONSOLIDATION 9
Precipitation methods -- sol gel techniques --ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods.

UNIT III NANOCERAMICS 9
Introduction to nanoceamics- properties of nano ceramics- advanced nano ceramics- carbon nano tubes, fibres, nanosilica-nano alumina- nano titania and zinc oxide- applications.

UNIT IV NANO COMPOSITES 9
Definition- importance of nanocomposites- nano composite materials-classification of composites- metal/ceramics, metal-polymer- thermoplastic based, thermostet based and elastomer based- influence of size, shape and role of interface in composites-applications.

UNIT V CHARACTERIZATION METHODS 9
X-ray diffraction, Raman spectroscopy- UV- visible spectroscopy, scanning probe microscopy, atomic force microscopy, scanning electron microscopy and transmission electron microscopy techniques.

TOTAL: 45 PERIODS

TEXT BOOKS
REFERENCES

CT9036 MECHANICAL BEHAVIOUR OF CERAMICS LTPC
3 0 0 3

AIM
The course is aimed to enable the students to have a detailed understanding about the behaviour of ceramic materials with different mechanical properties.

OBJECTIVES
On completion of the course the students are expected to
- Have learnt in detail about the elastic property and brittle nature of ceramics.
- Have understood the fracture behaviour of ceramics.
- Have studied the behaviour of the materials in strength and engineering design.
- Have learnt the creep behaviour of ceramic materials.
- Have understood the thermal shock behaviour of the ceramic materials.

UNIT I ELASTIC BEHAVIOUR 7

UNIT II FRACTURE MECHANICS 8
Theoretical strength and stress concentrations, linear elastic fracture mechanics, microstructural aspects, fracture testing techniques.

UNIT III STRENGTH AND ENGINEERING DESIGN 10
Strength testing, statistical treatment to strength, time dependent strength behaviour – subcritical crack growth, stable crack propagation, cyclic fatigue – SPT diagram. Toughening of Ceramics.

UNIT IV CREEP BEHAVIOUR 10

UNIT V THERMAL BEHAVIOUR 10
Thermal stress, thermal shock resistance parameters, thermal stresses and cracking, testing technique, applications of thermal stress.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
The course is aimed to enable the students to have a basic knowledge about the various non-destructive methods of testing.

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

UNIT I SURFACE NDT METHODS
Introduction- Definition of terms, discontinuities and defects/flaws- fracture mechanics concept of design and the role of NDT- life extension and life prediction- penetrant testing and magnetic particle testing - basic principle, limitations & advantages – development and detection of large flux – longitudinal and circular magnetization – demagnetization.

UNIT II RADIOGRAPHIC TESTING

UNIT III ULTRASONIC TESTING
Ultrasonic waves- velocity, period, frequency and wavelength- reflection and transmission- near and far field effects and attenuation- generation- piezoelectric and magnetostriction methods- normal and angle probes- methods of Ultrasonic testing- Principle of pulse echo method- Equipment – examples- rail road inspection, wall thickness measurement- range and choice of frequency.

UNIT IV EDDY CURRENT TESTING
Introduction- principles of eddy current inspection- conductivity of a material- magnetic properties- coil impedance- lift off factor and edge effects- skin effect- inspection frequency- coil arrangements - inspection probes- types of circuit- Reference pieces- phase analysis-display methods-typical application of eddy current techniques.

UNIT V OTHER METHODS

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
The course is aimed to enable the students to the basic concepts about processing the ceramic materials in microwave atmosphere.

OBJECTIVES
On completion of the course the students are expected to
- Have learnt the introduction about microwave processing.
- Have learnt the concepts of microwave heating circuit.
- Have learnt the applicator types of microwave.
- Have studied the industrial applications of microwave processing.
- Have studied the hazard and safety of microwave processing.

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

TEXT BOOKS

REFERENCES
AIM
The course is aimed to enable the students to the basic concepts of ceramic materials used for nuclear and space applications.

OBJECTIVES
On completion of the course the students are expected to
- Have studied the basic concepts of nuclear physics.
- Have learnt about the nuclear reactors.
- Have studied in detail about the production and properties of various fuels.
- Have studied about the radiation protection.
- Have studied the basics about space ceramics.

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.

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.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
The course is aimed to enable the students to have a basic knowledge about entrepreneurship and development in that area.

OBJECTIVES
On completion of the course the students are expected to
- Have studied the basic concepts of entrepreneurship and entrepreneurial environment.
- Have learnt about small business and preparation of feasibility chart.
- Have a basic knowledge about establishment of a business.
- Have learnt about how to manage a business unit.
- Have some basic concepts about promotion of entrepreneurship and practical knowledge about some case studies.

UNIT I ENTREPRENEURSHIP AND ENTREPRENEURIAL ENVIRONMENT
Definition of entrepreneurship, entrepreneur, entrepreneurial potentials, traits and types of entrepreneurs, differences between entrepreneur and intrapreneur, entrepreneurship as a career, business environment, roll of family/society in entrepreneur, institutional support to entrepreneurs, entrepreneur support organizations (financial and non-financial), entrepreneur training organizations, government policies about industrial and entrepreneur development, incentives and subsidies for industries.

UNIT II BUSINESS PLAN/FEASIBILITY REPORT PREPARATION
Small enterprises, definition, classification, characteristics, ownership structure, project history, project formulation, importance of feasibility report, format for preparation of business feasibility report, steps involved in setting up a business, sources of product identification, criteria for selection of products, selecting a good business opportunity, market survey and research, techno-economic feasibility assessment, preliminary project report, project appraisal, sources of information, classification of needs and agencies.

UNIT III ESTABLISHMENT OF BUSINESS UNIT
Mobilization of sources (financial, personal and material), selection and training of human resource, purchase of project equipments and raw materials, plant location, infrastructure, building, installation of machinery, material production, marketing channel selection, commercialization of product, legal agents of business.

UNIT IV MANAGEMENT OF BUSINESS UNIT
Introduction to general management, financial management, management accounting, production management, human resource development, marketing management, organization development, TQM-ISO 9000 series, sickness of industries, strategies for closing business.

UNIT V PROMOTION OF ENTREPRENEURSHIP AND CASE STUDIES
Risk taking and decision making, role of government agencies like DIC, TIIC, SIDCO, SIPCOT, TIDCO, SISI, NSIC, IFC, ITCOT, banks, etc., case study of a successful entrepreneur, case studies on identification and selection of products, preparation of project feasibility report, establishment of business unit and sickness of business unit.

TOTAL: 45 PERIODS

TEXT BOOKS
AIM
The course is aimed to enable the students to have a basic knowledge about designing of equipment and instruments by computers.

OBJECTIVES
On completion of the course the students are expected to
- Have learnt the concepts about computers.
- Have studied some fundamentals of finite element analysis.
- Have studied about the basic solid modeling using computers.
- Have some practical knowledge of designing equipments using computers.
- Have a basic knowledge in doing graphics.

UNIT I  INTRODUCTION  9
Introduction to microprocessors- input, output and memory devices- interfacing concepts, evaluation of OS- functions and characteristics. Fundamentals of computer aided design- requirements of hardware and software- the design process steps-morphology of design.

UNIT II  FINITE ELEMENT ANALYSIS  9

UNIT III  SOLID MODELLING  9
Geometric modeling- wireframe, surface and solid models- techniques- solid modelling packages- interface to drafting, design analysis and CNC- rapid prototyping.

UNIT IV  EQUIPMENT DESIGN  9
Computer aided design of size reduction equipments, dryers, filters and centrifuges, shaping machines, furnaces.

UNIT V  COMPUTER GRAPHICS  9
Analysis of design data- creating a basic graph - different display techniques- labeling the axes- plotting the data- logarithmic graphs- bar graphs.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
To sensitize the engineering students on blending both technical and ethical responsibilities.

OBJECTIVES
- Identify the core values that shape the ethical behavior of an engineer.
- Utilize opportunities to explore one’s own values in ethical issues.
- Become aware of ethical concerns and conflicts.
- Enhance familiarity with codes of conduct.
- Increase the ability to recognize and resolve ethical dilemmas.

UNIT I ENGINEERING ETHICS 9

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9
Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III ENGINEER’S RESPONSIBILITY FOR SAFETY 9

UNIT IV RESPONSIBILITIES AND RIGHTS 9

UNIT V GLOBAL ISSUES 9

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
AIM
To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

OBJECTIVES
- To understand the various principles, practices of TQM to achieve quality
- To learn the various statistical approaches for quality control.
- To understand the TQM tools for continuous process improvement.
- To learn the importance of ISO and Quality systems.

UNIT I INTRODUCTION

UNIT II TQM PRINCIPLES
Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I

UNIT IV TQM TOOLS & TECHNIQUES II

UNIT V QUALITY SYSTEMS

TOTAL: 45 PERIODS

TEXT BOOK

REFERENCES
AIM
The aim of this course is to create awareness in every engineering graduate about the importance of environment, the effect of technology on the environment and ecological balance and make them sensitive to the environment problems in every professional endeavour that they participate.

OBJECTIVE
- At the end of this course the student is expected to understand what constitutes the environment, what are the precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity and the role of government and non-government organization in environment managements.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14
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 – biogeographical 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 8
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 10
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 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

TEXT BOOKS

REFERENCES

IB9309  PROCESS ECONOMICS & INDUSTRIAL MANAGEMENT  L T P C  
            3 0 0 3

AIM
To introduce process economics and industrial management principles to chemical engineers.

OBJECTIVES
- The objective of this course is to teach principles of cost estimation, feasibility analysis, management, organization and quality control that will enable the students to perform as efficient managers.

UNIT I  PRINCIPLES OF PRODUCTION MANAGEMENT AND ORGANISATION  15
Planning, organization, staffing, coordination, directing, controlling, communicating, organization as a process and a structure; types of organizationsMethod study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning; routing; scheduling; dispatching; costs and costs control, inventory and inventory control.
UNIT II ENGINEERING ECONOMICS FOR PROCESS ENGINEERS - INTEREST, INVESTMENT COSTS AND COST ESTIMATION

Time Value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital, invested capital and profitability.

UNIT III PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT

Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.

UNIT IV ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE

Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth.

UNIT V ECONOMIC BALANCE AND QUALITY AND QUALITY CONTROL

Essentials of economic balance – Economic balance approach, economic balance for insulation, evaporation, heat transfer.

Elements of quality control, role of control charts in production and quality control.

TOTAL : 45 PERIODS

TEXT BOOKS


REFERENCES