# Pottery and Porcelain Technology-II

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<tr>
<th>Subject Code</th>
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<table>
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**Rationale:**

**Objective:**

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<td>03</td>
<td>Electrical and Electronic Ceramics.</td>
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<td>04</td>
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<td>Testing and Quality Control.</td>
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**Total : (50)**
CONTENTS:

TOPIC: 01 – WHITE WARES:

01.01 Types:- Sanitary Ware, Floor and Wall tiles, Stone Ware, Porcelain, Chemical Porcelain, Dental Porcelain, Earthen Ware, Bone China, Low and high voltage porcelain.

01.02 Body Preparation :- Batch Calculation, Batching Ball milling, Screening, De-Watering of Clay slip, Casting Slip, Plastic forming, Dry Press bodies.


01.04 Firing :- Types of Kilns, Setting, Firing Schedules.

01.05 Properties and Tastes.

TOPIC: 02 – HEAVY CLAYWARE:

02.01 Common Building bricks, Roofing tiles, Sanitary Fireday goods, Flooring Tiles, Salt Glazed Pipes and Fitting, Sewer Pipes, Hollow blocks-their manufacturing methods and properties.

TOPIC: 03 – ELECTRICAL AND ELECTRONIC CERAMICS:

03.01 High voltage low frequency applications-Porcelain Insulators, Low-Voltage high frequency application-Porcelain, Steatite, Cordierite, Registers, Capacitors, Hard and Soft Ferrites.
TOPIC: 04 – GLAZES AND DECORATION:

04.01 Types of glazes, Glaze materials, Colouring ingredients, Metallic decoration, Compounding of glazes, Fritting of glazes, Blending of glaze slips, Preparation of glaze, Glaze application, Firing, Properties and defects.

TOPIC: 05 – TESTING AND QUALITY CONTROL:

05.01 Absorption and Porosity, Plasticity of clay, Loss on ignition, Viscosity, Shrinkage, Strength, Dielectric Strength, Puncture Voltage, Power Factor, Dielectric Constant.

Books Recommended:

2. Ceramic Fabrication Process - W. D. Kingrey.
5. Industrial Ceramics - S. S. Singer
6. Ceramics-Vol.-I, II and III. - E. P. McNamara

SCHEME OF EXAMINATION FOR FINAL EXAMINATION  F.M. : 80

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The above table refers to the annual examinations only.
Refractory Technology-II

Subject Code
03303

Theory

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No. of Periods in one session: 60

Full Marks: 100
Annual Exam.: 80
Internal Exam.: 20

Rationale:

Objective:

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Total: (60)
CONTENTS:

TOPIC: 01 – REFRACTORY INDUSTRY:

01.01 (a) Status and Scope of Indian Industry :-
Growth Pattern and historical background, Production and demand, Future Plan and R and D.
(b) Lay out of modern Refractory Plant.

TOPIC: 02 – TESTING AND QUALITY CONTROL:

02.01 Bulk density, Porosity, Apparent Porosity, True Porosity, Water absorption, Apparent Specific Gravity, Permeability Refractoriness (P.C.E.), Refractoriness Under Load (R. U. L.) Stag attack, Resistance to thermal Shocks, Cold Crushing Strength.

TOPIC: 03 – PROCESS OF MANUFACTURE, PROPERTIES AND USE:

03.01 Acid refractory :- Fire Clay, Alumino-Silicate, Kyanite Sillimanite and Silica refractories.
03.02 Basic refractory :- Magnesite, Chrome magnisite, Magnisite Chrome, Dolomite and Forstirile refractories.
03.03 Neutral refractory :- Chromite, Carbon, Graphite and Silicon Carbide refractories.
03.04 Special :- Alumina, Zirconia, Thoria, Zircon and Spinel, Refractory Cement and Mortar Castables, Asbestos, Insulator.
TOPIC: 04 – APPLICATIONS:

04.01 Iron and Steel: - Blast Furnace, Steel melting, including open hearth, Electric melting, Casting Pit, Mill houses, Soaking Pits and Rehrating Furnace.

04.02 Gas Plants: - Coke-ovens and Producer Gas, Plants.

04.03 Power Plants: - Boilers, Stationary and movable like loco and naval ships.

04.04 Non-Ferrous Metals: - Aluminium, Copper, Nickel, Lead and Zinc Industries.

04.05 Ceramics: - Pottery, Refractory and Glass Industries.

04.06 Cement and Chemicals: - Portland Cement, Basic Chemical, Fertilizer and Petro Chemical Industries.

Books Recommended:

1. Refractories and their manufacture, Properties and uses. - M. L. Mishra

SCHEME OF EXAMINATION FOR FINAL EXAMINATION

F.M. : 80

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Glass Technology-II

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Total: (60)
CONTENTS:

TOPIC: 01 – LAYOUT OF MODERN GLASS PLANT:

01.01 Glass Manufacture:-

TOPIC: 02 – TESTING AND QUALITY CONTROL:

02.01 Sieve analysis, Purity, Density, Chemical durability, Viscosity, Thermal expansion, Thermal Stress and Strain, Strength of glass, Annealing of glass, Devetrification, Softening Points, Bursting Pressure and Thermal Shock Resistance.

TOPIC: 03 – GLASS FORMING MACHINE:

03.01 Hand Operation, Forehearth and Feeder, Machines for Blown Ware, Press machines, Moulds.

TOPIC: 04 – MANUFACTURE OF GLASS:

04.01 Glass-bottles, Rods, Tubes, Bangles, Sheet glass, Plate glass, Rolled glass, Float Glass.
TOPIC: 05 – DEFECTS IN GLASS: (Their Causes and Remedies)

05.01 Seeds and Blisters, Cords, Striae, Strain, Stones sources of trouble and their elimination.

TOPIC: 06 – DECORATION OF GLASS:

06.01 Etching, Sand Blasting, Selvering, Straining.

TOPIC: 07 – SPECIAL GLASSES:

07.01 Heat resistant glass, Fibre glass, Glass-ceramics, Optical Glass, Opthalmic glass, Glass Wool, Toughned glass, Laminated Safety glass, Glasses for Electrical and Electronic Industries.

Books Recommended:


SCHEME OF EXAMINATION FOR FINAL EXAMINATION

F.M. : 80

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Rationale:

Cement is termed as basic material required for developing infrastructure of any country. Besides taking care of the construction activities, it also becomes the parameter of development of any country. Various types of cement is required in the construction of buildings, bridges, dams, oil installation, factories etc., a through study of this subject is quite essential for the Diploma students in Ceramic Engineering.

Objective:

The objective in general is to :-

1. Understand the role & use of lime & cement.
2. Understand various type of cement.
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<td>Raw materials and Preparation.</td>
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**CONTENTS:**

**TOPIC: 01 – INTRODUCTION OF LIME AND CEMENT:**

01.01 Origin and development of lime industries.
01.02 Origin and development of cement industries.

**TOPIC: 02 – CLASSIFICATION OF LIME AND CEMENT:**

02.01 Classification of lime.
02.02 Classification of cement.

**TOPIC: 03 – RAW MATERIALS AND PREPARATION:**

03.01 **Raw materials for lime**: selection and proportioning.
03.02 **Raw materials for Cement**: selection and proportioning.
03.03 Preparation of raw materials; Crushing and Grinding, Blending and Beneficiation.
TOPIC: 04 – PLANT AND MACHINERY EMPLOYED:

04.01 Crushers and grinders.
04.02 Screening, Silos, Conveyers.
04.03 **Kilns:** Shaft Kilns, Rotary Kilns, Conventional Kilns,
        Refractories used is being of Kilns.
04.04 Dust Extractor, Pollution Control System.
04.05 Packaging and Dispatch.

TOPIC: 05 – LIME AND CEMENT MANUFACTURE:

05.01 Lime manufacture.
05.02 Cement Manufacture: Portland Cement, Pozzolons Cement,
        Slag Cement, Quick setting Cement, Rapid Hardening
        Cement, Low Heat Cement, High Alumina Cement, Sorrel
        Cement, White & Coloured Cement, Oil Well Cement,
        Hydrophobic Cement, Iron-ore Cement, Water-proof Cement,
        Sulphate Resisting Cement, Acid proof Cement, Super-
        sulphate Cement.

TOPIC: 06 – PROPERTIES, TESTS AND USES:

06.01 Physical and mechanical properties.
06.02 Effect of raw materials & constituents as the properties of
        Portland cement.
06.03 Various tests as per J. S. I. or A S T M.
06.04 Uses of cement.

TOPIC: 07 – APPLICATION TECHNOLOGY OF CEMENT:

07.01 Application while brick saying.
07.02 Casting, grinding, concreting.
07.03 Ramming & other applications.
TOPIC: 08 – OTHER ALLIED PRODUCTS:

08.01 Gypsum, Plaster of Paris.
08.02 Lime associated products.
08.03 Mosaic tiles.
08.04 Reinforced products such as pipes, precast concrete products, Railway sleepers.
08.05 Asbestos Sheets, Pipes.
08.06 Colours, Accelerators, Retarders, Water proofing materials.
08.07 Clinker.

Books Recommended:

   Company Inc., Indiana, U. S. A.

SCHEME OF EXAMINATION FOR FINAL EXAMINATION

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The above table refers to the annual examinations only.
Fuel and Furnace Technology

Subject Code
03306

Theory

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Rationale:

Objective:

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<td>Types of Furnaces and Kilns used in Ceramic Industries.</td>
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Total: (50)
CONTENTS:

TOPIC: 01 – INTRODUCTION:

01.01 General Introduction, fuel resource in India, Utility of fuel for Ceramic Industry.

TOPIC: 02 – CLASSIFICATION OF FUELS:

02.01 Solid Fuel :-
Coal- Origin of coal, Geological theories of formation of coal.
Classification-Rank and grading of coal. Handling and storage of coal, Washing of coal.
02.02 Liquid Fuel.
02.03 Gaseous Fuel :- Producer gas, Water gas, Coke-oven gas- their properties and uses.

TOPIC: 03 – TESTING:

03.01 Calorific Value:- Bomb Calorimeter and Gas Calorimeter.
03.02 Analysis of Coal:- Proximate and ultimate analysis.
03.03 Analysis of Gaseous Fuels:- Determination of various constituents by orsate apparatus.
03.04 Liquid Fuels :- Distillation, Flow Point, Flash-Point and Viscosity.

TOPIC: 04 – COMBUSTION:

04.01 Chemistry of Combustion, Combustion calculation pertaining to solid, liquid and gaseous fuel.
TOPIC: 05 – TYPES OF FURNACES AND KILNS USED IN CERAMIC INDUSTRIES:

05.01 Cement, Enamel, Pottery, Refractory Glass.

TOPIC: 06 – HEAT TRANSFER:

06.01 **Heat Transfer to Charge** :- Conduction convection and radiation in furnace chamber, Flow of heat through a furnace wall.
06.02 **Heat Loss**.
06.03 **Heat Balance**.

TOPIC: 07 – HEAT RECOVERY:

07.01 **Regnurators**.
- Principle of operation.
- Factor Governing heat transfer.
- Efficiency.
- Uses.
07.02 **Recuperator**.
- Principle of operation.
- Factor Governing heat transfer.
- Efficiency.
- Uses.

Books Recommended:

2. Industrial Furnace, Vol.-I and II. - W. Trinks and Mawhinney
### Scheme of Examination for Final Examination

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Rationale:

Drawing is the language of Engineering Professionals and therefore for ceramic professional the subject is all the more important. The subject imparts skill and understanding of the technical language presented through drawings. The knowledge of drawing will help the professional in designing the equipments and kilns desired in Ceramic Industries.

Objective:

The students will develop the skill :-

(i) To read and understand the drawing.
(ii) To understand design aspects of plant and equipment and Kilns.
(iii) To understand design aspects of products.
(iv) To impart ideas, convey informations and specify shapes through drawing.
S.No.  | Topics                                      | Periods |
-------|---------------------------------------------|---------|
01     | General concept of drawing.                 |         |
02     | Ceramic Products.                           |         |
03     | Ceramic Plant and Machinery.                |         |
04     | Ceramic Driers/Kilns/Furnaces.              |         |
05     | Plant Layout drawings.                      |         |

Total: (120)

CONTENTS:

**TOPIC: 01 – GENERAL CONCEPT OF DRAWING:**

01.01 Study of drawings / Prints / Sketches.
01.02 Study of various ceramic products / machinery / Driers / Kilns and Plant Layout.

**TOPIC: 02 – CERAMIC PRODUCTS:**

02.01 **Refractory Bricks**: Standard, Side Arch, End Arch, Shapes, Nozzles, Sleeves, Stoppers, Zig-zag bricks for roof.
02.02 **Pottery**: Ash tray, Cup & Saucer, Dinner Plate, Flower vase, Tea pots, Mugs, Jugs, Tiles, Wash Basin, Indian Pan, European Commode, Insulators, Pipes.
02.03 **Glass**: Jug, Glass, Bulb, Tube Light, TV tube, Bottle, Rods, Syringe, Prism, Lens, Sheet Glass, corrugated glass.
02.04 **Electronic Ceramics**: Carbon film resistors, Ceramic Capacitors.
**TOPIC: 03 – CERAMIC PLANT AND MACHINERY:**

03.01 **Crushing and Grinding Machinery**: Jaw Crusher, Gyratory Crusher, roll Crusher, Cone Crusher, Muller Mixer, Ball Mill, Tube Mill, Rod Mill.

03.02 **Screens**: Vibrators, Screening equipment. Blungers, Agitators, Diaphragm pump, Filter press.

03.03 Jigger and Jolley, Potters Wheel, Shaping Machine.

03.04 Screw Press, Automatic Press, Toggle Press.

**TOPIC: 04 – CERAMIC DRIERS / KILNS / FURNACES:**

04.01 **Driers**: Hot floor, Chamber Drier, Tunnel Drier, Dehumidifier.

04.02 **Kilns / Furnaces**: Bottle Kiln, Up draft Kiln, Down draft Kiln, Muffle Kiln, Shuttle Kiln, Tunnel Kiln, Shaft Kiln, Chamber Kiln, Glass Melting Furnaces, Electric Furnaces, Induction Furnaces.

**TOPIC: 05 – PLANT LAYOUT DRAWINGS:**

05.01 Plant Layout for a: Crockery Plant, Tiles Plant, Sanitary Wave Plant.

05.02 Plate Layout for a: Glass bottle plant, Glass tumbler plant, Sheet glass plant.

05.03 Plant Layout for a: Enamel Plant, Cement Plant, Refractory Plant.
Books Recommended:


SCHEME OF EXAMINATION FOR FINAL EXAMINATION  

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Rationale :

Present century is moving towards a technologically advanced arena where electronics is playing a major role and electronics and modern ceramics are playing a big and critical role in the advancement and achievement of competitive and durable products. Electronics and modern ceramics has been selected as a theory paper to deal with various modern and contemporary components and products used in the development key sectors such as communications, power, Nuclear etc. The students will lay their hands on the developing technology to copy up with the changes and needs of the world in the field of High technology.

Objective:

The students will be able to :-

(i) Understand electronic & modern ceramic components and products.
(ii) Understand various key topics dealt while dealing with the subject.
(iii) Understand high temperature ceramics, cermets, Ceramics components, Nuclear & magnetic ceramics etc.
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<td>02</td>
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<td>Modern Ceramic</td>
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**Total : (50)**

**CONTENTS:**

**TOPIC: 01 – INTRODUCTION:**

01.01 Introduction and concept of electronics & modern ceramics.
01.02 Classification basis.

**TOPIC: 02 – ELECTRONIC CERAMIC COMPONENTS AND PRODUCTS:**

02.01 Resistors.
02.02 Capacitors.
02.03 *Other Components*: Piezo Electric, Quartz Crystal, Ferrites etc.
02.04 Optical Fibre.
02.05 TV tube.

**TOPIC: 03 – MODERN CERAMIC:**

03.01 High Temperature Ceramics such as:
- **Oxides**: Beryvia, Magnesia, Titania, Thoria, Urania etc.
- **Non-Oxides**: Carbon, Carbides, Nitrides, Slicides, Borides etc.
03.02 Abrsives and grinding wheels.
03.03 Ceramic tools (for cutting etc.).
03.04 Cermets.
03.05 Nuclear Power Sector Ceramics.
03.06 Ceramics Fibres.
03.07 Steatite and Cordierite bodies.
03.08 Ceramic coatings, metallised ceramics etc.

Books Recommended:

   London.

SCHEME OF EXAMINATION FOR FINAL EXAMINATION

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The above table refers to the annual examinations only.
**Rationale:**

Enamel Technology is an important organ of Ceramics Engineering. Not only this branch dominated in the area of utensils, decorative pieces etc. in olden days, but it also has shown its relevance in modern technology. Enamelling is carried out in electrical and electronic products. Since it is mainly a glassy layer applied over a base material, it produces all the properties of glass and thus acquires top usefulness in domestic as well as industrial uses. For Diploma students it is designed to impart modern technological aspects of Enamel suiting to the present time.

**Objective:**

The objective in general is to achieve :-

(i) Understanding the subject thoroughly.
(ii) Understanding its deeper impact in Electrical & Electronic product making.
(iii) R & D efforts knowledge base for future development.
S.No. | Topics                                                                 | Periods |
---|------------------------------------------------------------------------|---------|
01  | Introduction.                                                          |         |
02  | Properties of Enamel and Tests.                                       |         |
03  | Theory of Adherence and Pickling.                                     |         |
04  | Special Processes and Control.                                        |         |
05  | Equipments for Enamelling & Decorations.                              |         |
06  | Enamelling Furnaces and Effects of Furnace Atmosphere.                |         |
07  | Enamel Calculations.                                                  |         |

Total : (50)

CONTENTS:

**TOPIC: 01 – INTRODUCTION:**

01.01 Enamel, Low fusing glasses.  
01.02 Various uses of Enamel.

**TOPIC: 02 – PROPERTIES OF ENAMEL AND TESTS:**

02.01 Thermal Properties.  
02.02 Optical Properties.  
02.03 Physical and Mechanical Properties.  
02.04 Chemical and Electrical Properties.

**TOPIC: 03 – THEORY OF ADHERENCE AND PICKLING:**

03.01 Theory of Adherence.  
03.02 Theory of Pickling.  
03.03 Methods and materials used for pickling.
TOPIC: 04 – SPECIAL PROCESSES AND CONTROL:

04.01 Special Processes:
- Nickel Dip.
- Pickling Accelerators.
- Nickel Reduction process.
- Pre Namel Process.
- Nickel Oxide Spray Process.
- The Hydrogen Treating Process.
- Process adopted on Components.
- Other Processes.

04.02 Control:
- Theory.
- Cleaner Control.
- Neutraliser solution and Pickle Acid Control.
- Other Controls.

TOPIC: 05 – EQUIPMENTS FOR ENAMELLING & DECORATIONS:

05.01 Equipments for:
- Preparation of raw materials.
- Applications.
- Drying and Brushing.
- Decoration.

TOPIC: 06 – ENAMELLING FURNACES AND EFFECTS OF FURNACE ATMOSPHERE:

06.01 Enamelling furnaces
- Box type Furnaces.
- Continuous Enamelling Furnaces.

06.02 Effects of Furnaces Atmospheres.
TOPIC: 07 – ENAMEL CALCULATIONS:

07.01 Various calculations adopted in Enamel Industries.

Books Recommended:

2. Technology of Enamel. - V. V. Vargin.

SCHEME OF EXAMINATION FOR FINAL EXAMINATION  F.M. : 80

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The above table refers to the annual examinations only.
Modern Refractory Technology
(Elective)

Subject Code
03310A

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Rationale:

This subject has been kept as an elective subject for Part-III Diploma students of Ceramic Engineering mainly to converse them with the new development taking place in the field of refractories. With R & D as the base, the refractory industries have gone to a significant change in its technology cope up with the changing needs of the industry. Nearly 60% of the raw materials used in steel plant are only refractories and so even 1 to 5 % savings in refractories speak a lot on the profitability. This in fact has put the focus on ceramic engineers to work hard and contribute towards new development with a view to bring high profitability highly competitive global market.

Objective:

This course will facilitate in :-

(i) Understanding refractories of 21st century.
(ii) Developing the professionals to thrive on challenges pored by user industries.
(iii) Understand new type of refractories developed for various user.
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<thead>
<tr>
<th>S.No.</th>
<th>Topics</th>
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<tr>
<td>01</td>
<td>Introduction.</td>
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<td>02</td>
<td>Status and Future Prospects.</td>
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<td>03</td>
<td>R &amp; D Activities in the country.</td>
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<td>04</td>
<td>Recent Trends in Refractory Applications and Technology.</td>
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<td>05</td>
<td>Technology Upgradation.</td>
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<td>06</td>
<td>Project Work and Seminar.</td>
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**Total: (60)**

**CONTENTS:**

**TOPIC: 01 – INTRODUCTION:**

01.01 General.
01.02 Classification of Refractories.
01.03 Raw materials-Availability & uses.
01.04 Plant and machinery.
01.05 Production Places.
01.06 User industries.

**TOPIC: 02 – STATUS AND FUTURE PROSPECTS:**

02.01 History of development.
02.02 Various units, Regional distribution.
02.03 Government Policies.
02.04 Installed Capacity & Production.
02.05 Futures Prospects.
TOPIC: 03 – R & D ACTIVITIES IN THE COUNTRY:

03.01 C G C R I.
03.02 N M L.
03.03 Steel Plant Laboratories.
03.04 Refractory Plant Laboratories.

TOPIC: 04 – RECENT TRENDS IN REFRACTORY APPLICATIONS AND TECHNOLOGY:

04.01 Steel Plant.
04.02 Non ferrous industries.
04.03 Chemical Industries.
04.04 Petrochemical Industries.
04.05 Other Industries.
04.06 World Trends.
04.07 Emerging Trends in India.
04.08 Factors effecting selection and application of Refractories emphasising techno-economic aspect.

TOPIC: 05 – TECHNOLOGY UPGRADATION:

05.01 In raw material processing.
05.02 Plant and Machinery.
05.03 Research and Development.
05.04 Quality Control.
05.05 Standardisation.
05.06 Skill Development.

TOPIC: 06 – PROJECT WORK AND SEMINAR:

This will follow as prepared for Part-III Ceramic Engineering.
Books Recommended:

1. Refractories, Smt. Lakshmi Devi, Jamshedpur - M. L. Mishra
5. Journals:
   - Indian Ceramic Society - C G C R I, Calcutta
   - Indian Refractory Manufactories Association - I R M A, Calcutta
   - American Ceramic Society - U. S. A
   - British Ceramic Society - U. K.

SCHEME OF EXAMINATION FOR FINAL EXAMINATION  
F.M. : 80

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The above table refers to the annual examinations only.
Modern Furnace Technology
(Elective)

Subject Code
03310B

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No. of Periods in one session: 60

Rationale:

The subject has been taken as an elective considering the very importance of Furnaces used in Ceramic and other industries. The subject deals with entire aspects of Furnaces such as its construction, combustion, Heat transfer in the furnace, Fuel used in the furnace, Fuel economy, Strength & durability of the furnace, Heat releasing equipments, Furnace using Industries, Heat exchanges, material of construction used in a furnace etc. The subject has been designed to provide all the necessary knowledge required to the students about furnaces, which become an important organ of any industry.

Objective:

The objective in general to achieve will be to:

(i) Understand the furnace with its role and use.
(ii) Understand the basic principle of operation.
(iii) Understand fuel economy in furnace operation which is very important.
(iv) Understand the use of refractories to achieve economy.
(v) Understand various type of furnaces used in industries.
S.No. | Topics                                                                 | Periods |
-------|------------------------------------------------------------------------|---------|
01     | Introduction.                                                          |         |
02     | Classification of Furnaces.                                            |         |
03     | Combustion.                                                            |         |
04     | Heat Transfer.                                                         |         |
06     | Solution of Heat Transfer.                                             |         |
07     | Fuel and Fuel Economy.                                                 |         |
08     | Heat Exchange.                                                         |         |
09     | Furnace Construction.                                                  |         |
10     | Control of Furnace Temperature and Atmosphere.                         |         |
11     | Diagnostic Study of a Furnace.                                         |         |
12     | Safety Measures.                                                       |         |
13     | Project Work and Seminar.                                              |         |

Total: (60)

CONTENTS:

**TOPIC: 01 – INTRODUCTION:**

01.01 Definition of a furnace and general description.
01.02 Function of a furnace.
01.03 Typical Industrial Furnaces.

**TOPIC: 02 – CLASSIFICATION OF FURNACES:**

02.01 **Furnaces used in Ceramic Industries such as:**
Pottery, Glass, Enamel, Refractory, Electronic Ceramics, Cement & Lime etc.

02.02 **Furnaces used in Iron & Steel Industries such as:**
Blast Furnace, Open hearth Converters, Electric Furnace, Re-heating Furnaces, Soaking Pits, Annealing Furnaces etc.
02.03 **Furnaces used in other non Ferrous Industries such as:**
Aluminium, Copper, Alloys etc.

02.04 **Furnaces used in Industries such as:**
Chemical, Petrochemical, Boiler, Regenerators, Recuperators, Dryers, Coke ovens.

**TOPIC: 03 – COMBUSTION:**

03.01 Heat of Combustion.
03.02 Specific heat and sensible heat.
03.03 Control of Combustion.
03.04 Available Heat.
03.05 Flue Gas analysis.
03.06 Flames & flame temperature.
03.07 Characteristics of Industrial Fuels.

**TOPIC: 04 – HEAT TRANSFER:**

04.01 Conduction.
04.02 Convection.
04.03 Radiation from Surfaces.
04.04 Heat loss.
04.05 Gas Radiation.
04.06 Heat Flow.

**TOPIC: 05 – GAS FLOW AND PROCESS BALANCE SHEETS:**

05.01 Introduction.
05.02 Gas Laws, nomograms.
05.03 Streamline and Turbulent Flow.
05.04 Energy of Gases.
05.05 Friction by Change, Energy Loss.
05.06 Buoyancy, Draught, Gas Leakage.
05.07  Gas Pressure & flow.

**TOPIC: 06 – SOLUTION OF HEAT TRANSFER:**

06.01  **Heat transfer through a Wall:**
Standard brick equivalent.
06.02  Heat loss by gas leakage.
06.03  Unsteady Heat Flow- Heat Storage.
06.04  Heat loss in Foundation, Water Cooling, through Openings, in complete Combustion.
06.05  Heat Transfer to stock.

**TOPIC: 07 – FUEL AND FUEL ECONOMY:**

07.01  **Types of Fuel used in a Furnace:**
Solid, Liquid, Gaseous,  Atomic or Special.
07.02  Furnace Efficiency and Distribution of Heat.
07.03  Effective fuel economy in various furnaces.

**TOPIC: 08 – HEAT EXCHANGE:**

08.01  Recuperators.
08.02  Regenerators.

**TOPIC: 09 – FURNACE CONSTRUCTION:**

09.01  Elements of Furnace Construction.
09.02  **Material of Construction:**
Steel, Cast Iron, Refractories, Cement, Brick etc.
09.03  Principle of Wall, Crown Construction and internal Walls.
09.04  Brick & Expansion joints in Construction and other measures taken during construction.
TOPIC: 10 – CONTROL OF FURNACE TEMPERATURE AND ATMOSPHERE:

10.01 Means of maintaining a given temperature.
10.02 Devices used in measuring temperature.
10.03 Control of Furnace Atmosphere and Pressure.
10.04 Effects of Furnace Atmosphere.

TOPIC: 11 – DIAGNOSTIC STUDY OF A FURNACE:

11.01 General idea on various probes conducted on:
Gas sampling, Gas temperature, Heat flow, using instruments.
11.02 Furnace instrumentation -A general idea
11.03 Modification suggestions to improve furnace efficiency & fuel economy with example.

TOPIC: 12 – SAFETY MEASURES:

12.01 General idea on safety measures adopted, for preventing explosion, Pilot flames, Safety Shutoff valves, Factory manual lock etc.

TOPIC: 13 – PROJECT WORK AND SEMINAR:

As prepared separately for Part-III Ceramic Engineering.

Books Recommended:

Text Books:

Reference Books:

   U. S. A.

SCHEME OF EXAMINATION FOR FINAL EXAMINATION

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The above table refers to the annual examinations only.
Instrumentation and Automatic Process Control
(Elective)

Subject Code
03310C

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Annual Exam. : 80
Internal Exam. : 20

Rationale :

Objective:

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Total : (60)
CONTENTS:

TOPIC: 01 – INSTRUMENTS:

01.01 General Principle of industrial instruments.
01.02 Measurements:
  ♦ Fluidity.
  ♦ Mass/Weight.
  ♦ Temperature.
  ♦ Pyro meters.
  ♦ Pressure.
  ♦ Flow.
  ♦ Velocity.
  ♦ Level.

TOPIC: 02 – AUTOMATIC PROCESS CONTROL:

02.01 Type of Automatic Process Control System.
02.02 Automatic Controls on:
  Mechanical, Hydraulic, Pneumatic, Electricals, Electronics System.
02.03 Flow measurements.
02.04 On-off, Proportional and integral control system.

TOPIC: 03 – PROJECT WORK AND SEMINAR:

This will be followed as given in this subject for Part-III.
Books Recommended:


SCHEME OF EXAMINATION FOR FINAL EXAMINATION

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Ceramic Engineering Workshop Practice-III (Pottery and Refractory)

Subject Code: 03311

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01 Selection of Raw materials and Preparation.
02 Compounding of different types of bodies.
03 **Shaping of Pottery wares:**
   (a) Hand Moulding.
   (b) Throwing.
   (c) Digger-Jolleying.
   (d) Pressing.
   (e) Slip Casting.
04 Preparation of Colour and Strains.
05 Decoration.
06 Application of Glaze.
07 Green Wave Finishing.
08 Drying, Firing and Inspection.
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<td>Selection of Raw materials for all kinds of Refractory.</td>
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<td>Compounding of Materials.</td>
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<td>11</td>
<td><strong>Shaping of Refractories of different shapes and sizes:</strong></td>
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<td>(a) Hand Moulding.</td>
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<td>(b) Extrusion Process.</td>
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<td>(c) Stiff Plastic Process.</td>
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<td>(d) Slip Casting.</td>
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<td>(e) Semi Dry-Pressing.</td>
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<td>Green Finishing and Drying.</td>
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<td>Firing and Inspection.</td>
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Ceramic Engineering Workshop Practice-IV
(Glass and Enamel)

Subject Code: 03312

Practical

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Rationale & Objective:

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<td>Glass</td>
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<tr>
<td>01</td>
<td>Preparation of coloured glass batches.</td>
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<tr>
<td>02</td>
<td>Melting of Glass batches.</td>
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<tr>
<td>03</td>
<td>Forming of different glass wares by blowing and pressing.</td>
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<tr>
<td>04</td>
<td>Polishing of glasses.</td>
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<td><strong>Decoration of Glass wares:</strong></td>
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<tr>
<td></td>
<td>(a) Etching.</td>
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<td>(b) Silvering.</td>
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<td>(c) Staining.</td>
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<td>(d) Sand Blasting.</td>
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Enamel

06 Compounding of different Enamel batch.
07 Fritting and Milling.
08 Cleaning and Nickelling of Metal surface.
09 Application of Enamel.
10 Firing of Enamel Wares.
11 Study of Enamel defects.

Total:-(60)

SCHEME OF EXAMINATION FOR FINAL EXAMINATION

F.M. : 40
Ceramic Engineering Lab.-II

Subject Code: 03313

No. of Periods in one session: 60

No. of Periods per week:

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Full Marks: 50
Annual Exam.: 40
Internal Exam.: 10

Rationale & Objective:

S.No. | Topics                                                                 | Periods |
-------|------------------------------------------------------------------------|---------|
01     | To determine true and apparent porosity.                               |         |
02     | To determine Cold Crushing Strength.                                  |         |
03     | To determine Refractoriness under load.                               |         |
04     | To determine Pyometric Cone equivalent.                               |         |
05     | To determine Moisture content of Plastic mass by Speedy balance.       |         |
06     | To determine Spalling resistance.                                     |         |
07     | To determine Thermal Expansion.                                       |         |

Refractory
Pottery

08 To determine moisture content of clay.
09 To determine the pH value of Casting Slip.
10 To determine Tensile Strength.
11 To determine the flow and rolling limit of clay.

Enamel

12 Adherence Test.
13 Hardness Test.

Glass

14 To determine chemical durability.
15 To determine Bursting pressure of glass bottle.
16 Low temperature viscosity.

Total:- (60)

SCHEME OF EXAMINATION FOR FINAL EXAMINATION F.M. : 40
Ceramics Engineering Drawing

Subject Code
03314

Sessional

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Rationale:

Same as given in the main theory paper for Ceramics Engineering Drawing (Sub Code-03307)

Objective:

Same as given in the main theory paper for Ceramics Engineering Drawing (Sub Code-03307)

CONTENTS:

Same as given in the main theory paper for Ceramics Engineering Drawing (Sub Code-03307)
Modern Refractory Technology
(Elective)

Subject Code
03316A

Sessional

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No. of Periods in one session
60

No. of Periods per week

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Rationale:

Same as given in Elective Theory Papers (Subject Code-03310A)

Objective:

Same as given in Elective Theory Papers (Subject Code-03310A)

CONTENTS:

Same as given in Elective Theory Papers (Subject Code-03310A)
Modern Furnace Technology
(Elective)

Subject Code
03316B

Sessional

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No. of Periods in one session
60

Rationale:

Same as given in Elective Theory Papers (Subject Code-03310B)

Objective:

Same as given in Elective Theory Papers (Subject Code-03310B)

CONTENTS:

Same as given in Elective Theory Papers (Subject Code-03310B)
Instrumentation and Automatic Process Control
(Elective)

Subject Code
03316C

Sessional

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<th>Annual Exam.</th>
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<td>30</td>
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<tr>
<td>0 0 3</td>
<td></td>
<td>20</td>
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No. of Periods in one session
60

Rationale:

Same as given in Elective Theory Papers (Subject Code-03310C)

Objective:

Same as given in Elective Theory Papers (Subject Code-03310C)

CONTENTS:

Same as given in Elective Theory Papers (Subject Code-03310C)
Project Work and its Presentation in Seminar

Subject Code
03317

Sessional

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Rationale:

Project work and its presentation in seminar has been kept in the curriculum to provide an opportunity to the final year students to develop skill in preparing project work and be eligible to give its presentation in a seminar with full and extensive understanding of the subject. This exercise not only develop communication skill, but it also generates confidence to the students in presenting the project to the audience. It provides an opportunity to discuss the project with an open mind with an intention to improve upon quality of the project. Technique to produce a quality report is also develop.

Objective:

The objective is to achieve:

- Trained professionals for handling a project.
- Knowledge to build a strong data base for the project.
- Skill of quality documentation.
- Interaction skill.
- Skill to give good and impressive presentation.
S.No. | Topics | Periods
--- | --- | ---
01 | Selection of a Project. | 
02 | Preparation of Data base. | 
03 | Draft Report Writing | 
04 | Presentation in Seminar. | 
05 | Final Report. | 

**CONTENTS**

**TOPIC: 01 – SELECTION OF A PROJECT:**

01.01 This exercise should be carried out in association with the Professor concerned, and a suitable Project should be selected related to that particular branch of Engineering. Allotment of Project Work should be done preferably in the beginning of the session to the students to give them ample time for its formation.

**TOPIC: 02 – PREPARATION OF DATA BASE:**

- Visit to Project, if required.
- Collection of datas.
- Compilation of datas.
- Analysis and Assimilation of Data.

**TOPIC: 03 – DRAFT REPORT WRITING:**

One draft report will be prepared either on new project or on existing project.
03.01  **New Project**

This should include:

- Introduction.
- Design/Technical aspect.
- Materials requirement.
- Cost of inputs such as materials & other such as power, fuel etc.
- Implementation Schedule.
- Operation Cost.
- Process of manufacture/Assembly/Fabrication.
- Plant & Machinery.
- Project estimate if required in brief.
- Conclusion.

03.02  **Existing Project**

This will be deal with problem related areas in any one of the following:

- Technical.
- Human Relation.
- Welfare.
- Safety.
- Any other.

Report should include:

- Introduction.
- Problem details (identified for the project).
• Details of plant/works/institution towards:
  ♦ Technical.
  ♦ Management.
  ♦ Marketing.
  ♦ Financial & Commercial.
  ♦ Profitability (Profit/Loss).

• Reason for selecting the problem.
• Analysis and Remedy.
• Conclusion.

**TOPIC: 04 – PRESENTATION IN SEMINAR:**

• Presentation of Draft, Project Report.
• Discussion on Project.
• Record of useful suggestions for incorporation in the report.

**TOPIC: 05 – FINAL REPORT:**

• Report Finalisation after incorporating changes.
• Preparation of Final Report.
• Submission of the Project Work Report for Sessional.

**SCHEME OF EXAMINATION**

1. Project Selection.
2. Project Work.
Inplant Training and Visit to Works

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Sessional</th>
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No. of Periods
per week

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<th>L</th>
<th>T</th>
<th>P/S</th>
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Full Marks : 100
Annual Exam. : 60
Internal Exam. : 40

Rationale:

In Plant Training and Visit to work has been kept in the curriculum mainly to impart practical knowledge to the students by getting them exposed to industries/Institutions. This gives the students opportunity to know technical, managerial, marketing, quality control, finance and accounts aspects being carried out in the works. They come to know about vocational advantage, plant layout, plant & machinery, manufacturing process, R & D besides management & manpower, market, commercial aspects. They also come across problems faced by the Industries and put their minds towards their possible remedies. And so, the students get access to the practical and demonstrative aspect of theory applied in an industry/Institution.

Objective:

The objective is to achieve:

- First hard exposure of the student towards Ceramic Industries/Institutions.
- Knowledge on the availability and source of raw materials, plant and machinery, manufacturing process etc.
- Knowledge of management & controls.
- Knowledge of problem areas & possible remedies.
S.No. | Topics
---|---
01 | Inplant Training.
02 | Visit to Works.

CONTENTS

**TOPIC: 01 – INPLANT TRAINING:**

01.01 Introduction.

01.02 Name of the Plant/Organisation with address details.

01.03 Location.

01.04 **Manpower and management details.**

- Total manpower.
- Details of managers including Chief Executive Officers.
- Supervision.
- Skilled labours.
- Unskilled labours.
- Others.

**Note:** Department/Shop wise details to be taken.
01.05 **Technical details.**

- Raw Materials/Software/Hardware details such as name, source, price, requirement etc.
- Raw mix details (Composition).
- Plant and Machinery/Equipments.
- Manufacturing Process/Operational details.
- Product mix.
- Quality Control.
- Inspection, Packing and Dispatch.

01.06 **Sales/Marketing details.**

- Selling Price of the Products/Services.
- Annual Turnover.
- Marketing Technique adopted.
- Competitors.
- Standing of the Company in the market.

01.07 **Financial and Commercial details.**

- Annual expenses on raw materials/software/hardware, salary & wages, Fuel, power, consumable, maintenance & others.
- Profit.

01.08 **Diagnostic Study.**

- Problem areas in any field.
- Possible remedy (This should include the remedial methods adopted by the plant and the suggestions put forward by the student).
01.09  Report Writing :

Covering all the aspects from 01.01 to 01.08, a “REPORT ON INPLANT TRAINING” should be written and submitted towards sessional

Note:  Inplant Training should be carried out in the concerned Industry of the particular branch of Engineering.

TOPIC: 02 – VISIT TO WORKS:

02.01  The visit will be carried out in the related branch of Engineering concerning works or institutions. It is preferable to visit big industries/organisations which are for the students of all the branches. (e.g. Steel Plant, Cement Plant, Atomic Energy installations, Power stations etc.)

02.02  The Visit to works will include:

02.02.01  Introduction.
02.02.02  Name of the works with address details.
02.02.03  Location.
02.02.04  Manpower & Management details (as given in Inplant Training).
02.02.05  Technical details (as given in Inplant Training).
02.02.06  Sales/Marketing details in brief.
02.02.07  Financial & Commercial details in brief.
02.02.08  Problem areas, if any, with possible remedy in brief.
02.02.09  Report writing covering 02.02.01 to 02.02.08 stated above for submission towards sessional.
Note: There will be separate reports for submission by the students for:

1. “INPLANT TRAINING” REPORT.

&

2. “VISIT TO WORKS” REPORT.

SCHEME OF EXAMINATION

Marks Distribution

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<tr>
<td><strong>Internal</strong></td>
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<td>40 %</td>
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<td>Regularity</td>
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<td>Report</td>
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<tr>
<td>Viva</td>
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| **External** |        | 60 %   |
| Report/Journal |        | 20 %   |
| Viva         |        | 40 %   |
## Scheme of Teaching and Examination for 3-years
### PART-III DIPLOMA in CERAMICS ENGINEERING

### THEORY

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>SUBJECTS</th>
<th>SUBJECT CODE</th>
<th>TEACHING SCHEME</th>
<th>EXAMINATION - SCHEME</th>
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<td>Periods per week</td>
<td>Periods in one session (Year)</td>
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<td>2.</td>
<td>Pottery &amp; Porcelain Technology – II</td>
<td>03302</td>
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<td>3.</td>
<td>Refractory Technology – II</td>
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<td>4.</td>
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<td>9.</td>
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Total Periods per week 28
Total Marks :- 1000

### PRACTICAL

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Total Periods per week 09
Total Marks:- 150
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Total Periods per week = 42  
Total Marks :- 1500
COURSE OF STUDY

FOR

PART - III Diploma

IN

Ceramics Engineering

THREE YEARS DIPLOMA COURSE