

## CHEMISTRY OF CERAMIC MATERIALS

**Period/Week: 4 Hours**  
**Theory : 60 period**

**Theory Exam : 3Hrs.**  
**End Term Exam: 80**  
**I.A. : 15 + 5 = 20**  
**Total : 100**

**Objectives :**

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

1. Know about the relation between ceramics and Thermodynamics.
2. Know about the fundamentals of phase diagram and its application in ceramics.
3. Understand colloids and its requirements in ceramics industry.
4. Understand thermal analysis of ceramic raw materials.
5. Understand Metal and Mineral extraction.

Topic wise distribution of periods

SI. No.	Main Topics	Periods
1.	Thermodynamics & thermo chemistry	15
2.	Phase rule & Phase diagram	15
3.	Colloids	10
4.	Thermal Analysis & Spectrometry	10
6.	Metals & mineral Extraction	10

## 1.0 THERMODYNAMICS AND THERMO CHEMISTRY

- 1.1 Define different terms of thermodynamics.
- 1.2 State ideal gas laws.
- 1.3 Explain Extensive and intensive properties.
- 1.4 Define and explain Homogenous and heterogeneous systems
- 1.5 State and explain first law of thermo dynamics.
- 1.6 Explain relation between heat and work.
- 1.7 Define internal energy.
- 1.8 Define heat capacity and specific heat.
- 1.9 Define adiabatic Isothermal process.
- 1.10 Define heat of formation.
- 1.11 Define heat of combustion.
- 1.12 State thermo-chemical laws.
- 1.13 Distinguish between second law of thermodynamics and 1<sup>st</sup> law of thermodynamics.
- 1.14 Explain the postulate of 2<sup>nd</sup> law of thermodynamics.
- 1.15 Explain efficiency of a machine.
- 1.16 Explain carnot cycle.
- 1.17 Explain absolute scale of temperature.
- 1.18 State and explain free energy.
- 1.19 Define entropy and chemical potential.
- 1.20 State the importance of thermodynamics in ceramics in ceramic industry.
- 1.21 State and explain 3<sup>rd</sup> law of thermo dynamics.

## 2.0 PHASE RULE AND PHASE DIAGRAM

- 2.1 Define equilibrium, phases, components and periods of transformation.
- 2.2 Define in solid solution, one component system.
- 2.3 State & explain the allotropic modification of SiO<sub>2</sub>.
- 2.4 State & explain different phases of ZrO<sub>2</sub>, Differentiate between one component systems and two component systems, Draw the different phase diagrams like Al<sub>2</sub>O<sub>3</sub>-SiO<sub>2</sub>, Fe-c, MgO-Al<sub>2</sub>O<sub>3</sub> system.
- 2.5 Explain three components and multiple component system, Gibbs phase rule.
- 2.6 Explain importance of phase diagram.

## 3.0 COLLOIDS

- 3.1 Define and classify colloids.
- 3.2 State & Explain different method of preparation of colloids.
- 3.3 Differentiate between Flocculation and deflocculation.
- 3.4 Explain clay water systems.
- 3.5 Define Base Exchange capacity.

## 4.0 THERMAL ANALYSIS AND SPECTROSCOPY.

- 4.1 Explain thermogravimetric analysis.
- 4.2 Classify different types of thermogravimetric Analysis.
- 4.3 Define automatic thermogravimetric analysis.
- 4.4 State different type of recording thermobalance.
- 4.5 State and explain spectrophotometry.
- 4.6 Define spectroscopy and describe various types of spectrophotometers.
- 4.7 Determination of various elements by spectroscopy (introduction only)
- 4.8 State Beer's law and describe its application.
- 4.9 Discuss different application of spectrophotometry.
- 4.10 Description of atomic absorption spectrophotometers.

## 5.0 METAL AND MINERAL EXTRACTION.

- 5.1 Discuss the occurrence, extraction, properties and use of iron and its alloy.
- 5.2 State & explain occurrence, extraction and application of Zircon and Silica.

## BOOKS RECOMMENDED

1. Engineering thermodynamics by P.K. Nag.
2. Engineering Chemistry by P.C. Jain and Monica Jain.
3. Physical chemistry of Puri, Sharma, Pathania
4. Instrumental method of chemical analysis by B.K. Sharma.
5. Introduction to Ceramic by W.D. Kingery.

## PRINCIPLE OF CERAMIC MANUFACTURE

**Period/Week: 4 Hours**  
**Theory : 60 period**

**Theory Exam : 3Hrs.**  
**End Term Exam: 80**  
**I.A. : 15 + 5 = 20**  
**Total : 100**

**Objectives :** After completion of the course, students will be able to :

1. Know various factors for efficient grinding and crushing.
2. Understand principles related to particle size determination and distributions.
3. Understand various factors related to slip casting and Plastic Shaping methods of Ceramic Fabrication.
4. Know factors related to shaping by pressing methods.
5. Understand idea about special forming methods for ceramics.
6. Know drying behaviors of clay and non clay ceramics.
7. Know various stages of firing and various factors related to firing operation of ceramic products.

SI. No.	Main Topics	Periods
1.	Size Reduction	15
2.	Forming Methods	25
3.	Drying Behaviors	10
4.	Firing Behaviors	10

### COURSE CONTENTS

#### 1.0 SIZE REDUCTION

- 1.1 Discuss various methods of Crushing and Grinding.
- 1.2 State and Explain various factors influencing Grinding Efficiency, special emphasize to ball mill, open and closed circuit grinding.
- 1.3 Explain particles sizes analyses furnas model of packing
- 1.4 State and Explain theory of setting.
- 1.5 Define Stokes Law.
- 1.6 Discuss various sieves used in ceramic industries for particle size reduction.

#### 2.0 FORMING METHODS.

- 2.1 Discuss various types of slip casting methods.
- 2.2 Explain various factors effecting slip casting process.
- 2.3 Discuss the following and explain the differences.
  - a. Hollow Casting, Drain casting
  - b. Vacuum Casting
  - c. Pressure Casting
- 2.4 Define the following and explain how they are related to slip casting process.
  - a. Flocculation
  - b. Deflocculation
  - c. Viscosity
  - d. Zeta Potential
  - e. Thixotropy
- 2.5 Discuss effect and  $P^H$  & rheological property of clay slip.
- 2.6 Plastic forming and pressing. State & explain the following :
  - a. Various types of plastic forming methods and their principles.

- b. Theory of practical packing.
- c. Practical size distribution.
- d. Principles of some special forming methods. Such as Isostatic pressing  
Vibration compaction, Reaction hot pressing. Injection moulding, CVD
- e. Defects occur in plastic forming and pressing operation.

### 3.0 DRYING BEHAVIORS

- 3.1 Discuss various stages of Drying.
- 3.2 State & Explain effects of external parameter on drying.
- 3.3 Discuss various changes on drying of clay and non-clay ceramic.
- 3.4 Description of various industrial drier.
- 3.5 Explain various drying defects

### 4.0 FIRING BEHAVIOR: State and explain the following

- 4.1 Types of Firing.
  - a. Bisque Firing
  - b. Glost Firing
  - c. Fast Firing
  - d. Single and Double Firing
- 4.2 Explain various changes during firing operation explain in details.
- 4.3 Discuss various firing defects.
- 4.4 Calcination
- 4.5 Sintering & Vitrification.

### BOOKS RECOMMENDED:

- 1. Industrial Ceramic by Singer and Singer
- 2. Introduction to Ceramic by W.D. Kingery.
- 3. Effect of Heat or Ceramic by W.F. Ford.
- 4. Effect of Drying by W.F. Ford.
- 5. Ceramic Fabrication process by WD Kingery

**GEOLOGY AND MINERALOGY OF CERAMIC RAW MATERIALS**

**Period/Week: 4 Hours**  
**Total Contact hrs. : 60**

**Theory Exam : 3Hrs.**  
**End Term Exam: 80**  
**I.A. : 15 + 5 = 20**  
**Total : 100**

**Objectives :**

After completion of the course, students will be

1. Understand importance of geology in the field of ceramic.
2. Know the formation of rocks, minerals and clay.
3. Know the classification of rocks in details.
4. Understand physical properties of minerals.
5. Understand types of clay and other important raw materials, their properties, sources and application in ceramic industries.
6. Understand the process of beneficiation of ceramic raw materials.

SI. No.	Main Topics	Periods
1.	Elementary Geology	05
2.	Physical Geology	05
3.	Petrology	10
4.	Mineralogy	15
5.	Important Raw Materials	20
6.	Beneficiation of ceramic Raw materials	05

**COURSE CONTENTS**

- 1.0 ELEMENTARY GEOLOGY – DESCRIBE THE FOLLOWING IN BRIEF.
  - 1.1 Various Branches of Geology.
  - 1.2 Origin of earth and earths crust.
  - 1.3 Geological ages.
  - 1.4 Various sources of ceramic raw materials from earth crust and their importance.
  
- 2.0 PHYSICAL GEOLOGY & PETROLOGY
  - 2.1 Define petrology.
  - 2.2 Discuss the types of weathering.
  - 2.3 Describe various types of weathering agencies.
  - 2.4 Discuss the process of weathering.
  - 2.5 State & explain fault, folds, joints, dips and strikes.
  
- 3.0 PETROLOGY
  - 3.1 Classify various types of rocks – formation of rocks.
  - 3.2 Define stratigraphy.
  - 3.3 Rocks a construction material.
    - a) For Building.
    - b) For Roads.
  - 3.4 Engg. Properties of rocks.
  - 3.5 Geological characters of rocks.
  - 3.6 General character of rocks.



## CERAMIC MACHINES & EQUIPMENT

**Period/Week: 4 Hours**  
**Total Contact hrs. : 60**

**Theory Exam: 3Hrs.**  
**End Term Exam: 80**  
**I.A.: 15 + 5 = 20**  
**Total: 100**

### Objectives:

After completion of the course, students will be able to:-

1. Know the ceramic machines and equipment or ceramic industries in details.
2. Know the working principle of various ceramic machines.
3. Know the construction and operation of various ceramic machines and equipment.
4. Understand overall idea about testing machines and equipment in ceramic laboratory.
5. Know equipment required in Kiln operation.
6. Know the BIS specification for ceramic machines of Equipments.

SI. No.	Main Topics	Periods
1.	Size Reduction	10
2.	Body Preparation	15
3.	Forming Machines	15
4.	Drier & Conveyers	05
5.	Testing Equipment	05
6.	Kiln Equipment	05
7.	Cutting & Finishing Equipment	05

### COURSE CONTENT

Size reduction.

- 1.1 Discuss various types of machines and equipment required for size reduction of ceramic raw materials.
- 1.2 Explain the working principle of the following machines.
  - a. Jaw Crusher
  - b. Edge Crusher
  - c. Roll Crusher
  - d. Pan Mill
  - e. Ball Mill :-
    - i. The construction & operation
    - ii. Lining of ball mill
    - iii. Grinding media
    - iv. Critical speed
  - f. Describe in brief tube mill, jet mill, vibro energy mill etc.
- 2.0 Body Preparation – Discuss various types of machines and equipment required to make ceramic body and glaze.
  - 2.1 Mixing & Kneading – State different components and explain principle of operation of the following.
    - a) Blunger            b) Agaitator
    - c) Pan mixer        d) Muller mixer
    - e) Pot mill
  - 2.2 Size separation – Describe in brief.
    - a) Various types of standard sieves i.e. BS, BIS, ASTM etc.

- b) Vibrating screen
    - c) Cyclone separation
- 2.3 De-watering & De-airing- describe & De-ironing describe in brief.
  - a) Filter press – Principle and operation
  - b) Pug Mill – Principle and operation & effect of vacuum treatment on plastic mass.
  - c) Spray drier – Principle and operation.
  - d) Permanent and electro magnet used for de-ironing.
- 3.0 Forming Machines
  - 3.1 Discuss various machines required for ceramic fabrication.
  - 3.2 Shaping, machine-describe in brief.
    - a) Potter’s wheel.
    - b) Jigger Jolley.
    - c) Roller head machines.
    - d) Shaping machines for Electrical insulator making.
  - 3.3 Pressing machine – Describe in brief operation & construction of.
    - a) Toggie Press.
    - b) Hydraulic Press.
    - c) Friction Serew Press.
    - d) Vibro Press.
    - e) Rotary Press.
    - f) Isostatic Press.
    - g) General Idea about machines and equipment required for glazing operation.
    - h) Pneumatic Rammer.
- 4.0 Dryers & Conveyor.
  - 4.1 State various types of dryers and their advantages one over other.
  - 4.2 Describe in brief types of feeders and their use in ceramic industries.
- 5.0 Testing equipment and machines for ceramic laboratory.
  - 5.1 Describe in brief equipment uses in modern ceramic laboratory.
  - 5.2 Mention the name of the reputed ceramic machine manufacturers in India as well as abroad.
  - 5.3 Discuss the specification of equipment and its requirement.
- 6.0 Klin Equipment
  - 6.1 Burnners.
  - 6.2 Compressor.
  - 6.3 Temperature measuring instruments.
  - 6.4 Kiln furniture.
- 7.0 Cutting and Finishing Equipment & forming Tools for ceramic product.
  - 6.1 Tools for cutting.
  - 6.2 Tools for grinding.
  - 6.3 Tools for drilling.
  - 6.4 Forming tools for ceramic shaping.
  - 6.5 Roberts for refractory manufacturing.

**BOOKS RECOMMENDED:-**

1. Industrial Ceramics by Singer & Singer.
2. White wares by Sudhir Sen.
3. Modern pottery by H.N.Bose.
4. Modern brick making by A.B. Searle
5. Unit operation of Chemical Engineering by Mac Cabe and Smith

**CERAMIC TESTING - I**

**Period/Week: 6 Hours**  
**Practical : 90 period**

**End Term Exam: 25**  
**Sessional: 75**  
**Total : 100**

*(Atleast 10 nos of tests will be conducted)*

**Detail Course Contents:**

1. Observe colour of ceramic clays and detect impurities by simple test.
2. Determine specific gravity of clay and other powder materials.
3. Determine power of suspension of clay.
4. Determine slaking properties of various clays.
5. Determine water of plasticity of various clays and clay mixture.
6. Determine plasticity of clay.
7. Determine shrinkage of various types of clay and clay mixture.
  - i) Drying shrinkage linear and volume
  - ii) Burning shrinking linear and volume.
8. Determine shrinkage water and pore water.
9. Determine moisture content of clay and ceramic raw materials.
  - a) By Speedy moisture tester.
  - b) By The help dryer
  - c) By The help of infrared moisture balance
10. Determine P<sup>H</sup> of liquid solution and clay slip.
11. Sieve analysis of various raw materials & study various types of sieve.
12. Testing of slip.
13. Determine the grinding efficiency of ball mill.
14. Observe various ceramic raw materials used for white ware and refractory making.
15. Study the rate of heating and cooling of Electric furnace and drying oven.

**CERAMIC WORKSHOP - I**

**Period/Week: 5 Hours**  
**Practical : 75 period**

**Practical Exam: 3hrs**  
**End Exam. 50 marks**  
**Sessional : 25**  
**Total : 75**

**SECTION - A**

(Minimum 10 nos of jobs)

1. **DESCRIBE PHYSICAL CHARACTERISTICS OF VARIOUS CERAMIC RAW MATERIALS MINIMUM 10 NOS.**  
Kaolin, talk, chalk, pyrophilite, bentonite, gypsum, quartz, quartzite, laterite, silimanite, kyanite, serpentite, feldspare, nepheline, sycnite, limestone, dolomite, magnesite, calcite, bauxite, diaspor, hematite, beryl, illmanite.

**SECTION-B**

(Minimum 3 nos of jobs)

1. Prepare various type of model by the help of plastic clay.
2. Prepare moulds by the help of plaster of paris
3. One piece mould
4. Tow piece mould
5. Multi pieces mould

**SECTION -C**

(Minimum 3 nos of jobs)

**WHITE WARE AND HEAVY CLAY WARE**

- A. Raw Material processing & body preparation.
- i. Explain crushing and grinding of raw materials with jaw / roller crusher, edge runner, ball mill.
  - ii. Explain charging the batch in ball mill or pot mill.
  - iii. Study operation of fitter press.
  - iv. State and explain magnetic separation of iron bearing particles.
  - v. Sieve analysis.
  - vi. Explain operation of filter press, de-watering pug mill.
  - vii. Study operation of potters wheel and jigger jolley.

ELEMENTARY MECHANICAL ENGINEERING

**Period/Week: 4 Hours**  
**Theory : 60 period**

**Theory Exam : 3Hrs.**  
**End Term Exam: 80**  
**I.A. : 15 + 5 = 20**  
**Total : 100**

**Objectives :**

On completion of this subject, students will have basic understanding of the major fields of mechanical engineering like Mechanism, Machines, Thermodynamics and Heat Engines, Machine Tools and Maintenance Engineering.

COURSE CONTENTS (in terms of specific objectives)

1.0 CHAPTER -I

- 1.1 Define shear force & bending moment
- 1.2 Construct shear force & bending moment diagram of cantilevers, simple supported beam with point load and uniformly distributed load.
- 1.3 Determine stress and deflections of loaded beams.

2.0 CHAPTER - 2

- 2.1 Define machine, mechanism, kinematics, link, kinematics pair, kinematics chain.
- 2.2 Illustrate four-bar linkage, crank-connecting rod, quick return mechanism.
- 2.3 Understand function of a cam follower.

3.0 CHAPTER – 3

- 3.1 Determine the length of open belt drive
- 3.2 Determine the ratio of tensions and power transmitted by belt drive.
- 3.3 Discuss advantage of rope and chain drives.
- 3.4 State working principle of simple brakes & dynamometers.
- 3.5 Define & classify bearing (bush and anti-friction)
- 3.6 Explain functions of flywheel & governors.

4.0 CHAPTER -4

- 4.1 Define heat and work and derive inter-relationship.
- 4.2 Determine work done by compression and expansion of gases.
- 4.3 Explain properties of steam (sensible, latent heat & dryness fraction)
- 4.4 Discuss use of steam tables.

5.0 CHAPTER – 5

- 5.1
- 5.2

- 5.3 Define IHP, BHP & Mechanical efficiency.
- 5.4 Define & Classify steam turbines (impulses & reaction types)
- 6.0 CHAPTER -6
  - 6.1 Define and Classify internal combustion (I.C.) engine.
  - 6.2 Explain Otto & diesel cycles.
  - 6.3 Explain & compare 2 stroke & 4 stroke & I.C. engine.
  - 6.4 Define IHP, BHP & mechanical efficiency of I.C. engine.
- 7.0 CHAPTER -7
  - 7.1 Define Refrigeration and Air-Conditioning and state various applications.
  - 7.2 Explain simple vapour compression refrigeration system.
  - 7.3 Explain function and working principle of a gas compressor.
  - 7.4 State types of refrigerants and explain their properties.
  - 7.5 Describe the basic concept of air-conditioning with reference to a room air conditioner.
- 8.0 CHAPTER -8
  - 8.1 Define machine tools
  - 8.2 Describe different machine tools and their functions (lathe, drill, shaper, milling machine and grinding machine)
  - 8.3 Describe types of maintenance (break down, preventive, planned).

**RECOMMENDED BOOKS :**

1. Applied Mechanism R.S. Khurmi.
2. Engineering Thermodynamics : P.L. Balleney
3. Refrigeration & Air Conditioning : P.L. Balleney
5. Theory of Machine : R.S. Khurmi
6. Industrial Engineering & Management : O.P. Khanna
7. Elements of Workshop Technology : Hazra Chaudhury, Vol. I & II.

**WORKSHOP PRACTICE – II**  
(COMMON TO MET.CHE.,CER. & T.T.)

**Period/Week: 4 Hours**  
**Theory : 60 period**

**Sessional : 25**  
**End. Exam. 25**  
**Total : 50**

UNIT	TOPIC/SUB-TOPICS	HRS.	MARKS
1.0	MACHINE SHOP		
	1.1 Shop talk on different types of machine tools, their functions, different tools used and general safety precautions to be observed.		
	1.2 Study a centre lathe.		
	1.3 Operate a centre lathe on a cylindrical ob and perform following operations : turning, taper turning, facing, parting.		
	1.4 Operate a drill machine to perform drilling and counter borings on a job.		
	1.5 Observe milling, shaping and grinding operations during demonstration at shop floor.		
2.0	FOUNDRY SHOP		
	2.1 Prepare a simple wooden pattern.		
	2.2 Make a green sand mould using above pattern.		
3.0	WELDING SHOP		
	3.1 Observe demonstration of different type of welding electrodes and TIG & MIG welding.		

Reference Books :

Engineering Thermodynamics – P.L. Balleney.  
Workshop Technology – II, Hazra & Choudhury.

V.B. – The textile Tech. Students will do the following practicals in additions to the above.

1. Study and sketching of I.C. Engineers (two stoke, four stroke, Diesel and Petrol Engineers)
2. Boiler and checking its different parts.
3. Study and sketching of reciprocating pumps, rotary pumps.
4. Air compressor.

**APPLIED ELECTRONICS AND CONTROL**

Total Contact hrs.: 60  
Theory : 40  
Practical : Nil

Total Marks : 100

Theory Exam : 3 Hrs.  
End Term Exam : 80  
L.A.: 15+5

**Objectives :**

On completion of this course, students will be able to develop understanding and use of

1. Special Semiconductor devices
2. Opto – electronic supply
3. Regulated power supply
4. Principles of digital electronics
5. Sensors and transducers
6. Microprocessor
7. PLC

**Distribution of Periods**

UNIT-1	Special Semiconductor Devices	06
UNIT-2	Opto-Electronic Devices	03
UNIT-3	Regulated Power supply	09
UNIT-4	Principles of Digital Electronics	08
UNIT-5	Sensors and Transducers	15
UNIT-6	Microprocessors	12
UNIT-7	PLC	07
	Total	60

**UNIT-1 SPECIAL SEMICONDUCOR TOR DEVICES**

Explain Characteristics, Principle of operation and applications of

- 1.1 PET
- 1.2 MOSFET
- 1.3 UJT
- 1.4 SCR
- 1.5 TRIAC
- 1.6 DIAC

**UNIT -2 OPTO-ELECTRONIC DEVICES**

Explain the operation and use of

- 2.1 LED
- 2.2 LCD
- 2.3 Opto-Coupler
- 2.4 LASER

**UNIT-3 REGULATED POWER SUPPLY**

- 3.1 Explain the function of ordinary DC power supplier
- 3.2 Classify different units of DC series voltage regulators
  - (i) Sampling units
  - (ii) Reference units
  - (iii) Comparising units

- (iv) Amplifier units
- (v) Control units
  
- (vi) Complete series & shunt voltage regulators

#### IV- SEM- CER

3.3 Explain the operation of switching mode power supply (AC & DC)

#### UNIT – 4 PRINCIPLES OF DIGITAL ELECTRONICS

- 4.1 Explain types of flip – Flop and its use
- 4.2 Describe briefly about memory element
- 4.3 Explain the function of shift registers
- 4.4 Describe the function and use of Mod – 10 and ring counter.

#### UNIT – 5 SENSORS AND TRANSDUCERS

- 5.1 Describe Sensors for sensing pressure, temperature, moisture humidity, flow, level.
  - (i) Explain temperature measurement using Resistance Thermometer, Thermocouple, Thermister.
  - (ii) Explain Pressure measurement using manometer, U – tube, Elastic type Pressure gauge ( Bourdon tube, diaphragm, bellows etc.)
  - (iii) Classification of flow – meter, Variable – head flow – meter, principle of operation advantage and disadvantage of orifice plate, venture tube nozzles.
- 5.2 Describe the function of Limit switch. Proximity Switch. Alarm annunciation and its use.

#### UNIT – 6 MICROPROCESSOR

- 6.1 Describe introduction to intel 8085
- 6.2 Explain register organization of 8085
- 6.3 Introduction sets of 8085
- 6.4 Describe assembly language concepts
- 6.5 Describe preparation small programmes using 8085
- 6.6 Explain the use of
  - (i) Data bus
  - (ii) Address bus
  - (iii) Control bus
  - (iv) Interrupt time line
  - (v) Multi – planning busses.

#### UNIT – 7

- 7.1 Explain basic structure and operation of PLC
- 7.2 Describe simple ladder logic
- 7.3 Right simple ladder programme (implementing only OR, AND, NOR & NAND logic.)

#### Recommended Books :

- 1. Integrated Electronics, analog and Digital systems by J. Millman & Christos C. Halkius.

2. Electronic Devices and Circuits by Motor Shed.
3. Electronic Device and Circuits by G. K. Mithal
4. Power Electronics by Rashid
5. Digital Circuits & Systems by doughals 1: Hall Mc. Graw Hill Publications

**IV- SEM- CER**

6. Digital Electronics by Gaur
7. Digital Systems Design by Mano
8. Microprocessor by Gaonkar
9. Microprocessor by B. Ram
10. Industrial Electronics by Paul B. Zaber
11. Mechanical Measurement & Measuring Circuit by S. Khedkar
12. Instrumentation by Nakara Choudhury.
13. Industrial electronics by S. N. Biswas
14. Mechanical and Industrial Measurement by R. K. Jain
15. Electrical and Electronic Instrumentation by A. K. Sawhney
16. Industrial Instrumentation by Fibrace
17. Industrial Electronics by G. K. Muhal
18. .... by P. C. Sen.

**CEMENT TECHNOLOGY**

L     T     P  
4     0     0

Total Contact hrs.: 60

Total Marks : 100

Theory Exam : 3 Hrs.

Theory : 60

End Term Exam : 80

Practical : Nil

L.A.: 15+5

**Objectives :**

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

1. Know lime and lime stone, their qualities, calcinations and cementing property.
2. Understand details about Portland cement.
3. Understand manufacturing of various types of cement, their qualities
4. Know about cement kiln and its operation
5. Know various methods of testing qualities of cement.
6. Know various types of cement concrete products and its manufacturing process.
7. Know details about Gypsum, plaster of paris and plaster products.

Sl.No.	Major Topics	Periods
1	Lime and Hydraulic Materials	05
2	Portland Cement Making & its properties	15
3.	Testing cement	15
4.	Testing of Cement	10
5.	Cement Products	10
6.	Plaster and Gypsum	05

**COURSE CONTENTS****1. LIME AND OTHER HYDRAULIC MATERIALS**

- 1.1 Define various terms related to lime and lime stone
- 1.2 State & explain properties of lime stone
- 1.3 Impurities of lime stone and its effect
- 1.4 Explain calcinations and slaking of lime stone
- 1.5. Describe Lime kiln
- 1.6. Pozzolana Materials
- 1.7. Lime Stone for manufacture of OPC
- 1.8 Fly ash and slag for cement making.
- 1.9 Natural Cement Rock.

**2.0 PORTLAND CEMENT : Discuss the following details :-**

- 2.1 Introduction to OPC
- 2.2 Raw Materials for OPC, Their properties and effect on cement making.
- 2.3 Manufacturing Process of OPC
- 2.4 Rotary Kiln and its operation (RCK)
- 2.5. Vertical shaft kiln and its operation burn ability if raw mix for OPC.
- 2.6 Clinker formations and clinker chemistry
- 2.7. Hydration of cement Setting of Cement.
- 2.8. Effect of acid water and sulphate water on cement
- 2.9. Effect of alkalis, fluorides, phosphorus, sulfur compound of OPC.
- 2.10. Various types of Accelerator and retraders used in cement.
- 2.11. Water and air enteraining agents.

- 2.12 Properties of cement, 43 grade and 53 grade OPC
- 2.13 Constituents of cement clinker, grinding of clinker
- 2.14. Storage of cement
- 2.15. Dust controlling in cement industry
- 2.16 Impurities in cement and their effect.

#### IV- SEM- CER

### 3.0 VARIOUS TYPES OF CEMENT:

Describe the composition, quality, property and making of the following cement:-

- 3.1 Pozzuolana Cement
- 3.2 Blast Furnace slag cement
- 3.3 Acid Resistant Cement
- 3.4 Masonary Cement
- 3.5 Sulphate Resisting and Super Sulphate Cement
- 3.6 Rapid Hardening Cement
- 3.7. Quick Setting Cement
- 3.8. High alumina Cement
- 3.9. White Cement
- 3.10 Coloured Cement
- 3.11 Oil well cement
- 3.12 Sorel cement
- 3.13 Hydrophilic Cement
- 3.14 Explanding Cement
- 3.15 Low heart cement
- 3.16 Natural cement

### 4.0. TESTING OF CEMENT :

Discuss the following testing methods for cement in brief.

- 4.1 Consistency of cement
- 4.2 Initial and Final setting of Cement.
- 4.3 Expansion of Cement
- 4.4 Compressive & Tensile Strength.
- 4.5 Particle size of cement
- 4.6 Impurities in Cement
- 4.7 Specific gravity of cement.
- 4.8 Chemical analysis of cement.

### 5.0. CEMENT CONCRETE PRODUCTS :

- 5.1 Describe various cement concrete products used in low cost housing
- 5.2 Explain various types of ferro-cement products.
- 5.3 Describe making of mosaic tiles.
- 5.4 Describe making of cement concrete (RCC) pipes
- 5.5. Describe making of cement concrete Block
- 5.6 Making of RCC Railway slipper
- 5.7. Making of FAL-G Brick

### 6.0 GYPSUM AND PLASTER DESCRIBE THE FOLLOWING IN BRIEF.

- 6.1. Various types of Gypsum and their composition availability and use
- 6.2 Manufacturing of plaster of paris.
- 6.3. Various types of plaster of paris
- 6.4 Testing the quality of plaster of paris
- 6.5 Various types of plaster products.
- 6.6. Glass re-inforced gypsum

### Book Recommended :-

- 1. Chemistry of Cement - Bouge
- 2. Chemistry of Cement and Concrete – F. M.Lea.

3. Cement – Mukherjee
4. Multi functional cement based materials by Marcel Decker (Inc 203)

**REFRACTORY TECHNOLOGY**

L     T     P  
4     0     0

Total Contact hrs.: 60

Total Marks : 100

Theory Exam : 3 Hrs.

Theory : 60

End Term Exam : 80

Practical : Nil

I.A.: 15+5

**Objectives :**

After completion of the course the students will be able to

1. Understand various types of refractories their classification and their manufacturing process.
2. Know testing of Refractories in details
3. Understand the causes of failure of refractories.
4. Understand refractories, cement and monolithic and their application in metal extraction.
5. To know about insulating brick and fibrous refractories materials .
6. Know specifications of refractories as per B.I.S.

Sl.No.	Major Topic	Periods
1.	Refractories and its classification	05
2.	Acid Refractories and Basic Refractories	15
3	Neutral Refractories & other refractories	15
4	Testing of Refractories	10
5	Refractories Cement & Monolithic	05
6	Failure Refractories	05
7	Specification as per B.I.S	05

**COURSE CONTENTS****1.0 INTRODUCTION TO REFECTORIES**

- 1.1 Define Refractory
- 1.2 Refractories and its classification
- 1.3 State the importance of refractory
- 1.4 Classify refractories
- 1.5 Raw materials for refractory, impurities and their influence on refractory
- 1.6. Refractory grog and its importance.

**2.0 ACID AND BASIC REFRACTORY (Manufacturing, properties and uses)**

- 2.1 Acid Refractories
  - (a) Fire clay Refractories
  - (b) Silica Refractories & Semi Silica refractory.
  - (c) Sillimanite refractory, Kyanite and other alumino silicate refractories
- 2.2 Define Basic Refractories Discuss preparation properties uses of following refractories in brief.
  - (i) Magnesite refractories
  - (ii) Chrome magnesite refractories
  - (iii) Chrome refractories

- (iv) Dolomite refractories
- (v) Mag-Dolo Refractories
- (vi) Forsterite Refractories
- (vii) Mag. Chrome Refractories

#### IV- SEM- CER

### 3.0 NETURAL AND OTHER REFRACTORIES

3.1 Discuss preparation, properties and uses of following refractories in brief:-

- |                                    |                     |
|------------------------------------|---------------------|
| (i) Graphite refractories          | (v) Fused Alumina   |
| (ii) Zirconia refractories         | (vi) Fused Magnesia |
| (iii) Silicon Carbide Refractories | (vii) Fused Silica  |
| (iv) Spinal Bricks                 | (viii) Mullite      |

3.2 Fusion cast refractories – types, properties and application

3.3 Insulation refractory bricks : type of insulating bricks, properties, uses and manufacturing.

3.4. Carbon containing Refractory:- Manufacturing, Properties and Uses.

Magnesia – Carbon Refractory

Alumina – Magnesia – Carbon Refractory

Alumina – Carbon Refractory

3.5. Refractory hollow ware:- stopper, Nozzle, Pipes and Crucibles, Muffle, Glass Pot etc.

3.6 Fibrous Refractory materials

- Prepared fibrous refractory materials
- Refractory tile
- Refractory Blanket
- Refractory rope

### 4.0 TESTING OF REFRACTORIES:

4.1 Specific gravity

4.2 Bulk density

4.3 Porosity

4.4. Slag attack

4.5. P.C.E. value

4.6. Thermal shock resistance

4.7. Cold crushing strength

4.8. Spalling Resistance

4.9. R.U.L.

4.10. Thermal Expansion

4.11 Thermal conductivity

4.12 Permeability

4.13 Abrasion resistance

4.14 Modulous of rupture

4.15 P.L.C.R.

4.16 Creep

### 5.0 FAILURE OF REFRACTORIES

5.1 Various factory responsible for failure of refractories

5.2 Various methods of repairing in hit atmosphere in furnace

### 6.0 MONOLITHIC REFRACTORIES

Castables

Plastic masses

Ramming Masses

Gunning Masses  
Spraying Masses  
Patching Masses  
Refractory Cement and mortars

#### IV- SEM- CER

7.0 State and Explain – B.I.S. specification for refractories

#### **Books Recommended :**

1. Refractories : production & Properties by J.H. Chester.
2. Refractories by Chisti
3. Refractories their manufacturing properties & uses by M.L. Mishra
4. Technology of ceramics & refractories by P.P. Budnikov
5. Refractories by NANDI  
Refractory – F.H. Norton

**FUELS AND CERAMIC KILNS**

L     T     P  
4     0     0

Total Contact hrs.: 75

Total Marks : 100

Theory Exam : 3 Hrs.

Theory : 75

End Term Exam : 80

Practical : Nil

L.A.: 15+5

**Objectives :**

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

1. Understand types of fuels required for ceramic industry.
2. know in detail of various solid, liquid and gaseous kilns
3. Know the construction operation of various ceramic kilns
4. Know regarding various types of metallurgical furnaces and their construction & operation.
5. Know the conservation of energy in ceramic kiln operation.
6. understand general idea on pyrometer and pyroscope.

Sl.No.	Major Topic	Periods
1.	Introduction to fuels and combustion	05
2.	Solid Fuels, Liquid Fuels & Gaseous Fuels	20
3	Ceramic kilns	15
4	Metallurgical furnaces	10
5	Energy Conservation in Ceramic Industry	05
6	Introduction to Pyroscope and Pyrometer	05

**COURSE CONTENT****1.0 INTRODUCTION TO FUEL & COMBUSTION**

- 1.1. State and explain introduction to solid, liquid and gaseous fuels
- 1.2. Explain Non-conventional source of energy for burning ceramic kiln
- 1.3. State and explain combustion of fuels
- 1.4. Combustion calculation
- 1.5. Terms & Definition relating to fuel testing.

**2.0 SOLID, LIQUID AND GASEOUS FUELS:**

- 2.1 State various types of solid fuels.
- 2.2 Classify solid fuels.
- 2.3. Describe methods of formation of coal.
- 2.4. State & explain the properties of coal.
- 2.5. Describe in detail how coke is prepared in coke oven.
- 2.6. State the properties of coke.
- 2.7. Describe the procedure for storage of coal.
- 2.8. State the reasons for washing of coal.
- 2.9. Describe briefly the gradation of coal.
- 2.10 Testing of solid fuel.
- 2.11 Classify liquid fuels.
- 2.12 Describe the process of refining crude petroleum product.
- 2.13 State and explain the properties of various liquid fuels and petroleum by products.

- 2.14 State the advantages of liquid fuels over solid fuels.
- 2.15 Testing of liquid fuels such as flash point, fire point, pour point, smoke point, dew point etc.
- 2.16 Describe the procedure for storage of liquid fuels.

#### **IV- SEM- CER**

- 2.17 Classify gaseous fuel.
- 2.18 State and explain the properties of various gaseous fuels and their application in industries & Blast Furnace Gas, Coke oven gas, BOF Gas, Coal Gas, Oil Gas.
- 2.19 Explain in details the manufacturing method of producer gas.
- 2.20 List the advantages of gaseous fuel over liquid and solid fuel.
- 2.21 Describe the manufacturing methods of biogas.
- 2.22 Testing Gaseous fuel.

### **3.0 CERAMIC KILNS**

- 3.1. Define kiln, furnace and oven
- 3.2. Classify ceramic kiln in details
- 3.3. Describe the construction operation of the following kilns in details :-
  - a) Down Draft kiln
  - b) Up draft kiln.
  - c) Chambr kiln
  - d) Tunnel kiln
  - e) Muffle kiln
  - f) Shaft Kiln
  - g) Glass Pot furnace
  - h) Glass Tank furnace
  - i) Electric furnace for glass melting
  - j) Rotary kiln etc.
- 3.4. List the advantages of continuous kiln over periodic kiln
- 3.5. Describe various type of kiln furniture used in ceramic kilns
- 3.6. Describe various types of furnace and kiln accessories used in kiln operation.

### **4.0 METALLURGICAL FURNACES:**

- 4.1 Various types of furnace used in metal extraction.
- 4.2 Describe briefly construction and operation of the following furnaces.
  - a) Blast furnace.
  - b) Cupola
  - c) Open hearth furnace
  - d) Ladle refining furnace
  - e) Basic Oxygen Furnace etc.
  - f) Electric Arc Furnace.

### **5.0. ENERGY CONSERVATION IN CERAMIC INDUSTRIES**

- 5.1 Explain briefly the heat losses in furnaces.
- 5.2 State and describe various types of heat exchanger.
- 5.3 Describe various types of energy efficient burner used in furnaces.
- 5.4 State various types of furnace insulation.
- 5.5 State and describe various modern methods for energy conservation.
- 5.6 State various factors responsible in energy conservation in ceramic kiln.

## **6.0 PYROSCOPE AND PYROMETER**

- 6.1 Define pyroscope and pyrometer
- 6.2 Discuss various types of pyroscope.
- 6.3 Describe various types of cones used in ceramic kiln firing.
- 6.4 State the requirements of pyroscope and pyrometer in kiln firing.
- 6.5 Describe various pyrometers used in ceramic kiln firing.

**IV- SEM- CER**

### **Books Recommended :-**

- 1. Rules and Combustion by S.Sarkar
- 2. Fuels Solid, liquid & gaseous by J.S.S. Brame & King.
- 3. Fuels furnace refractory by Gupta.
- 4. Furnace – By Trink
- 5. Industrial Ceramic by singer and signer.

**FUELS TESTING LAB**

L     T     P  
0     0     3

Total Contact hrs.: 45

Total Marks : 100

Practical Exam : 3 Hrs.

Theory : 45

I.A : 25 Marks

Practical : Nil

Practical : 25 Marks

**MINIMUM SIX NUMBER OF JOBS TO BE PRACTICED BY THE STUDENT**

1. Determine of proximate analysis of coal
  - (a) Moisture content.
  - (b) Volatile matters, Ash content.
  - (c) Fixed carbon content etc.
2. Determination of calorific value of solid and liquid fuel by Bomb Calorimeter.
3. Determination of viscosity of liquid fuels.
4. Determination of Density of liquid fuels.
5. Determination of flash point of liquid fuels.
6. Study of ORSAT apparatus.
7. Determination of fusion point of coal ash.
8. Study of thermo-couples pyrometer
9. Study of the operation of optical and radiation Pyrometers.
10. Study of Pyroscope such as segar cone & Orton cone etc.

**CERAMIC WORKSHOP - II**

L     T     P  
0     0     6

Total Contact hrs.: 90

Total Marks : 100

Practical Exam : 3 Hrs.

Theory : Nil

Sessional : 75 Marks

Practical : 90

Practical : 25 Marks

MINIMUM FIFTEEN NUMBER OF JOBS FROM BOTH SECTION SHOULD BE PRACTICED BY THE STUDENT)

**(SECTION –A)**

1. Preparation of refractory mixture for making the following standard bricks.
1. Acid Bricks - Fireclay bricks
2. Basic Bricks - Dolomite, Magnetite
3. Neutral Bricks - fused Alumina
4. Preparation of saggar.
5. Preparation of insulation bricks
6. Preparation of refractory cements and mortars.
7. Preparation of refractory crucibles.
8. Study of various refractory shapes used in furnace lining.
9. Preparation of cement castables
10. Preparation of ramming masses.

**(SECTION – B)**

1. Preparation of Cement concrete products.
2. Ferro cement Water Tank
3. Ferro cement Roofing Sheet
4. Concrete Block
5. Preparation of Mosaic tiles.
6. Preparation of plaster of paris.
7. Chalk crayons making
8. Decorative plaster of Paris tiles making.
9. Making of Plaster paris Art products
10. Preparation of cement clinker
11. Grinding of cement clinkers with other additives for making various types of cement.

**CERAMIC TESTING - II**

L     T     P  
0     0     6

Total Contact hrs.: 90

Total Marks : 100

Practical Exam : 3 Hrs.

Theory : Nil

Sessional : 25 Marks

Practical : 90

Practical : 25 Marks

MINIMUM TEN NUMBERS OF JOBS TO BE PRACTICED BY THE STUDENTS

**A. TESTING OF REFRACTORIES**

1. Grading of grog for refractories
2. Determine the physical properties refractory products.
3. Determine C.C.S.
4. Determine thermal expansion
5. Determine permeability
6. Determine PCE value
7. Determine RUL
8. Determine Thermal Shock Resistance
9. Determine PLCR
10. Determine MOR & Hot MOR.

**B. TESTING OF CEMENT**

1. Determine consistency of cement.
2. Determine initial and final setting time of cement
3. Determine compressive strength of cement mortar.
4. Determine Tensile strength of cement concrete and mortar
5. Determine testing of plaster paris
6. Determine expansion of cement
7. Determine particle size of cement
8. Chemical analysis of cement
  - i) CaO
  - ii) SiO<sub>2</sub>
  - iii) Fe<sub>2</sub>O

**APPLIED ELECTRONICS AND CONTROL LAB**

L     T     P  
0     0     6

Curri. Ref. No. :

Total Contact hrs.: 60  
Theory : Nil  
Practical : P/W

Total Marks : 50

Practical Exam : 3 Hrs.  
Sessional: 25 Marks  
End Exam: 25 Marks

1. Study of different types of thermometer
2. Study of different types of Pressure Gauge
3. Study of Orifice Plate, Venturi meter, nozzles
4. Implementation of AND, OR, NAND, NOR, XOR, NOT gates and verification truth table.
5. Verification of R-S flip – flop and J-K-flops.
6. Verification of performance of Mod-10 Counter
7. 4-bit up/down counters.
8. Study of 8085 based Microprocessor Kit.
9. Simple programs using 8085 microprocessor kit.
10. Study the performance of electronic on – off temperature controller.

**GLASS TECHNOLOGY****Total Contact hrs. : 60****Total Marks : 100****Theory Exam : 3Hrs.****Theory : 60 period****End Term Exam: 80****I.A. : 15 + 5 = 20****Total : 100****Objectives :**

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

1. Know various types of raw materials for glass making and formulating batch composition.
2. Understand general ideas about glass melting furnace and glass melting process.
3. Understand idea about the various process of glass forming methods.
4. Know knowledge about strain in glass and its elimination.
5. Understand general idea about the quality of glass.
6. Understand different glass defects and their remedies.
7. Know decoration of glass and special glass making.
8. Know idea on layout of modern glass plant.

SI NO.	Major Topics	Periods
1.	Raw Material and Batch Composition	10
2.	Glass Melting Process	05
3.	Forming of Glass Wares	05
4.	Annealing and Toughening of Glass	05
5.	Manufacturing of Glass products	10
6.	Properties of Glass	10
7.	Testing of Glass	05
8.	Glass Decoration	05
9.	Special Glass	05

**COURSE CONTENT****1.0. RAW MATERIAL AND BATCH COMPOSITION**

- 1.1 Define Glass & Glassy state
- 1.2 Historical background of Glass
- 1.3 Glass Industries in India.
- 1.4 Describe the major ingredients for glass making
- 1.5 Describe the minor ingredients used for glass making
- 1.6 Define Cullet and its use in glass making
- 1.7 Explain beneficiation of cullets.
- 1.8 Describe selection of glass composition for various types of glasses.
- 1.9 Properties of glass sand for glass making.
- 1.10 Impurities in glass raw materials in their influence in glass making.

**2.0 GLASS MELTING PROCESS: EXPLAIN THE FOLLOWING IN BRIEF**

- 2.1 Calculation of batch of raw materials for making glass.
- 2.2 Process of glass formation

- 2.3 Refining of glass
- 2.4 Decolourisation of glass
- 2.5 Role of viscosity in glass melting.
- 2.6 Glass melting furnaces, construction and operation
- 2.7 Glass Tank Furnace & Glass pot furnace.
- 2.8 Devitrification of Glass

### **3.0 FORMATION OF GLASS WARE**

- 3.1 Various methods used for making glass products.
- 3.2 Various machines used for glass making.
- 3.3 Manufacture of glass by blowing & manual process
- 3.4 Float process
- 3.5 Semi automatic & automatic pressing machines.
- 3.6 Various moulds for glass making.

### **4.0 ANNEALING & TOUGHENING OF GLASS**

- 4.1 Define Annealing and Toughening of Glass & Aim of annealing.
- 4.2 Describe Construction of Annealing Lehr.
- 4.3 Describe the process of annealing in details.
- 4.4 Determine annealing schedule for various glass products.
- 4.5 Explain tempering of glass by various methods.
- 4.6 State and explain Chemical & mechanical toughening of glass.
- 4.7 Relation between annealing and viscosity of glass.

### **5.0 MANUFACTURING OF GLASS PRODUCTS**

- 5.1 Glass Bottle & Tumbler
- 5.2 Sheet glass
- 5.3 Fibre glass & glass wool
- 5.4 optical fibre
- 5.5 Glass bangle
- 5.6 Electric Bulb
- 5.7. Thermo flask
- 5.8 Optical Lense
- 5.9 Picture tube
- 5.10 Lay out of modern glass plant.
- 5.11 Defects in Glass and their elimination

### **6.0 PROPERTIES OF GLASS**

- 6.1 Describe the following properties of glass in detail.
  - a) Viscosity
  - b) Thermal expansion
  - c) Density
  - d) Optical Properties
  - e) Electrical properties
  - f) Chemical durability and other physical properties of glass.
  - g) Thermal properties.

### **7.0 TESTING OF GLASS : Describe in brief**

- 7.1 Testing of defects of glass by visual observation.
- 7.2 Blistering, cords, stones in glass
- 7.3 Determination and observation of strain in glass
- 7.4 Measurement of thermal resistance of glass

7.5 Testing of viscosity of glass.

7.6 Testing of density of glass

7.7 Testing of strength of glass

7.8 Durability of glass

## 8.0 GLASS DECORATION

Describe the following methods of glass decoration in brief.

- |                  |              |              |
|------------------|--------------|--------------|
| a) Polishing     | b) Grinding  | c) Etching   |
| d) Sand Blasting | e) Panting   | f) Engraving |
| g) Cutting       | h) Staining  | i) Engobing  |
| j) Lustruing     | k) Enameling |              |

## 9.0 SPECIAL GLASSES

9.1 Define special glass.

9.2 Describe the characteristics and application of the following glasses:-

- Borosilicate glass
- Vycor glass
- Pyrex glass
- Heat resisting glass
- Coloured glass
- Ruby glass
- Glass for electrical & electronic Industries.
- Laminated Glass
- Glass for optical communication.
- Alumino Silicate Glass, Alkali Silicate Glass, Lead Glass & Vitreous Silica Glass.

## BOOKS RECOMMENDED

- Glass by Tooley
- Glass by Scholes
- Glass by R. Charan
- Glass by Shand

**WHITE WARE AND HEAVY CLAY WARES**

**Total Contact hrs. : 60**  
**Theory : 60 period**

**Total Marks : 100**

**Theory Exam : 3Hrs.**  
**End Term Exam: 80**  
**I.A. : 15 + 5 = 20**  
**Total : 100**

**Objectives :**

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

1. Know various raw materials used in white ware and heavy clay wares.
2. Know the process of manufacturing of various white ware and heavy clay wares.
3. Understand various composition and body formulation of various types of white ware, and heavy clay wares their manufacturing process and the characteristics.
4. Understand various qualities and process of testing of various ceramic products.
5. Know general idea about the specification as per the B.I.S. for white wares and heavy clay ware.

Sl.No.	Major Topic	Periods
1	Raw Materials	10
2	Process of manufacturing	10
3	Body Formulation & characteristics	15
4	Electrical proclain & special Electrical ceramics	10
5	Testing of Heavy clay wares	05
6	Important testing of white ware	05
7	B.I.S. Specification for white wares & Heavy clay wares	05

**COURSE CONTENT****1.0 RAW MATERIALS**

- 1.1 Selection of principal raw materials for use in white ware and heavy clay ware industries.
- 1.2 Explain the qualities and Characteristics.
- 1.3 Describe the influence of raw materials on white ware and heavy clay ware products making.

**2.0 PROCESS OF MANUFACTURE FOR WHITE WARE & HEAVY CLAY WARES: Describe in details of the following.**

- 2.1 Materials processing.
- 2.2 Fabrication: Slip casting, softmud, stiffmud, dry press.
- 2.3 Drying operation

- 2.4 Glazing operation
- 2.5 Firing operation
- 2.6 Describe various problems arises during manufacturing process and their remedies.
- 2.7 Explain the remedies for green rejection.
- 2.8 Describe the causes of firing defects and their remedies.
- 3.0 **BODY & GLAZE FORMULATION, CHARACTERISTICS AND MANUFACTURING** of the following white wares and heavy clay ware in detail
- 3.1 **EARTHEN WARE**
  - a) Fine earthen ware
  - b) Common earthen ware glaze tile (floor & wall)
  - c) Earthen ware sanitary ware
- 3.2 **STONE WARE : DESCRIBE OF BRIEF.**
  - a) Fine stone ware.
  - b) Coarse stone ware
  - c) Sanitary ware
  - d) Stone ware jars
  - e) Fire clay sanitary ware
  - f) Vitreous china sanitary wares
  - g) Chemical stone ware for chemical Engineering.
  - h) Acid-resistant bricks and tiles
- 3.3 **PORCELAIN : WARE**
  - a) Hard Porcelain
  - b) Soft Porcelain
  - c) Chemical Porcelain
  - d) Dental Porcelain
  - e) Bone Chine and frited China.
- 3.4 **HEAVY CLAY WARES :**
  - a) Building bricks.
  - b) Paving brick.
  - c) Face brick
  - d) Building tiles
  - e) Salt glaze stone ware pipes
  - f) Hollow titles,
- 4.0 **ELECTRICAL PORCELAIN AND SPECIAL ELECTRICAL CERAMICS**
  - 4.1 a) High-Tension Electrical porcelain
  - 4.2 b) Low – Tension Electrical porcelain
  - 4.3 c) Special Electrical ceramics
    - i) Non-metallic heating element
    - ii) Alumina Dielectric
    - iii) Steatite porcelain
    - iv) Low – loss steatite Bodies
    - v) Low – loss cordierite bodies
    - vi) Low loss alumina bodies
    - vii) Low loss zirconia porcelain

## **5.0 TESTING OF HEAVY CLAY WARES**

5.1 Tests for building bricks & Tiles & stone ware pipes.

- a) Dimensional Tolerance
- b) Water absorption
- c) Soluble salts Efflorescence
- d) Strength
- e) Warpage

## **6.0 IMPORTANT TESTING OF WHITE WARE**

- 6.1 Water absorption and porosity
- 6.2 crazing resistance
- 6.3 Chipping resistance
- 6.4 Alkali and Acid resistance
- 6.5 Strength

7.0 State and explain B.I.S. Specification for white wares and Heavy Clay wares.

### **BOOKS RECOMMENDED :**

- 1. Industrial ceramics by Singer & Singer
- 2. White ware by W. Ryan & Redford
- 3. Modern Pottery by H.N. Bose
- 4. White wares by S. Sen
- 5. White ware by F. H. Norton

**CERAMIC WORKSHOP III**

**Total Contact hrs. : 90**  
**Theory : Nil**  
**Practical : 90**

**Total Marks : 100**

**Practical Exam. : 3 hrs**  
**End Exam: 25**  
**Seasonal : 75 Marks**

**(Minimum 15 numbers of jobs to be practices by the students)**

**A. CERAMIC SHAPING**

1. Preparation of plaster of pairs moulds for crockery.  
(Two pieces and three pieces mould)
2. Preparation of
  - i) Earthen ware body
  - ii) Stone ware body
  - iii) Porcelain body
3. Use of potter's wheel (each student must learn how to prepare simple hollow wares by throwing)
4. Preparation of cups and saucers by Jiggering & Jolleying.
5. Preparation of bodies by dry pressing, Toggle pressing and casting.
6. Preparation of common bricks and tiles.
7. Preparation of art pottery products by slip casting process.

**B. DRYING, FIRING & DECORATION OF WHITE WARE**

1. Drying of thick and thin wares, determination of drying characteristic curve.
2. Glost firing of earthenware articles using fritted glazes.
3. Glost firing of stoneware articles using felespathic glazes.
4. Glost firing of porcelain ware with white & coloured glazed.
5. Melting of glaze frit.
6. Decorate tiles by (a) Hand Painting (b) Transfer printing.

**C. GLASS**

1. Process and purification of glass sand
2. Melting of glass by crucible furnace.
3. Melting of coloured glass.
4. Drawing of rods from molten glass.
5. Grinding and polishing lenses.
6. Decoration of glass by :
  - a) Etching
  - b) Sand Blasting

- c) Enameling
- d) Silvering of glass
- 7. Grading of sand for glass batch.

**D. CERAMIC COATING (GLAZE & ENAMEL)**

- 1. Preparation of enamel frit.
- 2. Surface preparation of metals for enameling.
- 3. Preparation of enamel sign board.
- 4. Preparation of coloured glaze.
- 5. Preparation of glaze for :
  - a) Earthen ware
  - b) Stone ware
  - c) Porcelain
- 6. Preparation of glaze frit.

**V-SEM-CER**

**COMPUTER APPLICATION IN CERAMIC INDUSTRY LAB.**

**Total Contact hrs. : 60**

**Total Marks : 50**

**Practical Exam. : 3 hrs**

**Theory : Nil**

**End Exam: 25**

**Practical : 60**

**Seasonal : 75 Marks**

**1.0. CAD**

- 1.1 To study the basics of Auto CAD
- 1.2 To draw 2D ceramic Drawing of Block diagram, plot lay out, Machine and lilne.
- 1.3 To draw simple 3D ceramic Products -
  - i. Porcelain insulator
  - ii. Refractory products.
- 1.4 To creat realistic ceramic products.
- 2.0 Furnace design by Computer.
- 3.0 Simple programming to calculate physical parameter density, porosity, CCS, MOR
- 4.0 Programming to convert chemical analysis to rational analysis and vice versa.
- 5.0 Programming to calculate a batch.
- 6.0 Calculate on batch white ware glazed and refractories.

**7.0 Web Page designing**

- 7.1 HTML
- 7.2 Page Designing Containing images.
- 7.3 Form
- 7.4 Frame
- 7.5 Flow chart for preparation of Insulators, Refractories.

V-SEM-CER

**CERAMIC TESTING – III**

**Total Contact hrs. : 90**  
**Theory : Nil**  
**Practical : 90**

**Total Marks : 100**

**Practical Exam. : 3 hrs**  
**End Exam: 25**  
**Seasonal : 75 Marks**

*(Minimum Sixteen numbers of tests to be practiced by the students)*

**(SECTION – A)**

**(Minimum 5 nos of test)**

**A GLASS**

1. Simple test for iron in sand.
2. Determination of chemical durability of glass.
3. Determination of refractive index of glass.
4. Study of absorption in coloured glass by spectro photometer.
5. Comparison of reflectance of glass.
6. Determination of defects in glass article by visual observation and under Microscopic.
7. Observation of strain by strain viewer.
8. Determination of thermal shock resistance of glass.

**(SECTION – B)**

**(Minimum 2 nos of test)**

**B CERAMIC COATING**

1. Adherence of enamel and glaze.
2. Hardness of enamel coating .
4. Tensile strength.
5. Determination acid and alkali resistance.
6. Change of transfer colours on heating at oxidizing and reducing atmosphere.

**(SECTION – C)**

**(Minimum 6 nos of test)**

**A WHITE WARES AND HEAVY CLAY WARES.**

1. Determination of particles size by Wet sieve analysis.
2. Determination of moisture content by infra-red moisture balance.
3. Determination of optimum deflocculates by measuring viscosity of slips.
4. Measure pH during deflacculation.
5. Determination of bulk density, apparent porosity and water absorption of white ware products.
6. Determination of crazing resistance of glaze by autoclave test.
7. Determination of impact resistance of glazed and unglazed bodies.
8. Testing of thickness of glaze.
9. Determination of CCS and MOR of various white ware bodies.
10. Testing of Building bricks.
  - a) Efflorescence
  - b) CCS
  - c) Water absorption
  - d) Dimensional Tolerance
  - e) Warpage

**(SECTION – D)**  
**(Minimum 3 nos of test)**

**A STUDY OF FOLLOWING EUIPMENTS.**

1. DTA
2. TGA
3. Spectrophotometer
4. Mineralogical Microscope
5. X-RD
6. X-RF

## V-SEM-CER

### TESTING OF CERAMIC RAW MATERIALS & PRODUCTS

**Period/Week: 4 Hours**  
**Theory : 60 period**

**Theory Exam : 3Hrs.**  
**End Term Exam: 80**  
**I.A. : 15 + 5 = 20**  
**Total : 100**

#### Objectives :

After completion of the course, students will be able to :-

1. know importance of testing for quality product.
2. know importance physical and chemical test enquired for various ceramic raw materials and products.
3. know the important test required and their procedure for refractory products.
4. know the important test for ceramic insulation.
5. know the testing Schedule, routine control and quality control required for various ceramic products.

SI. No.	Main Topics	Periods
1.	Introduction	05
2.	Particles size, moisture, plasticity etc.	20
3.	Test after firing.	10
4.	Testing of Refractory	10
5.	Test for electrical insulator	05
6.	Testing Shedule, Routine work & QC.	10

#### COURSE CONTENT

##### 1.0 INTRODUCTION

- 1.1 Importance of Testing of Ceramic Raw materials & products.
- 1.2 Sampling of raw materials.

- 1.3 Selection of products sample for testing.
- 1.4 Various types of testing.
- 2.0 **MEASUREMENT OF MOISTURE:** Determine moisture content of raw materials and plastic body.
  - 2.1 By the help of infrared moisture balance.
  - 2.2 By speed moisture Tester.
  - 2.3 By drying Oven.
- 3.0 **PARTICLES SIZE ANALYSIS:** Determination of particles size of powder materials and Slip.
  - 3.1 By sieve analysis.
  - 3.2 By Sedimentation method
  - 3.3 Stokes law and its application.
  - 3.4 By Andresen Pipette
  - 3.5 Hydrometer method
  - 3.6 Modern method
    - a. Micrometric Sedigraph
    - b. Laser Diffraction particles size Analyzer
- 4.0 **SURFACE AREA**
  - 4.1 By permeametry
  - 4.2 Adsorption & Gas adsorption
- 5.0 **PLASTICITY OF CLAY BODY**
  - 5.1 Factors affecting plasticity.
  - 5.2 Pfefferkon Test for plasticity
  - 5.3 Atterberg plasticity Test.
- 6.0 **PHYSICAL PROPERTIES AFTER FIRING OF CERAMIC PRODUCTS.**
  - 6.1 Density of fired body.
  - 6.2 Apparent and True porosity.
  - 6.3 Water Absorption
  - 6.4 Shrinkage
  - 6.5 Modulus of Rupture.
  - 6.6 Vitrification range
  - 6.7 Thermal & Chemical Analysis.
  - 6.8 X-Ray Fluorescence
  - 6.9 Inductively coupled plasma
  - 6.10 Differential Thermal Analysis
  - 6.11 Thermo Gravimetric Analysis
- 7.0 **TESTING OF ELECTRICAL CERAMIC PRODUCTS.**
  - 7.1 Flash over Test
  - 7.2 Dielectric strength
  - 7.3 power and loss factor
  - 7.4 Specific gravity and water absorption
  - 7.5 True porosity
  - 7.6 strength
  - 7.7 Crazing resistance
  - 7.8 Resistance Acid & alkalies
  - 7.9 Thermal shock resistance.
- 8.0 **TESTING OF REFRATORIES.**
  - Physical Properties
  - 8.1 Density
  - 8.2 Specific gravity
  - 8.3 Porosity
  - 8.4 Permeability and pore size distribution
  - 8.5 Chemical Properties
  - 8.6 Wet Chemical analysis
  - 8.7 By XRF
  - 8.8 Hydration resistance Test
  - 8.9 Mechanical Properties
  - 8.10 Compressive strength
  - 8.11 Bending strength
  - 8.12 Tensile strength
  - 8.13 Elastic Modulus
  - 8.14 High temperature Deformation
  - 8.15 Abrasion resistance
  - 8.16 Thermal properties
  - 8.17 Thermal expansion
  - 8.18 Thermal conductivity
  - 8.19 Thermal shock resistance

**9.0 DESCRIBE THE TESTING SEHEDULE FOR THE FOLLOWING CERAMIC PRODUCTS**

- 9.1 Building Bricks
- 9.2 Roofing Tiles
- 9.3 Salt Glass pipes
- 9.4 Floor tiles
- 9.5 Wall tiles
- 9.6 Sanitary ware
- 9.7 Table ware
- 9.8 Chemical ware

**10.0 DESCRIBE THE ROUTINE CONTROL AND LABORATORY TEST REQUIRED AT REGULAR INTERVAL IN WHITE WARE INDUSTRY.**

11.0 Describe the works control on refractory making.

12.0 Describe the Testing and Quality control for

- a. Table wares
- b. Sanitary wares
- c. Wall titles
- d. Refractory

**13.0 ROBOTICS AND CAD/CAM APPLICATION IN CERAMIC INDUSTRIES.**

13.1 Introduction to Robotics

13.2 Application of Robotics in white ware industry

13.3 Application of Robotic in Refractory industry

13.4 Application of Robotics in furnace operation

13.5 Application of CAD /CAM for ceramic design.

**BOOKS RECOMMENED**

- 1. Industrial ceramic By Singer & Singer
- 2. White ware – W Ryan
- 3. Refractory – Chesti
- 4. Refractory - F.H. Nontom
- 5. Refractory - Nandi

**ENTREPRENEURSHIP & INDUSTRIAL MANAGEMENT**

Total Periods : 75  
 Periods Per week : 05

Full Marks : 80(Th)+- I.A. ( I)  
 Time : 3 hours

( COMMON TO ELECT, ECT, AE&I, MECH,AUTO,CSE,CPA,MET, CHEM, TEX, CER, FT)

**TOPLCWISE DISTRIBUTION OF PERIODS**

<b><u>Sl. No.</u></b>	<b><u>Topic</u></b>	<b><u>Periods</u></b>
1.	Concept of Organisation & Enterprise Management	08
2.	Entrepreneurship & Management of S.S.I. s	14
3.	Financial Accounting & Cost Control	09
4.	Stores & Financial Management	09
5.	Production Management	03
6.	Sales & Marketing Management	03
7.	Human Resource Management	04
8.	Industrial Sickness	04
9.	The Factories Act 1948	05
10.	Workmen's Compensation & Payment of Wages Act	08
11.	Industrial Dispute Act	04
12.	Trade Union Act	04

**RATIONALE**

The course intends to provide the fundamental aspects of entrepreneurship as a means for self employment. Management functions, in an organization, coordinates various resources to allow the manufacturing activities to continue on a sustained basis. It is essential that the diploma engineers are given an exposure industrial activities.

Various statutory rules acts and regulations have been instituted in Indian by Central/State Govt. to ensure that the workmen are not exploited and they can they can earn their livelihood with respect. As a supervisor . manager has to work in an industry under binding of such rules and acts, they should have a fair idea of such rules / acts / regulations.

**OBJECTIVES**

On Completion of the course the student will be able to :

1. Understand the concept of different forms of organisation & Management function.
2. Explain the role of an entrepreneur in industrial environment & detailed idea on SSI and various related aspects.
3. Learn about financial accounting and cost control.
4. Know the different areas of management relating to stores & finance, production, sales & marketing and human resource in he organisation.
5. Understand about the industrial sickness & its remedies.
6. Have a comprehensive idea on some important legislations relating to factory, workmen's compensation, payment of wages, industrial disputes and trade union.

**COURSE CONTENT**

**1. Concept of Organisation & Enterprise & Management.**

- 1.1 Define & state the features of Business.
- 1.2 Explain the components of Business.
- 1.3 State the feature of different forms of Business Organisation.

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- 1.4 Define Management & different Management with Administration.
- 1.5 Discuss the functions of Management.
- 1.6 Discuss the principles of 'Scientific Management'.
- 1.7 Explain organisation structure and delegation of authority & responsibility.
- 1.8 State the principles of a sound organisation.

**2. Entrepreneurship & Management of S.S.I. s**

- 2.1 Define and state the meaning of 'Entrepreneurship'.
- 2.2 Discuss the entrepreneurial characteristics
- 2.3 Explain the role of an entrepreneur in industrial development .
- 2.4 Define S.S.I. , Ancillary , Tiny, Cottage, Medium, & Large scale Industrial .
- 2.5 Explain the features of SSI.
- 2.6 Discuss the criteria for selection of SSI.
- 2.7 Prepare a preliminary & detailed project report of a SSI.
- 2.8 Enumerate the incentives available to SSI as per IPR.
- 2.9 State the inputs required for setting up a SSI.
- 2.10 Discuss the institutional support to SSI at State and National level.  
( OSEC, OSIC, IPICOL, IDCO, SIDBI, IDBI, ICICI & Commercial Banks)

**3. Financial Accounting & Cost Control.**

- 3.1 State the different types of Accounts & explain the double entry system of book keeping.
- 3.2 Explain Journal , Ledger, Trial Balance & Cash Book.
- 3.3 Explain the components of Final Accounts and Balance sheet.
- 3.4 Define Cost and explain its elements.
- 3.5 Prepare a simple cost sheet.
- 3.6 Explain cost – volume – profit relationship & break – even – point.

**4. Stores & Financial Management**

- 4.1 State the procedures involved in purchasing
- 4.2 Explain the centralized & decentralized purchasing.
- 4.3 State the meaning & importance of Inventory control.
- 4.4 Explain the different stores records – Bin Card, Stores Ledger & Goods Received Note etc.
- 4.5 State the meaning & importance of Financial Management in context with S.S.I.
- 4.6 Explain the types of capital – Fixed & Working.
- 4.7 Discuss briefly the components of Working Capital Management .

**5. Production Management**

- 5.1 State the importance of Production, Planning, & Control.
- 5.2 Discuss the steps involved in Production Planning, & Control.

**6. Sales & Marketing Management**

- 6.1 Discuss the importance of sales & marketing management.
- 6.2 Mention & explain different selling methods.
- 6.3 Explain the product policy briefly

( Types of Product, Packaging, Branding, Pricing, Cost Plus pricing, Variable Pricing policy, Price strategy.)

6.4 Enumerate the techniques of sales promotion.

6.5 Explain Advertising & its media.

**7. Human Resource Management**

7.1 Mention the different sources of recruitment.

7.2 Explain the different methods of selection.

7.3 Discuss the different training methods.

7.4 State the need of performance appraisal

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**8. Industrial Sickness.**

8.1 Define & explain the meaning of Industrial sickness

8.2 State the cause of sickness.

8.3 Explain the remedial measures to avoid Industrial Sickness.

**9. The factories Act.**

9.1 State the meaning & objectives of factories Act.

9.2 Outline the various provisions related to Health, Safety, Welfare, Hours of Work, Holidays , Wage , employment of Women , Accidents, Diseases, Penalties & Procedures.

9.3 Explain the duties of Factory Inspector

**10. Workmen's Compensation & Payment of Wages Act.**

10.1 State the rules regarding Workmen's Compensation.

10.2 Explain the employees liability for compensation

10.3 State the obligations and rights of employer.

10.4 Give the meaning of Payment of Wages Act.

10.5 State the different rules for payment of minimum wages.

10.6 State the provision of E.P.F & E.S.I.

**11. Industrial Dispute Act**

11.1 Outline the objects & Meaning of Industrial Dispute Act.

11.2 State the causes of Industrial Dispute.

11.3 Enumerate the machinery set up for settlement of Industrial Disputes

11.4 Explain the measures for prevention of Industrial Disputes.

**12. Trade Union Act.**

12.1 State the meaning & functions of Trade Union

12.2 Explain the features of Trade Union Act 1926.

**Books Recommended :**

1. Industrial Engineering & Management – O.P. Khana
2. Entrepreneurial Development – Gupta & Srivastay.
3. Small Scale Industry – Vasant Desai
4. Business Orgainsation – Sharma & Gupta.
5. Principles & Practice of Management – L.M. Prasad
6. Entrepricurship for Engineers – B. Badhei.
7. Industrial Law – N.D. Kapoor.

## CERAMIC SCIENCE

L                    T                    P  
4                    0                    0

Total Contact Hrs : 60  
Hrs.

Total Marks :100

Theory Exam : 3

Theory : 60

End Term Exam :80

Practical : Nil

I.A. : 15 + 5

(Fundamental ideas only )

**Objectives :** After completion of course study will be able to :

1. Know detail on atomic structure and periodic table.
2. Understand chemical bonding, crystallography.
3. Understand Phase transformation.
4. Know properties of ceramic material.
5. Understand Microstructure of ceramic product.
6. Know effect of Temperature on ceramic materials .

Sl. No.	Major Topics	Periods
1	Atomic Structure	05
2	Chemical Bonding	10
3	Crystallography	10
4	Phase Transformation	10
5	Effect of Temperature	05
6	Conductor Semiconductor	05
7	Properties of Ceramic materials	10
8	Micro structure	05

## COURSE CONTENTS

### 1.0 ATOMIC STRUCTURE AND PERIODIC TABLE.

- 1.1 Discuss Atomic Structure in details
- 1.2 Discuss the importance of the periodic table
- 1.3 Explain electronic configuration of atoms.

### 2.0 CHEMICAL BONDING

- 2.1 Define Chemical Bonding
- 2.2 State and explain different types of bonds like Ionic covalent metallic, vander walls and Hydrogen bond
- 2.3 Bond energy and Bond strength.
- 2.4 State and explain different physical properties based on chemical bond

### 3.0 CRYSTALLOGRAPHY

- 3.1 Define Crystal system
- 3.2 Explain different types of crystal system
- 3.3 Define Crystal Defects
- 3.4 State different types of crystal defects
- 3.5 Draw the following structure of :
  - a. NaCl
  - b. CSCI
  - c. Spinel

- d. Clay
- e. Silicate structure
- f. Structure of glass

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- 3.6 Define solid Solution
- 3.7 Explain Different types of solid solution.

### 4.0 **PHASE TRANSFORMATION ( Fundamental idea only)**

- 4.1 Diffusion
- 4.2 Fix law of Diffusion
- 4.3 Phase Transformation
- 4.4 Define Nucleation and grain crystal growth
- 4.5 State the role of nucleation and grain growth in phase transformation.
- 4.6 Sintering and grain growth
- 4.7 Sintering and Vitrification
- 4.8 Method of Sintering
- 4.9 Factors affecting sintering & vitrification

### 5.0 **EFFECT OF TEMPERATURE**

- 5.1 State the effect of temperature on Silica, Zircon, Magnesite and clay
- 5.2 Describe the different change during firing of Silica and Zirconia kaolin, dolomite, chromite & Graphite etc.
- 5.3 Pyro chemical changes in triaxial bodies

### 6.0 **CONDUCTOR , SEMICONDUCTOR, INSULATORS AND SUPER CONDUCTOR**

- 6.1 Behavopus
- 6.2 Types
- 6.3 Mechanism of condition.
- 6.4 Ceramic Products showing properties of conductor, semi-conductor, insulator

and

super conductor.

### 7.0 **PROPERTIES OF CERAMIC MATERIALS**

- 7.1 State and explain following properties of ceramic material in brief
  - a. Mechanical
  - b. Electrical
  - c. Chemical
  - d. Optical
  - e. Thermal
  - f. Nuclear
  - g. Magnetic
- 7.2. How Ceramic is different from polymer and metals.

### 8.0 **MICRO STRUCTURE**

- 8.1 Define Micro Structure & its characteristics
- 8.2. Various technique of studying microstructure
- 8.3 Describe different types of Micro scopes like :
  - a. Mineralogical Micro Scope
  - b. Electron Microscope

- 8.4 Describe the process to prepare a specimen to study microstructure of typical ceramic materials and products .
- 8.5 Micro Structure of various ceramic white wares and refractories products.
- 8.6 Development of microstructure in relation to sintering and control of microstructure.

**Book Recommended :**

1. Introduction to Ceramics by W.D. Kingery
2. Material Science by V. Ragavan
3. Material Science and Engineering By Natrneet Gupta and R.C. Gupta.
4. Material Science by F. D. Gyanm.

**PROCESS CONTROL & POLLUTION  
CONTROL IN CERAMIC INDUSTRY**

L            T            P  
4            0            0

Total Contact Hrs : 60  
Hrs.

Total Marks :100

Theory Exam : 3

Theory : 60

End Term Exam :80

Practical : Nil

I.A. : 45 + 5

**Objectives** : After completion of study of environment engineering and pollution control, the student will able to

1. Aware air, water, noise pollution and its control
2. Solid waste management and hazardous waste and their effects.
3. Understand methods of pollution control and their standards.
4. Know disaster management.
5. Know about process control and automatic control
6. Know various instrument used for measurement of temperature. Density, viscosity, moisture pH.

Sl. No.	Major Topics	Periods
1	Air Pollution	10
2	Water Pollution	10
3	Pollution Control in industries	10
4	Environment Management	10
5	Process Control	10
6	Instrumentation	10

**COURSE CONTENTS :**

**1.0 AIR POLLUTION** : State and explain

- 1.1 Air pollution
- 1.2 Compositions of air, 1
- 1.3 Nature of air pollution and its effect on environment
- 1.4 Sources of air pollution, quality of air.
- 1.5 Pollution problems in different Ceramic Industries and it will be controlled.
- 1.6 Effect of Air pollution of human being and air born diseases and control of air pollution.
- 1.7 Classify air pollution control equipments and explain their functions.

**2.0 WATER POLLUTION**

- 2.1 State and explain water pollution.
- 2.2 Water pollution by industrial wastes and its effect of environment and on human being.
- 2.3 Evaluate and classify different waste with reference to different ceramic industry.
- 2.4 Describe different water pollution parameters.
- 2.5 Quality of water and testing of water.

**3.0 POLLUTION IN CERAMIC & ALLIED INDUSTRIALS & ITS CONTROL**

- 3.1 Noise pollution in ceramic and other industries.
- 3.2 Effect of noise pollution and its control.
- 3.3 Water and Air pollution by ceramic and other allied industries.
- 3.4 Soil pollution due to various industries and its control.
- 3.5 Role of pollution control board.
- 3.6 Pollution control laws in India .

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### 4.0 ENVIRONMENTAL MANAGEMENT & DISASTER MANAGEMENT

- 4.1 Solid waste management
- 4.2 Waste water Management
- 4.3 Disaster Management
- 4.4 Disaster Mitigation
- 4.5 Environmental management system I.S.O. fourteen thousand. (Introduction

only)

### 5.0 PROCESS CONTROL

- 5.1 Define automatic control system.
- 5.2 Explain Automatic control.
- 5.3 State the elementary idea a about transfer and time constant.
- 5.4 Classify & explain different types of automatic controller.

### 6.0 INSTRUMENTATION.

- 6.1 State & explain density, viscosity, moister pH, electrical conductivity and its determination.
- 6.2 Define temperature scale.
- 6.3 Define pyrometric cone equivalent and explain various steps of cones used in ceramic industry.
- 6.4 Define and explain thermocouple, themister, pyrometer.
- 6.5 Explain the function of temperature measuring instruments in ceramic industries.

### Book Recommended:

- 1. Instrumentation – S.K. Singh
- 2. Fundamentals of Automatic Process Control – A.S. Narayan.
- 3. Environmental Chemistry – A.K. De.
- 4. Air Pollution – M.N. Rao
- 5. Environmental Engineering – Raw & Pearvy
- 6. Environmental Pollution Control by Wiely.

**SPECIAL CERAMIC**

L            T            P  
4            0            0

Total Contact Hrs : 60  
Hrs.

Total Marks :100

Theory Exam : 3

Theory : 60

End Term Exam :80

Practical : Nil

I.A. : 45 + 5

(Fundamental idea only )

Objectives : After completion of course student will be able to

1. Know about latest development of ceramic in various area.
2. Know uses of electrical and electronic ceramic for engineering purpose .
3. Know various abrasive products and there uses
4. know ceramic material systems and ceramic composites and their application
5. Know bio-ceramic products and their application.
6. Understand application of special ceramics and Fibres and Whiskers in various industries.

Sl. No.	Major Topics	Periods
1	Classification of Special Ceramic	02
2	High Temperature material	15
3	Electric and Electronic Material	10
4	Abrasives	10
5	Fibre and Whisker	10
6	Ceramic Metal system	05
7	Glass Ceramic.	08

**COURSE CONTENTS :****1.0 CLASSICIZATION OF SPECIAL CERRAMICS**

- 1.1 Define spécial ceramic
- 1.2 Classification of Spécial Ceramic
- 1.3 Importance of Spécial Ceramic

**2.0 HIGH TEMPERATURE CERAMICS (Manufacturing, Properties & application)**

- 2.1 Introduction of High Temperature Ceramics.
- 2.2 Explain the properties and application of the following oxide Ceramics. :
  - a. Alumina
  - b. Silica
  - c. Zirconia
  - d. Thoriam oxide

**2.3 EXPLAIN THE PROPERTIES OF NON OXIDE CERAMIC**

- a. Carbide ceramics
- b. Borides ceramics
- c. Nitrides ceramics
- d. Sialon

**3.0 ELECTRICAL AND ELECTRONICS CERAMICS**

- 3.1 Define Dielectric ceramics.

- 3.2 Explain properties and uses of dielectric ceramics.
- 3.3 Define Ferro Electric pyroelectric ceramics.
- 3.4 Explain properties and uses of ferro electric.
- 3.5 Steatite ceramics properties & application.
- 3.6 Define ceramic semi conductor.
- 3.7 Explain the properties and uses of ceramic semi conductor.

#### Electric Ceramics

### VI- SEM- CER

- 3.8 Define Capacitor, conductor and Register.
- 3.9 Explain the use of capacitor conductor and register.
- 3.10 Define Integrated circuits.
- 3.11 Explain the use of Integrated circuit.
- 3.12 Define Ferrites
- 3.13 Explain following types of Ferrites
  - a. Spinel
  - b. Manganese zinc
  - c. Nickel-zinc.
- 3.14. Differentiate between hard and soft Ferrites with example.
- 3.15. Explain the manufacturing process of :
  - a. Arial Roads
  - b. Memory Core.
  - c. Permanent magnets.

#### 4.0 ABRASIVES

- 4.1 Classification and properties
- 4.2 Process for manufacturing of abrasive grains
- 4.3 Bonded & Coated abrasives
- 4.4 Ceramic cutting tolls
- 4.5 Fundamental of grinding & Polishing

#### 5.0 FIBRES AND WHISKERS

- 5.1 Define fibre whiskers
- 5.2 Various types of fibres and whiskers
- 5.3 Property's and application

#### 6.0 CERAMIC METAL SYSTEM

- 6.1 Define ceramets
- 6.2 Explain Metals ceramics.
- 6.3 Ceramic composites
- 6.4 Define composites.
- 6.5 Classification of composites
- 6.6 Properties of Ceramic composites
- 6.7 Application. of Ceramic composites

#### 7.0 SPECIAL CERAMIC FOR BIOLOGICAL USE.

- 7.1 Define Bio Ceramics
- 7.2 Explain Bone Morphology
- 7.3 Explain the use of Bio Ceramics.

#### Books Recommended :

- 1. Industrial Ceramics By Singer & Singer
- 2. Material Science and Engineering By Gupta and Gupta
- 3. Introduction to Ceramics by W.D. Kingery
- 4. Ceramic material for Electronics By Heneb & West.

5. Special ceramic by popper
6. Magnetic ceramic by Richerson

**REFRACTORIES FOR METALLURGY AND  
ALLIED INDUSTRIES (ELECTIVE)**

L                    T                    P  
4                    0                    0

Total Contact Hrs : 60  
Hrs.

Total Marks :100

Theory Exam : 3

Theory : 60

End Term Exam :80

Practical : Nil

I.A. : 45 + 5

**Objectives :** After completion of course student will be able to

1. Understand heat transfer by refractories.
2. Know ferrous, and non-ferrous refractories.
3. Understand the uses of refractories in chemical, thermal power plant, and cement industries etc.
4. Know the refractories us in spong Iron , Coke oven , ceramic and glass kiln.
5. Know refractories for energy conservation .

Sl. No.	Major Topics	Periods
1	Heat transfer by refractory	05
2	Ferrous metal refractories	15
3	Non ferrous metal refractories	10
4	Refractories in fertilizer and petrochemical Industries	05
5	Refractories in Cement industries	05
6	Refractories in power plant	05
7	Refractories in Iron Alloys	05
8	Refractoris for ceramic kilns and furnances	10

### 1.0 HEAT TANSMISSION BY REFRACTORIES

- 1.1 Explain Theory of heat transfer through a porous body.
- 1.2 Explain measurement of thermal conductivity value for refractories.
- 1.3 Discuss flow of heat, through walls of furnace under variable conditions.
- 1.4 Explain heat losses, heat balance and heat recovery.

### 2.0 FERROUS METAL REFRACTORIES :

- 2.1 Describe various types of refractories used in Iron making process such as Blast Furnace, Open Earth Furnace, Cupola. - BOF Laddle LRF , EAF and Tandis.
- 2.2 Hot Stove and Torpedoladdle.
- 2.3 State and explain slide gate Refractories.
- 2.4 Explain plates, sliding plate, fixed plate and Collecting nozzle, Laddle Nozzle, Well Block.
- 2.5 Discuss Continuous casting refectories/ Mono Block, Shroud, sub entry Nozzle. Stopper.
- 2.6 Discusses the process of Iron making and steel making in details.

### 3.0 NON FERROUS METAL REFRACTORIES

Discuss the following in brief:-

- 3.1 Refractories for flash smelter.

- 3.2 Copper converter
- 3.3 Carbon anode Furnace refractories.
- 3.4 Submerge electric Arc Furnace for slag cleaning.
- 3.5 Zinc reort.
- 3.6 Zinc smelter.
- 3.7 Discuss the process of non- ferrous metal extraction of the follow:

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- a. Aluminum
- b. Copper
- c. Zinc

#### **4.0 FERTILIZER AND PETROCHMICAL INDUSTRY**

Explain the following terms and mention the refractions used for the same.

- 4.1 Secondary reformer, Primary Reformer, Heaters
- 4.2 Rotary kilin for calcinations of coke.
- 4.3 Refractories for carbon black Industry.

#### **5.0 REFRACTORIES IN CEMENT INDUSTRY**

- 5.1 Describe Rotary kiln & refractories use in different zones in details.
- 5.2 Vertical shaft kiln for mini cement plant.
- 5.3 Describe Refractories used in vertical shaft kiln.

#### **6.0 REFRACTORIES IN POWER PLANT.**

Describe the requirement of refractories of the following in brief.

- 6.1 Thermal power plant.
- 6.2 Nuclear power plant

#### **7.0 REFRACTORIES USES IN FERRO-ALLOYS INDUSTRY**

Explain in brief

- 7.1 Ferro-Chrome plant.
- 7.2 Ferro-Manganese plant.
- 7.3 Ferro-vanadium plant.
- 7.4 Ferro silicon plant.
- 7.5 Spong iron making

#### **8.0 REFRACTORIES FOR CERAMIC KILN**

- 8.1 Refractories for D.D. kiln construction
- 8.2 Refractories for tunnel kiln construction
- 8.3 Refractories for shuttle kiln.
- 8.4 Refractories for Roller hearth kiln.
- 8.5 Kiln furniture
- 8.6 Refractories for energy conservation
- 8.7 Refractories for glass industry

#### **9.0 REPAIRING AND MAINTENANCE OF FURNANCES**

- 9.1 Lining of Blast furnace
- 9.2 Lining of BOF
- 9.3 Lining of E.A.F.
- 9.4 Hot repairing of steel making furnance
- 9.5 Study of coke oven brick shapes and their lining.

#### **Books Recommended:**

- 1. Refractories production and Properties by J.H. Chester.
- 2. Refractories by M.L. Mishra.
- 3. Refractories by Chesti.
- 4. Refractories by Nandy.
- 5. Refractories by Norton.

6. Industrial ceramics by Singer and Singer.

**OXIDE, NON OXIDE CERAMICS AND  
CERAMICS COMPOSITIONS ( ELECTIVE)**

L                    T                    P  
4                    0                    0

Total Contact Hrs : 60  
Hrs.

Total Marks :100

Theory Exam : 3

Theory : 60

End Term Exam :80

Practical : Nil

I.A. : 45 + 5

**Objectives :**

After completion of this course, students will be able to

1. know various s Oxide Ceramics, non-oxide ceramics and ceramics Composites.
2. know the various application of the above special ceramics.
3. know the general idea on the production of above special ceramic products.

Sl.No.	Major Topics	Periods
1	Oxide Ceramics	25
2	Non Oxide Ceramics	25
3	Ceramic Composites	10

**COURSE CONTENT**

**1.0 OXIDE CERAMICS**

- 1.1 Introduction to crystal structure
- 1.2 Structure of Oxide ceramics
- 1.3 Describe the manufacturing method, properties and application of the following in

brief.

- |                                |                                |
|--------------------------------|--------------------------------|
| a. $\text{Al}_2\text{O}_3$     | f. $\text{MgO-Al}_2\text{O}_3$ |
| b. Mullite                     | g. $\text{TiO}_2$              |
| c. $\text{Cr}_2\text{O}_3$ ,   | h. $\text{ZrO}_2$              |
| d. $\text{MgO}$                | i. $\text{ZrO}_2\text{-SiO}_2$ |
| e. $\text{MgO-Cr}_2\text{O}_3$ | j. $\text{MgO-SiO}_2$ ceramics |

**NON OXIDE CERAMICS**

- 2.1 State and explain the following non oxide ceramics.
- 2.2 Testing, properties and application of the following non-oxide ceramics
  - 2.2.1 Carbides
  - 2.2.2 Nitrides
  - 2.2.3 Silicides
  - 2.2.4 Graphite

**3.0 CERAMIC COMPOSITES**

- 3.1 Classify ceramic composites.
- 3.2 Describe influence of microstructure on properties of composites.
- 3.3 State and explain constitute of composites.
- 3.4 Describe Portland cement glass fibre composites, oxide ceramist.
- 3.5 Explain fibre glass reinforced gypsum, organometallic compounds in brief.
- 3.6 Describe manufacture , properties, application and testing of composites in brief.

**Books recommended**

1. Industrial ceramics by Singer and Singer
2. Structural ceramics by J.B Watchman.
3. Electro ceramics by Edited by A.J. Manison and Other BIC, U.R.
4. Introduction to Technical ceramics by B. Wave.

## VI- SEM- CER

### CERAMIC KILN AND PRODUCT DRAWING

L	T	P
4	0	0

Total Contact Hrs : 60  
Hrs.

Total Marks :100

Practical Exam. : 3

Theory : Nil  
Marks

Sessional : 25

Practical :  
Marks

End Exam : 25

**Objectives :** After taking this course the student will be able to :

- i) sketch and draw to measurement various furnace, kin.
- ii) sketch and draw various electrical insulators, tableware, sanitary wares and mould of various product.
- iii) sketch and draw symbols of equipment used in ceramic and chemical industries.
- iv) represent a process with the help of flow charts.

#### **COURSE CONTENTS**

1. Draw different types of shapes used in furnace construction.
2. Furnace / Kiln drawing – Draw the following
  - i. Down draft kiln.
  - ii. Tunnel Kiln.
  - iii. Muffle kiln.
  - iv. Chamber Kiln.
3. Draw various types of
  - a. Electrical insulators
  - b. Tableware
  - c. Sanitary wares and mould of various products.
4. Sketch symbols of Equipment used in ceramic and chemical industries.
5. Plant lay out of various ceramic industries.

#### **Book recommended :**

1. Industrial ceramics by Singer and Signer.
2. Outline of chemical engineering.
3. Refractories by Chesty.
4. Refractories by Nandi.

**CERAMIC TESTING – IV**

L                    T                    P  
0                    0                    4

Total Contact Hrs : 60  
Hrs.

Total Marks :50

Practical Exam. : 3

Theory : Nil  
Marks

Sessional : 25

Practical : -4  
Marks

End Exam : 25

**SECTION-A****MINIUME FIVE NUMBER OF TESTINGS TO BE PRACTICED BY THE STUDENT****CHEMICAL ANALYSIS OF CERAMIC RAW METERIALS AND PRODUCTS.**

1. Sampling
2. Determine of loss on Ignition.
3. Opening of sample by fusion for analysis
4. Estimate of SiO<sub>2</sub>.
5. Estimate of Al<sub>2</sub>O<sub>3</sub>
6. Estimate of TiO<sub>2</sub>
7. Estimate of Fe<sub>2</sub>O<sub>3</sub>
8. Estimate of CaO
9. Estimate of Mgo
10. Analyse of Glaze, enamel and frits.
11. Analyse of Glays.
12. Estimation of hardness of water using EDTA.

**SECTION-B**

1. To study of DTA apparatus
2. To Study TGA apparatus
3. To study of flame photometer
4. To study microstructure of ceramic products
5. To study spectrophotometer
6. To study particle size analyzer

**MACHINE EQUIPMENTS FOR CERAMIC TESTING LABROTORY –I, II, III & IV**

<b>SL No.</b>	<b>Name of Equipment</b>
1	Drier
2	Muffle furnace
3	Speedy moisture Telter
4	Infrared moisture Balance
5	pH meter
6	BS Sieve & BIS Sieves
7	Vicat Apparatus
8	Le- Chaterlear
9	Tensile Testing machine
10	RUL Furnace
11	Dilatometer
12	MOR Machine
13	PCE Furnace
14.	Auto claves
15.	DTA
16	TGA
17	Mineralogical microscope
18	Particle size analyzer
19	CCS Machine
20	Hydro meters
21	Torsion Viscometer
22	Permeability apparatus
23.	Anderson pipatte
24	Pffiercon apparatus
25	Strain viewer
26	Spectrophotometers
27	Refractometer
28	Glossymeter
29	Water softner

**FUEL TESTING LAB**

1	Muffle furnace
2	Thermo couple
3	Optical Pyrometer
4	Flash Point apparatus
5	Viscometer
6	Bombealorimeter
7	Orsat apparatus

## MACHINE EQUIPMENTS FOR CERAMIC WORKSHOP

SI NO.	Name of Equipment
1	Weighing Balance
2	Muffle furnace 1600 <sup>o</sup> C
3	Raw materials sample
4	Ball mill
5	Pot mill
6	Potter's wheel
7	Magnetic separator
8	Refractory Bricks moulds
9	Sieve shaker
10	Jigger jolley
11	Potters wheel
12	Toggle Press
13	Blunger
14	Jaw crusher (Lab type)
15	Pug mill (Lab type)
16	Vibrating table
17	Vibrating screen
18	Filter press (Lab type)
19	Moulds for bricks and tiles
20	Painters wheel
21	Grinder
22	Spray Drier (Lab type)
23	Atritor
24	Mixing machine for plaster (Lab type)

**BASIC COMPUTER APPLICATION IN CREAMIC INDUSTRY****Total Contact hrs. : 60****Total Marks : 100****Theory Exam : 3Hrs.****Theory : 60 period****End Term Exam: 80****I.A. : 15 + 5 = 20****Total : 100****Objectives :** After completion of the course, students will be able to:

1. Know the use of computer in ceramic industries and computer design in various ceramic products and also know ceramic in computer.

SI No.	Major Topics	Periods
1	Scope of Computer in Ceramic Industry	05
2	Operating System	10
3.	Computer Language	10
4.	Computer and Communication	10
5.	Computer Designing in Ceramic Industry	15
6.	Ceramic in Computer	10

**COURSE CONTENT****1.0 Scope of Computer in Ceramic Industry.**

1.1 Define Computer

1.2 Explain the necessity of computer in ceramic industry.

**2.0 OPERATING SYSTEM**

2.1 Describe operating systems.

2.2 State operating systems fundamental and roots of M.S. DOS.

**3.0 COMPUTER LANGUAGE**

3.1 Define Assembly Language.

3.2 Explain Higher level programming language like C.C. etc (Fundamental idea only)

3.3 Solve simple programming on decision controlling structure.

3.4 State application of computer language in ceramic industry.

**4.0 COMPUTER AND COMMUNICATION**

4.1 Define Internet and World Wide (network) Web

4.2 State communication protocol

4.3 Explain Fundamental idea about HTML, JAVA script.

4.4 Explain importance of Dream weaver.

4.5 State application in Ceramic and cement industry.

**5.0 COMPUTER DESIGNING IN USE OF CERAMIC**

5.1 Explain Computer Aided Designing.

5.2 State Application of computer in design.

- 5.3 Explain the typical cad system.
- 5.4 Define Computer aided manufacturing.
- 5.5 State manufacturing planning and control
- 5.6 Explain computer integrated manufacturing (CAD/CAM)
- 5.7 Define Robotics.
- 5.8 State and explain Robot Anatomy.
- 5.9 Explain common robot configuration
- 5.10 State robot control system
- 5.11 Explain Sensors in robotics.
- 5.12 Define Robot programming and robot language.
- 5.13 State application of robotics and designing in ceramic industry.

## **6.0 CERAMIC IN COMPUTER**

- 6.1 Explain different ceramic materials (specially electronic ceramic) like memory core integrated circuit, semi-conductor, capacitor used in computer.
- 6.2 States inter relation between ceramic and computer.

## **BOOKS RECOMMENDED**

1. Introduction to Technical Ceramics by B.E. Waye.
2. Automation, production and computer integrated manufacturing by Michell. P. Grover.
3. Computer fundamental by V Rajaramana
4. Let us see by Yasvant Kanitkar
5. Principles of electronic ceramics by L.L. Hence and West.

**V-SEM-CER- Tech.**

## **DENTAL CERAMICS**

**Total Contact hrs. : 60**  
**Theory : 60 period**

**Total Marks : 100**

**Theory Exam : 3Hrs.**  
**End Term Exam: 80**  
**I.A. : 15 + 5 = 20**  
**Total : 100**

**Objectives :** After completion of the course, students will be able to:

1. Know about Bio ceramic Application
2. Know Dental Porcelains manufacturing.
3. Know various types of Dental cement
4. Know Bio-ceramic for medical application

SI No.	Major Topics	Periods
1	Introduction Bio-Ceramic	05
2	Dental Ceramic Material	10
3.	Dental Porcelains	15
4.	Dental Cement	10
5.	Abrasion & Polishing Materials	10
6.	Metal ceramic & all ceramics	10

## **COURSE CONTENT**

### **1. INTRODUCTION OF BIO-CERAMICS**

Definition of Bio-ceramics

### **2. TYPES OF BIO CERAMICS MATERIALS AND MEDICALS APPLICATION:**

Alumina, Zirconia, Carbon, Calcium phosphate ceramic (CRC), Bioglass ceramic and ceramic composite with brief applications

#### **TYPES OF BIO CERAMICS:**

Bioinert ceramics, Biodegradable ceramics & Bioactive ceramics with each definition.

#### **ARTIFICIAL BONE AND JOINTS:**

Briefly explain and draw artificial alumina bone and joints.

Briefly explain & draw the alumina head metal stem and HDP socket

Draw the human body skeleton (ortho structure) and also mention the example of applications of bio-ceramic artificial bone & joints.

### **3. INTRODUCTION OF DENTAL CERAMIC MATERIALS:**

Definition of dental ceramic, applications, classification of dental ceramics. CLCP, LEP, HLFP, Glass ceramic, specialized core ceramics and CAD CAM ceramics. Dental ceramic classified by type, by use, by processing method, by substructure materials.

### **4. DENTAL PORCELAINS**

Definition, classification, raw materials, composition, manufacturing of dental porcelain.

### **5. COLORS AND SHADES:**

Factors affecting the colors of ceramics, shades matching explain briefly guidelines.

### **6. METAL CERAMIC & ALL CERAMICS RESTORATIONS:**

Metal ceramic restoration : Porcelain condensation, firing procedure, add-on shading materials, cooling, cast copying, explain briefly porcelains used in the construction of a metal ceramic crown with diagram.

Technical aspects of metal ceramic restorations. Benefits and drawbacks of metal ceramics.

## **ALL CERAMICS RESTORATIONS :**

Ceramic jacket crown (CJC), Glass ceramic crown, Injection molded glass ceramic (IPS Empress), Glass-Infiltrated Alumina Core Ceramic, Ceramic Veneers, Inlay & onlays, CAD CAM Ceramics with brief explanation of each.

### **7. DENTAL CEMENTS**

Definitation of dental ceramic classification of dental cement silicate cement, zinc phosphate cement, zinc oxide eugenol cement, glass innomer cements, zinc silicophosphte cement, zinc polycarboxylane cement, resin cement, calcium hydroxide cement. Composition properties and application of each cement.

### **8. DENTAL GYPSUM PRODUCTS**

Introduction, definition, chemical formula, manufactures gypsum products. Dental plaster, dental stone & improved stone with each brief explanation other gypsum products. Theories of setting, setting reactions, Water plaster ratio, setting time, measurement of setting time, factors effecting setting time. Setting expansion Normal & hydrosopic setting expansion. Brief expansion. Difference between dental plaster & dental stone.

### **9. CASTING PROCEDURES FOR DENTAL ALLOYS AND CERAMICS**

Steps in casting (14 steps). Defects in casting. Mention some important defects.

### **10. ABRASION & POLISHING MATERIALS.**

Types of abrasives, grading of abrasive, difference between abrasive and polishing.