

## 4.1 CERAMIC COATING TECHNOLOGY

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### RATIONALE

A thorough knowledge of different type of coatings done on ceramic & metallic materials in the ceramic industries enable the students to know different type of coatings and their application methods.

### DETAILED CONTENTS

1. Introduction of Glaze: Definition of Glaze, Similarities & Dissimilarities between glaze and glasses. Classification of glazes, Definition and explanation of Raw glaze, Fritted glaze, Lead glaze, Leadless glaze, Vapour glaze, Opaque glaze, Matt glaze & Crystalline glaze. (08 hrs)
2. Raw Materials:
  - Clay: china clay, bentonite, ball clay,
  - Silica: quartz, flint, sand stone, silica sand,
  - Fluxes: Soda feldspar, Potash feldspar, nepheline syanite, cullet,
  - Amphoteric Oxide: Alumina,
  - Alkalie materials: Sodium Carbonate, Sodium Chloride, Sodium Nitride, Sodium Hydroxide, Sodium Silicate floride Potassium Carbonate, read lead,
  - Alkaline earth materials: Barium Carbonate, Calcium Carbonate, Borax, Boric oxide,
  - Opacifiers: Tin oxide, Zirconia, Zircon, Antimony oxide, Calcium fluorideExplain role of each raw material in glaze. (14 hrs)
3. Preparation of glaze: Selection of raw materials, composition, batch preparation, mixing, grinding. Definition of frit, preparation of frit & importance of fritting.
  - Application of glaze: Dipping, brushing, pouring & Spraying. (10 hrs)
4. Firing of glazed ware: Drying, placing precautions of glazed ware before firing.
  - Glaze defects & remedies : Crazing, Crawling, Peeling, Pin hole discuss their causes and remedies (10 hrs)
5. Decorations: Under glaze, in glaze & on glaze decorations, Decoration methods like painting, stamping, stenciling, screen printing, & chromolithography. (06 hrs)
6. Introduction & Classification of Enamels: Definition of Enamel. Types of enamels.

- Base Metal preparation : Cleaning by organic detergent, chemical method, de greasing by heating method & pickling
- Preparation & Application:- Composition, batching, grinding, & milling additives. Ground coat and cover coat, application of enamel by dipping and spraying.
- Defects in Enamel: Under fired, rolling, scaling, chipping, pinholes, crazing, & their causes (16 hrs)

## INSTRUCTIONAL STRATEGY

Students must visit different ceramic industries to know more about different coating techniques and defects in coating

## RECOMMENDED BOOKS

1. Porcelain Enamels by Andrew
2. Industrial ceramics by Singer F and Singer SS
3. Modern pottery by HN Boss
4. Hand Book of ceramics
5. White ware by W. Rayan
6. Fine ceramics by FH Norton.

## SUGGESTED DISTRIBUTION OF MARKS

Sr. No	Time Allotted (Hrs)	Marks Allotted (%)
1	08	12
2.	14	20
3.	10	16
4.	10	16
5.	06	10
6.	16	26
<b>Total</b>	<b>64</b>	<b>100</b>

## 4.2 CEMENT TECHNOLOGY

L T P  
3 - 4

### RATIONALE

This specialized subject is taught to the diploma holders of ceramic engineering in order to widen their scope of employment cement manufacturing units also.

### DETAILED CONTENTS

1. Definition and Classification of cements, Types of cements: Portland cement, Pozzolona cement, slag cement, Quick setting cement, Rapid hardening cement, Low heat cement, High alumina cement, White & coloured cement, Oil well cement, Iron ore cement, Water proof cement, Sulphate resisting cement, Acid proof cement, Hydrophobic cement. (08 hrs)
2. Raw materials, their selection and proportionality, Calcareous and Argillaceous materials, additives, Manufacture of cement (wet and dry process). (10 hrs)
3. Effect of raw materials and constituents on the properties of cement. Calculations of raw mix. Thermo chemistry of clinker formation, sequence of reaction, hydration of portland cement, setting and hardening of Portland cement, physical and mechanical properties of portland cement. (12 hrs)
4. Lime and other building materials, different classes of lime, their properties and uses. (06 hrs)
5. Gypsum and plaster of Paris, setting and hardening of plaster of Paris, its uses. (06 hrs)
6. Testing-Water consistency, initial setting time, final setting time, fineness, soundness. Health and Safety Measures taken in cement industries. Precautions for environmental pollution. (06 hrs)

### LIST OF PRACTICALS

1. Determination of fineness of cement.
2. Determination of water cement ratio.
3. Determination of initial & final setting time of cement.
4. Determination of initial & final setting time of Plaster of Paris.
5. Determination of soundness of cement by Le Chateliers apparatus.
6. Determination of tensile strength of cement mortar cubes.
7. Determination of tensile strength of lime mortar cubes.

8. Determination of compressive strength of cement mortar cubes.
9. Determination of compressive strength of lime mortar cubes.
10. Chemical analysis of cement.

### **INSTRUCTIONAL STRATEGY**

Students must visit cement plants to be familiar with raw materials and manufacturing process of cement

### **RECOMMENDED BOOKS**

1. Text Book of Cement and Concrete by Lee
2. Advances in Cement Technology by S.M. Ghose
3. Hand book on Cement Technology by Dudda

### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Sr. No</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	08	18
2.	10	22
3.	12	24
4.	06	12
5.	06	12
6.	06	12
<b>Total</b>	<b>48</b>	<b>100</b>

### 4.3 CERAMIC WHITEWARE TECHNOLOGY-I

L T P  
4 - 6

#### RATIONALE

In this specialized subject, whiteware technology inputs are provided to the students about raw materials, processes, fabrication, drying and firing techniques.

#### DETAILED CONTENTS

1. Introduction and classification: Division and brief history, scope and division of Pottery, Terracotta, Earthen ware, Stone ware, Porcelain ware. (08 hrs)
2. Introduction to raw materials: Naturally occurring raw materials-Clay, Quartz, Napthelene cyanide, Talc Sillimanite, Kyanite, Andalusite, Zircon, Bone-ash, Gypsum, Plaster of Paris, Synthetically prepared materials-Alumina, Zirconia, Beryllia. (14 hrs)
3. Processes:- Crushing and grinding, mixing, agitating, magnetising, sieving, pumping, filtration, plugging and batting. (06 hrs)
4. Fabrication or Shaping Methods: Detailed study of slip casting, pressure fabrication, hot pressing, plastic forming, dry pressing, isostatic pressing, jiggering & jollying, extrusion, injection moulding, throwing, finishing operation; sponging, smoothing, fitting, jointing or stickup. Theoretical concept about slip casting, zeta potential, double layer formation, role of electrolytes, deflocculants. (20 hrs)
5. Drying: Removal of water, factors affecting drying, types of driers-batch & continuous, hot flow, steams pipes, chamber driers & tunnel driers etc., defects in drying. (08 hrs)
6. Firing: Effect of heat on clay & other materials, effect of heat on ceramic bodies, firing of bone-china bodies, different types of firing kilns. (08 hrs)

#### LIST OF PRACTICALS

1. Study of effect of electrolytes on different clays.
2. Determination of dry content by pint weight method.
3. Preparation of casting slip with a body suitable for making (a) white ware (b) Earthenware

4. Study of heating & cooling schedule.
5. Determination of drying shrinkage of clay body.
6. Determination of firing shrinkage of clay body.
7. Determination of Water of Plasticity of clay.
8. Determination of loss on Ignition.
9. Determination of fineness of various raw materials used for whiteware bodies.
10. Determination of water absorption.
11. Determination of Specific gravity of suitable solution.
12. Making of a cup by casting method.
13. Making of plate by Jiggering method.
14. Study of defects in drying process in dry oven.

### **INSTRUCTIONAL STRATEGY**

Students must get industrial exposure of various whiteware industries to know more about process and products.

### **RECOMMENDED BOOKS**

1. Ceramic Whitewares by Sudhir Sen
2. Industrial Ceramics by Singer & Singer, Khanna Publishers, New Delhi
3. Handbook of Ceramics, Prentice Hall of India
4. Whiteware by W. Rayan

### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Sr. No</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	08	12
2.	14	22
3.	06	12
4.	20	30
5.	08	12
6.	08	12
<b>Total</b>	<b>64</b>	<b>100</b>

#### 4.4 CERAMIC REFRACTORY TECHNOLOGY-I

L T P  
3 - 4

#### RATIONALE

In this specialised subject on refractory technology, a thorough knowledge of classification and testing of refractories is provided along with manufacturing techniques of important refractories. Phase diagrams are also dealt in this subject.

#### DETAILED CONTENTS

1. Definition and classification of refractories (14 hrs)
  - Definition of refractory - Classification of refractories such as acid , basic , neutral and special refractories with examples.
  - Raw materials such as Fire clay, Sillimanite, Kyanite, Andalusite, Bauxite, Quartzite, Magnesite, Chromite, Dolomite, Zircon, Forsterite. Properties of materials, factors affecting the selection of raw material, occurrence of raw material and manufacturing units in India
  
2. Testing of refractories (14 hrs)
  - Refractoriness
  - Refractoriness under load
  - Expansion characteristics
  - Spalling/thremal chock resistance
  - Permeability
  - Porosity
  - Density
  - Compressive and tensile strength
  - Thermal conductivity
  - Cold crushing strength
  - Slag resistance
  - Permanent linear change
  
3. Manufacturing of Alumina, Silica, Magnesite, semi-Silica, Fire Clay, Carbon and Graphite refractories, Chromite, Chrome- Magnesium, Magnesium-Chrome refractories, Dolomite refractories, Fusion-cast refractories, Mullite Sillimanite refractory, their properties and uses. (14 hrs)

4. Phase diagrams with respect to the raw materials, Controlling and Firing temperature and schedule ( $\text{Al}_2\text{O}_3\cdot\text{SiO}_2$ ,  $\text{MgO}\text{-SiO}_2$ ). (06 hrs)

### LIST OF PRACTICALS

1. Determination of specific gravity of refractory materials.
2. Determination of porosity of different refractories.
3. Refractoriness determination (pyrometric cone equivalent) of different bricks
4. Green & sinter density determination of ceramic sample.
5. Study of density variance with pressure.
6. Determination of permanent linear change of different bricks.
7. Determination of modulus of rupture of different bricks.
8. Determination of cold crushing strength of different bricks.
9. Determination of effects of coarse medium & fine grog on clay.

### INSTRUCTIONAL STRATEGY

Industrial visits of students may be organized for better understanding of various manufacturing process and products of refractories.

### RECOMMENDED BOOKS

1. Refractory by Nandi, New Age Publication
2. Refractory by Mishra, Tata McGraw Hill Publishers, New Delhi
3. Introduction to Ceramics by W.D. Kingery, Prentice Hall of India Publication

### SUGGESTED DISTRIBUTION OF MARKS

Sr. No	Time Allotted (Hrs)	Marks Allotted (%)
1	14	30
2.	14	30
3.	14	30
4.	06	10
<b>Total</b>	<b>48</b>	<b>100</b>



## 4.5 GLASS TECHNOLOGY - I

L T P  
3 - 4

### RATIONALE

In this specialized subject on glass technology, starting from fundamental concepts, characteristics, composition and properties, furnaces for glass making are also discussed in detail for making the students competent in this technology area.

### DETAILED CONTENTS

1. Origin of glass, fundamental concept of glassy state, definition of glass, raw materials, Component of glass, glass making oxides like acidic oxide, basic oxide, intermediate oxide, properties and its functions. (12 hrs)
2. Chemical and physical characteristics of glass, principle of glass making, batch material, their storage, mixing and conveying, factors influencing choice of batch materials, Cullet. (08 hrs)
3. Chemical composition of different types of glasses, Calculation of batch from glass composition and vice-versa. Empirical formula, phase equilibrium studies. (08 hrs)
4. Furnaces for glass making-batch and continuous type, glass tank furnace, tank and pot type furnace, regenerators and recuperators, flue system, chimney draft, melting batch charging, tank temperature, control of furnace temperature floaters. (10 hrs)
5. Properties of glass- Density, thermal expansion, viscosity, surface tension, optical properties, moisture content, elastic module, Poisson's ratio, impact strength, hardness brittleness, bending test. (10 hrs)

### LIST OF PRACTICALS

1. Processing of raw materials: Preparation of sand from quartz
2. Purification of sand
3. Seive analysis of sand
4. Moisture estimation in raw materials
5. Removal of iron from sand
6. Batch formulation
7. Mixing & melting of batch ingredients
8. Drawing rods from molten glass
9. Determination of density of glasses
10. Preparation of soda lime & silica glass

## **INSTRUCTIONAL STRATEGY**

Different glass industries like sheet glass industry, hollow ware glass industry, float glass industry must be shown to students for better understanding of raw materials, processes and products etc.

### **RECOMMENDED BOOKS**

1. Modern Glass Practice by S.G. Scholze, Publisher McGraw Hill
2. Handbook of Glass Manufacturing by F.V. Tooley, Publisher Prentice Hall of India

### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Sr. No</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	12	20
2.	08	18
3.	08	18
4.	10	22
5.	10	22
<b>Total</b>	<b>48</b>	<b>100</b>

## **INDUSTRIAL TRAINING OF STUDENTS** (during summer vacation after IV Semester)

It is needless to emphasize further the importance of Industrial Training of students during their 3 years of studies at Polytechnics. It is industrial training, which provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice. Polytechnics have been arranging industrial training of students of various durations to meet the above objectives.

This document includes guided and supervised industrial training of a minimum of 6 weeks duration to be organised during the semester break starting after second year i.e. after IV Semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. A minimum of one visit per week by the teacher is recommended. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An internal assessment of 50 and external assessment of 50 marks have been provided in the study and evaluation scheme of V Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations. The formative and summative evaluation may comprise of weightage to performance in testing, general behavior, quality of report and presentation during viva-voce examination. It is recommended that such evaluations may be carried out by a team comprising of concerned HOD, teachers and representative from industry.

Teachers and students are requested to see the footnote below the study and evaluation scheme of IV Semester for further details.