

**STATE COUNCIL OF TECHNICAL EDUCATION AND VOCATIONAL TRAINING, ODISHA**  
**TEACHING AND EVALUATION SCHEME FOR DIPLOMA IN ENGINEERING COURSES**  
**DISCIPLINE: CERAMIC TECHNOLOGY**  
**SEMESTER: 3<sup>RD</sup>**

SL. SUBJECT NO. CODE		SUBJECT	PERIODS			EVALUATION SCHEME				TOTAL MARKS
			L	T	P	INTERNAL EXAM	END SEM	TERM WORK	PRACTICAL EXAM	
			TA			CT	Total	EXAM		
THEORY										
1.	MET 321	ELEMENTARY MECHANICAL ENGINEERING	4	-	-	10	20	30	70	100
2.	CTT 301	CERAMIC SCIENCE-I	4	-	-	10	20	30	70	100
3.	CTT 302	PROCESS CERAMIC	4	-	-	10	20	30	70	100
4.	CTT 303	CERAMIC RAW MATERIAL	4	-	-	10	20	30	70	100
5.	CTT 304	OPERATIONAL CERAMIC	4	-	-	10	20	30	70	100
PRACTICAL/TERM WORK										
6.	CTP 301	CERAMIC LAB	-	-	6	-	-	-	-	100
7.	MEP 321	WORKSHOP PRACTICE II	-	-	4	-	-	-	-	75
8.	CTP 302	CERAMIC TESTING I LAB	-	-	6	-	-	-	-	50
9.	CTP 303	TECHNICAL SEMINAR	-	-	3	-	-	-	-	75
GRAND TOTAL			20	19	40	80	120	380	100	750

Total Contact hours per week: 39

Abbreviations: L-Lecture, T-Tutorial, P-Practical, TA-Teacher's Assessment, CT-Class test  
 Minimum Pass Mark in each Theory Subject is 35% and in Practical subject is 50%

## ELEMENTARY MECHANICAL ENGINEERING

Period/Week: 4 Hours  
Theory : 60 period

Theory-I

Theory Exam : 3Hrs.  
End Term Exam: 70  
I.A. : 20 + 10 = 30  
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, Machines Tools and Maintenance Engineering.

### COURSE CONTENTS (in terms of specific objectives)

#### 1.0 CHAPTER -1

- 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 Explain the mechanism of boiler
- 5.2 Define fire tube, water tube, crank, crank shaft

- 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 them 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.



## CERAMIC SCIENCE-I

## III-SEM-CER

Period/Week: 4 Hours

Theory : 60 period

(Theory-2)

Theory Exam : 3Hrs.

End Term Exam: 70

I.A. : 20 + 10 = 30

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.

Topic wise distribution of periods

Sl. No.	Main Topics	Periods
1.	Thermodynamics & thermo chemistry.	20
2.	Phase rule & Phase diagram	20
3.	Colloids	10
4.	Thermal Analysis & Spectrometry	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 Distinguish between second law of thermodynamics and 1<sup>st</sup> law of thermodynamics.
- 1.13 Explain the postulate of 2<sup>nd</sup> law of thermodynamics.
- 1.14 Explain efficiency of a machine.
- 1.15 Explain carnot cycle.
- 1.16 Explain absolute scale of temperature.
- 1.17 State and explain free energy.
- 1.18 Define entropy and chemical potential.
- 1.19 State the importance of thermodynamics in ceramics in ceramic industry.
- 1.20 State and explain 3<sup>rd</sup> law of thermo dynamics.

## 2.0 PHASE RULE AND PHASE DIAGRAM

- 2.1 Define equilibrium, phases, components, degree of freedom, system.
- 2.2 Concept on equilibrium diagram, heating and cooling curve
- 2.3 Phase rule, one component, two component and three component system
- 2.4 Explain importance of phase diagram and its application
- 2.5  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ - $\text{SiO}_2$ ,  $\text{CaO}$ - $\text{MgO}$ , and  $\text{MgO}$ - $\text{Al}_2\text{O}_3$  System

## 3.0 COLLOIDS

- 3.1 Define and classify colloids.
- 3.2 State & Explain different method of preparation of colloids.
- 3.3 Application of colloids in ceramic making and in other areas
- 3.4 Base exchange capacity, flocculation, deflocculation & clay water system
- 3.5 Sol & gel, preparation & properties
- 3.6 Preparation of ceramic powder through sol & gel process

## 4.0 THERMAL ANALYSIS AND SPECTROSCOPY

- 4.1 State and explain spectrophotometry.
- 4.2 Define spectroscopy and describe various types of spectrophotometers.
- 4.3 Determination of various elements by spectroscopy (introduction only)
- 4.4 State Beer's law and describe its application.
- 4.5 Discuss different application of spectro photometry.
- 4.6 Description of atomic absorption spectrophotometers.

## 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.



## PROCESS CERAMICS

Period/Week: 4 Hours ( Theory-3)  
Theory : 60 period

Theory Exam : 3Hrs.  
End Term E10am: 70  
I.A. : 20 + 10 = 30  
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.

Sl. 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 Plastic forming and pressing. State & explain the following :
  - ✓ a. Various types of plastic forming methods and their principles.
  - ✓ b. Theory of practical packing. → *particle*
  - ✓ c. Practical size distribution.
  - ✓ d. Principles of some special forming methods. Such as Isostatic pressing Vibration compaction, Reaction hot pressing. Injection moulding,
  - e. Defects occur in plastic forming and pressing operation. Advance method for ceramic processing

#### 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 in drying.
- ✓ 3.4 Description of various industrial drier.
- ✓ 3.5 Explain various drying defects and their elimination

#### 4.0 FIRING BEHAVIOUR

- ✓ 4.1 State and explain various types of firing process
- ✓ 4.2 Explain various changes during firing operation
- ✓ 4.3 Discuss various firing defects and their elimination
- ✓ 4.4 Various stages of firing ceramic wares
- 4.5 Advance firing process in ceramic manufacturing

#### BOOKS RECOMMENDED:

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



## CERAMIC RAW MATERIALS

Period/Week: 4 Hours

Total Contact hrs. : 60

Theory Exam : 3Hrs.

End Term Exam: 70

I.A. : 20 + 10 = 30

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 minerals & rocks.
3. Understand the properties of minerals.
4. Understand clay in details.
5. Know the ceramic raw materials and their properties & application.
6. Understand the binders, additives, chemicals used in ceramic making.
7. understand the use of waste material for making ceramic

Sl. No.	Main Topics	Periods
1	Elementary Geology	10
2	Types of clay & their properties and uses	10
3	Major ceramic Raw materials	20
4	Availability of ceramic raw materials	05
5	Beneficiation of ceramic raw materials	05
6	Binder & additives used as raw material.	05
7	Utilisation of waste as ceramic raw materials	05

### COURSE CONTENTS

#### 1.0 ELEMENTARY GEOLOGY –

- 1.1 Various Branches of Geology.
- 1.2 Origin of earth and earth's crust.
- 1.3 weathering process.
- 1.4 Various types of rock & formation.
- 1.5 properties of minerals & their formation.
- 1.6 Important economic minerals.

#### 2.0 CLAY

- 2.1 Classification of clay.
- 2.2 Various types of clay & their properties & application.
- 2.3 Clay minerals & formation of clay.

#### 3.0 MAJOR CERAMIC RAW MATERIALS



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Discuss the properties and uses of the following ceramic raw materials.

3.1 Silica – Quartz, Quartzite and Glass sand.

3.2 Lime & Magnesia bearing minerals Lime stone, Dolomite, Magnesite  
Calcite and Gypsum.

3.3 Alumina Anhydrous – Bauxite, Diaspora, Pyrophyllite.

3.4 Aluminosilicate – Sillimanite, Kyanite, Andalusite.

3.5 Magnesium silicate – minerals – Talc, Forsterite, Steatite.

3.6 Fluorine minerals – Fluorapatite, cryolite.

3.7 Boron Compound Borax.

3.8 Graphite, Chromite & Zircon.

3.9 Feldspar and other fluxes, Nepheline, Sodalite, Wollastonite.

3.10 Misc : olivine, asbestos, rutile, vermiculite, mica, beryl & lithium mineral.

4.0 Availability of ceramic raw materials

4.1 Describe availability of various ceramic raw materials in India and special emphasis to  
state of orissa.

5.0 Beneficiation of ceramic raw materials

5.1 Prospecting of ceramic raw materials.

5.2 Washing of china clay.

5.3 Refining of china clay.

5.4 Benefaction of non plastic ceramic raw materials.

6.0 Binder.

6.1 additives used as ceramic raw materials.

6.2 chemicals & minor ingredients used in ceramic industries.

7.0 Utilisation of waste as ceramic raw materials

7.1 use of fly ash

7.2 use of blast furnace slag.

7.3 use red mud.

7.4 use of rice husk.

7.5 use of phosphogypso.

Period/Week: 4 Hours

Operational Ceramic

I.A.: 20+ 10 = 30

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.

Sl. No.	Main Topics	Periods
1.	Size Reduction	15
2.	Body Preparation	15
3.	Forming Machines	20
4.	Drier & Conveyers	05
5.	Kiln accessories	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) Agitator

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 ceramic slip
- 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 Screw Press.
    - d) Vibro Press.
    - e) Rotary Press.
    - f) Isostatic Press.
    - g) General Idea about machines and equipment required for glazing operation.
- 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 KILN ACCESSORIES
  - 5.1 Various types of kiln accessories
  - 5.2 Kiln furniture

**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: 50  
Total : 75

*(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. By Speedy moisture tester.
10. Sieve analysis of various raw materials & study various types of sieve.
11. Testing of slip.
12. Determine the grinding efficiency of ball mill.
- 13.
14. Study the rate of heating and cooling of Electric furnace and drying oven.
15. Determine moisture content of clay and ceramic raw materials. By the help of dryer.
16. Determine moisture content of clay and ceramic raw materials. By the help of infrared moisture balance.
17. Determine  $P^h$  of liquid solution and clay slip.



**CERAMIC WORKSHOP - I**

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

**Total marks=75**

**Practical Exam: 4hrs**  
**End Exam. 50 marks**  
**Sessional : 25**

**(Minimum 10 nos of jobs to be prepared)**

- 1) Study the machine and equipment available in the ceramic department.
- 2) Identification of various minerals and ceramic raw materials by visual observation.
- 3) Prepare various type of model by the help of plastic clay.
- 4) Prepare one piece moulds by the help of plaster of paris
- 5) Prepare two piece mould by the help of plaster of paris
- 6) Study crushing and grinding of raw materials with jaw / roller crusher, edge runner, ball mill.
- 7) Study charging the batch in ball mill or pot mill.
- 8) Study operation of fitter press.
- 9) magnetic separation of iron bearing particles.
- 10) Sieve analysis.
- 11) Study operation of filter press, de-watering pug mill.
- 12) Study operation of potters wheel and jigger jolley.
- 13) Observe various ceramic raw materials used for white ware and refractory making.
- 14) Study the operation of de-airing pug mill.

## 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 – H. 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. Engines (two stroke, four stroke, Diesel and Petro) Engines)
2. Boiler and checking its different parts.
3. Study and sketching of reciprocating pumps, rotary pumps.
4. Air compressor.