

**STATE COUNCIL FOR TECHNICAL EDUCATION AND VOCATIONAL TRAINING, ODISHA**

**TEACHING AND EVALUATION SCHEME FOR 4<sup>th</sup> SEMESTER (CERAMIC Technology) (Wef 2019-20)**

Subject Number	Subject Code	Subject	Periods/ week		Evaluation Scheme				
			L	T	P	Internal Assessment/Sessional	End Sem Exams	Exams (Hours)	Total
<b>Theory</b>									
Th1		Refractory Technology	4			20	80	3	100
Th2		Ceramic Science	4	1		20	80	3	100
Th3		Fuels and Ceramic kiln	4			20	80	3	100
Th4		Process Control in Ceramic Industry	4			20	80	3	100
		<b>Total</b>	16			80	320	-	400
<b>Practical</b>									
Pr.1		Work Shop-II	-	-	6	50	50	3	100
Pr.2		Ceramic Testing-II	-	-	6	50	50	3	100
Pr.3		Fuel Testing Lab-I	-	-	3	50	50	3	100
Pr.4		Technical Seminar	-	-	4	50	-		50
		Student Centred Activities (SCA)		-	3	-	-	-	
		<b>Total</b>	16		22	200	150		350
		<b>Grand Total</b>	16	1	22	280	470		750

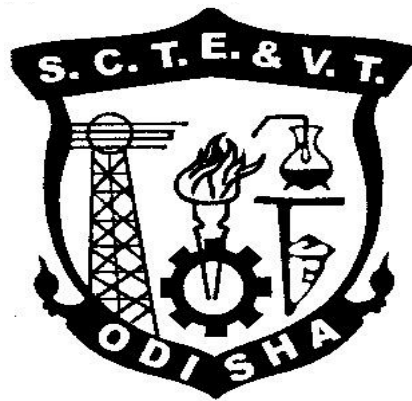
Abbreviations: L- Lecturer, T- Tutorial P-Practical. Each class is of minimum 55 minutes duration

Minimum Pass Mark in each Theory subject is 35% & in each Practical subject is 50 % & in Aggregate Is 40%

**SCA Shall Comprise of Extension Lectures/ Personality Development / Environmental issues/ Quiz /Hobbies/Field visits / Cultural activities /Library studies / Classes on MOOCS/SWAYAM etc. Seminar and SCA Shall be conducted in a section**

**There shall be 1 Internal Assessment done for each of Theory subject. Sessional Marks shall be total of the performance of individual difference job / experiments in a subject throughout the semester**

**CURRICULLUM OF 4<sup>TH</sup>SEMESTER**  
**For**  
**DIPLOMA IN CERAMIC TECHNOLOGY**  
**(Effective FROM 2019-20Sessions)**



**STATE COUNCIL FOR TECHNICAL  
EDUCATION & VOCATIONAL TRAINING,  
ODISHA, BHUBANESWAR**

# Th1. REFRACTORY TECHNOLOGY

Name of the course: Diploma in CERAMIC TECHNOLOGY			
Course code:		Semester	4th
Total Period	60	Examination :	3 hrs
Theory periods :	4p / week	Internal assessment	20
Tutorial			
Maximum marks	100	End Semester Examination ::	80

## A. Rationale:

Refractory is one of the important part of ceramic subject. For industrialization refractory plays an important role. So student of ceramic technology must aware of the quality,properties, production process and application of refractories in details.

## B. 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 the properties and testing of refractories in details
3. Understand the causes of failure of refractories.
4. Understand refractory cement and monolithics and their application.
5. Know specifications of refractories as per B.I.S.

## C. Topic wise Distribution of periods.

Sl.No.	Name of the Topic	Periods
1.	Refractories , classification & raw materials	05
2.	Acid Refractories and Basic Refractories	15
3	Neutral Refractories & other refractories	20
4	Testing of Refractories	10
5	Failure Refractories	05
6	Monolithic Refractories	05

## D. Course Contents

### 1.0 Refractories, Classification & Raw Materials

- 1.1 Introduction to refractories.
- 1.2 Define Refractory.
- 1.3 State the importance of refractory.
- 1.4 Classify refractories.
- 1.5 Raw materials for refractories making. Natural & Synthetic refractory raw materials

### 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 Andalusite, Kyanite and other alumino silicate refractories.

2.2 Define Basic Refractories. Discuss preparation, properties and uses of following

refractories in brief.

- (I) Magnesite refractories
- (II) Chrome based refractories
- (III) Dolomite refractories
- (IV) Forsterite Refractories

### **3.0 NETURAL AND OTHER REFRACTORIES**

3.1 Discuss preparation, properties and uses of following refractories in brief:-(i)Graphite refractories.

(ii)Zircon & Zirconia refractory.

(iii)Silicon carbide refractories.

(iv)Spinal Bricks.

3.2 Fusion cast refractories – & Chromaite refractories , properties & application.

3.3 Insulation refractory bricks : properties, uses and manufacturing.

3.4. Carbon containing Refractory:- Manufacturing, Properties and Uses. Magnesia – Carbon Refractory and Alumina -Magnesia-Carbon refractory

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

3.6 Fibrous Refractory materials & their application.

### **4.0 INTRODUCTION TO TESTING OF REFRACTORIES:**

4.1 Physical Testsof refractory

4.2 Testing ofrefractory Castables.

4.3 Dimension of Various refractory shapes.

4.4. Slag attack

4.5. P.C.E. & R.U.L of refractory.

4.6. BIS Specification for Various refractory

4.7. Cold crushing strength

### **5.0 FAILURE OF REFRACTORIES**

5.1 Various factors responsible for failure of refractories

5.2 Various methods of repairing in hot atmosphere in furnaces & Ovens.

5.3 Important term relating to refractories.

### **6.0 MONOLITHIC REFRACTORIES**

6.1 Different types of monolithic Refractory.

6.2 Different types of raw materials for monolithic refractory.

6.3 Important factors in castable lining.

6.4 Plastic masses, Ramming Masses, Gunning masses, Spraying Masses, patching Masses.

6.5 Refractory cement and mortars and their uses.

**Syllabus Coverage upto Internal Assessments:****Topics: - 1, 2&3**

Learning Resources :			
<b>Sl.NO</b>	<b>Title of the book</b>	<b>Name of the Authors</b>	<b>Name of the publishers</b>
1	Refractories : production & Properties	J.H. Chester.	Publisher W.P
2	Refractories	Chesti. A. Rashid	Prentice hall India learning Pvt. Ltd, New Delhi
3	Refractories their manufacturing properties uses	M.L. Mishra	Clear type press, Allahabad,
4	Technology of ceramics & refractories	P.P. Budnikov .	M I T Press
5	Hand book of refractories	Nandi. D. N.	Mc Graw -Hill
6	Refractory	F.H. Norton.	Mc Graw -Hill company Inc
7	Fuels & Refractories	Gil Christ J.D.	Pergamon press

## Th2. CERAMIC SCINCE

Name of the course: Diploma in CERAMIC TECHNOLOGY			
Course code:		Semester	4th
Total Period	60	Examination :	3 hrs
Theory periods :	4p / week	Internal assessment	20
Tutorial	01p / week		
Maximum marks	100	End Semester Examination ::	80

### A. Rationale:

The science of ceramic is very much essential for ceramic student to understand the physical properties of ceramics and various factors related to change in their properties.

### B. Objectives :

After completion of the course student will able to :

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

### C. Topic wise distribution of Periods

Sl. No.	Major Topics	Periods
1	Atomic Structure	05
2	Chemical Bounding	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

### D. COURSE CONTENTS

#### 1. 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. 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. 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 :
  - i. NaCl
  - ii. CsCl
  - iii. Spinel
  - iv. Clay.
  - v. Silicate structure.
- 3.6 Define solid solution.
- 3.7 Explain Different types of solid solution.

### **4. PHASE TRANSFORMATION ( Fundamental idea only)**

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

### **5. EFFECT OF TEMPERATURE**

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

### **6. CONDUCTOR , SEMICONDUCTOR, INSULATORS AND SUPER CONDUCTOR**

- 6.1 Behaviour
- 6.2 Types
- 6.3 Mechanism.
- 6.4 Ceramic Products showing properties of conductor, semi-conductor, insulator and super conductor.

### **7. 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. 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.

**Syllabus Coverage upto Internal Assessments :**

**Topics:- 1,2,3 &4 .**

Learning Resources :			
Sl.No.	Title of the book	Name of the Authors	Name of the publishers
1	Introduction to Ceramics	W.D. Kingery	Wiley India pvt Ltd
2	Material Science	V. Ragavan	Prentice hall India learning pvt Ltd
3	Material Science and Engineering	Navneet Gupta and R.C. Gupta	Dhanpat rai & co pvt Ltd
4	Materials Science	M.S Vijaya & G. Rangarajan	Tata McGraw – Hill bulishing company ltd. New Delhi
5	Materials Science	F.d Gyanum	Indian instituted of ceramic



### Th3. FUELS AND CERAMIC KILNS

Name of the course: Diploma in CERAMIC TECHNOLOGY			
Course code:		Semester	4th
Total Period	60	Examination :	3 hrs
Theory periods :	4p / week	Internal assessment	20
Tutorial			
Maximum marks	100	End Semester Examination ::	80

#### A. Rationale :

Solid, liquid and gaseous fuels are used in firing of ceramic in various types of kilns and furnaces. Students of ceramic must know about the types of kilns used in ceramic firing and their operation. Also they must know the fuels used in ceramic firing and their properties for proper use.

#### B. 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 fuels & their application
3. Know the principle of operation of various ceramic kilns .
4. Know about various types of metallurgical furnaces and their operation.
5. Understand general idea on pyrometer and pyroscope & their uses in kiln and furnace.

#### C. Topic wise Distribution of Periods.

Sl.No.	Major Topic	Periods
1.	Introduction to fuels and combustion	05
2.	Solid , Liquid & Gaseous Fuels	25
3	Ceramic kilns	15
4	Metallurgical furnaces	10
5	Pyroscope and pyrometer	05

#### D. 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. Conservation of fuels.
- 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 & types 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.
- 2.13 State and explain the properties of various liquid fuels and petroleum by products. ( Introduction only).
- 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. (General ideas only)
- 2.16 Describe the procedure for storage of liquid fuels.
- 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 Mixed Gas.
- 2.19 Explain in details the manufacturing method of producer gas& Water 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.( Introduction only)
- 2.23 Rocket fuel and nuclear fuel.

### **3.0 CERAMIC KILNS**

- 3.1. Define kiln, furnace and oven
- 3.2. Classify ceramic kiln in details
- 3.3. Describe the operation&uses of the following kilns in details :-
  - a) Down Draft kiln
  - b) Up draft kiln.
  - c) Chamber kiln
  - d) Tunnel kiln & Roller Hearth kiln
  - e) Muffle kiln
  - f) Shaft Kiln
  - g) Glass Pot furnace
  - h) Glass Tank furnace
  - i) Electric furnace for glass melting
  - j) Rotary kiln .
  - k) Coke Oven
- 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 FURNACES (Introduction only):**

- 4.1 Classification of furnaces.
- 4.2 Furnaces used in Iron & steel plant .
- 4.3 Fuels used in steel plant furnaces & their characteristics .
- 4.4 Sketch the following furnaces showing various section& explain their uses.
  - a) Blast furnace.
  - b) Cupola
  - c) Open hearth furnace
  - d) Ladle refining furnace
  - e) Basic Oxygen Furnace.
  - f) Electric Arc Furnace etc.

### **5.0. PYROSCOPE AND PYROMETER**

- 5.1 Define pyroscope and pyrometer.
- 5.2 Disuses various type of pyroscopes.
- 5.3 Describe various types of cones used in ceramic kiln firing
- 5.4 State the requirements of pyroscope and pyrometer in kiln firing.
- 5.5 Describe various pyrometers used in ceramic kiln firing.

**Syllabus Coverage upto Internal Assessments :****Topics:- 1,2,&3.**

Learning Resources :			
<b>Sl.No.</b>	<b>Title of the book</b>	<b>Name of the Authors</b>	<b>Name of the publishers</b>
1	Fuels and combustion	S.sarkar	University press
2	Fuels solid, & gaseous	J.S.S. Brame& King.	Edward Arnold Publisher
3	Fuels furnace & refractories	O.P. Gupta	Khanna publisher
4	Industrial Furnace	Trink	Jhonnwiley and sons
5	Industrial Ceramic	Singer and singer	Chemical publishing company
6	Fuel & Refractories	Gil Christ	Pergamon press
7	Pottery Manufacture	H.N.Bose.	Ceramic publishing house Bhagalpur India

## Th4. PROCESS CONTROL IN CERAMIC INDUSTRY

Name of the course: Diploma in CERAMIC TECHNOLOGY			
Course code:		Semester	4th
Total Period	60	Examination :	3 hrs
Theory periods :	4p / week	Internal assessment	20
Tutorial			
Maximum marks	100	End Semester Examination ::	80

### A. Rationale :

Most of the sophisticated ceramic machines ,equipment , kilns and furnaces are electronically controlled . Students of ceramic should know the basic concept on the electronically controlled equipment used for ceramic processing.

### B. Objective :

After completion of the course students will be able to know

1. Fundamental idea about electronics.
2. Concept and qualities of measurement.
3. How pressure and flow can be measured.
4. Temperature measurement.
5. Recorder and automatic controllers .

## 1.INTRODUCTION TO ELECTRONICS

1. Define electronic emission.
2. Explain vacuum tube& vacuum diode .
3. Define semiconductor ,Integrated circuit and simple circuit in use.
4. Explain the use of microprocessor .
5. Describe about different sensor and sensor made up of ceramic material.

## 2. QUALITIES OF MEASUREMENT

- 2.1 Describe measurement and it's aim.
- 2.2 Classify various electrical measuring instrument.
- 2.3 Measurement of displacement.
- 2.4 linear variable differential procedure.
- 2.5 Hydraulic force and Measurement of force.
- 2.6 Measurement of vacuum.

## 3. PRESSURE AND FLOW MEASUREMENT

- 3.1 Define pressure.
- 3.2 Define type of pressure.
- 3.3 Discusses different methods of pressure measurement .
- 3.4 Differential flow measurement.
- 3.5 Parts of a differential flow meter and its function.
- 3.6 Discusses about magnetic flow meter.

## 4. TEMPERATURE MEASUREMENT

- 4.1 Define temperature scales.
- 4.2 Discuss expansion thermometer.

- 4.3 Electrical Temperature measuring instruments Thermo couple, Therm esters.  
 4.4 Discuss about pyrometer like radiation pyrometer, optical pyrometer .  
 4.5 Discuss about the use of temperature measurement in ceramic industry

## 5. RECORDER

- 5.1 Discuss different recorder.  
 5.2 Describe about automatic controller .  
 5.3 Define process control action measuring element and deviation controlling element.  
 5.4 Discuss about control action.  
 5.5 Classify controller depending on the actuating medium & its uses in different ceramic & glass industry.

## 6. USE OF AUTOMATIC DEVICE

- 6.1 Define CAD,CAM.  
 6.2 Typical CAD system  
 6.3 Application of C A M.  
 6.4 Application of robotics in ceramic manufacturing.  
 6.5 Robot control system.

### Syllabus Coverage upto Internal Assessments : Topics:- 1,2& 3

Learning Resources :			
Sl. No.	Title of the book	Name of the Authors	Name of the publishers
1	Industrial instrumentation and control	S.K .Singh	Mc Grow Hill education
2	Principle of electronics	V.K Mehta	S. Chand
3	Automation production & computer Integrated manufacturing	Michel P. Mover	Pearson education
4	Process control instrumentation technology	femon	Education India
5	Industrial Ceramic	Singer and singer	Chemical publishing company

## Pr1. CERAMIC WORKSHOP – II

Name of the Course : Diploma in ceramic Technology			
Course Code		Semester	4 <sup>th</sup>
Total period	90	Examination	3 hours
Practical Period	6 period of week	Seasonal	50 marks
Maximum marks	100	End semester Examination	50 marks

### A. RATIONALE:

Ceramic student must practice the making of various refractory product and processing of refractory raw materials for making them. This will help the students while they work in industries and also when they want to start their own industry. So, the student must practice ceramic workshop jobs in making refractory products.

### B. OBJECTIVE:

After completion of course student will be able to know :

1. Preparation of Refractory shapes.
2. Preparation of Ramming mass, castables, refractory cement and mortar.
3. Preparation of grog and gunning mass and ramming mass.

### MINIMUM TEN NUMBER OF JOBS SHOULD BE PRACTICED BY THE STUDENT

1. Preparation of refractory mixture for making refractory bricks.
2. Acid Bricks- Fireclay and silica bricks by hand molding process.
3. Basic Bricks – Dolomite and Magnesite bricks.
4. Neutral Bricks – fused Alumina, and silicon carbide bricks.
5. Preparation of sagger body composition & making of sagger by hand molding.
6. Preparation of fire clay insulating bricks.
7. Preparation of refractory cement and mortars.
8. Preparation of refractory crucibles.
9. Study of various refractory shapes used in furnace lining.
10. Preparation of refractory castables.
11. Preparation of ramming masses.
12. Firing of fire clay bricks.
13. Preparation of Grog.
14. Grading of Grog for refractory by sieve analysis.
15. Preparation of mud gun Mass.

## Pr2. CERAMIC TESTING-II

Name of the Course : Diploma in ceramic Technology			
Course Code		Semester	4 <sup>th</sup>
Total period	90	Examination	3 hours
Practical Period	6 period of week	Seasonal	50marks
Maximum marks	100	End semester Examination	50marks

### A. RATIONALE:

To manufacture good quality refractory products and to know the property of refractories testing of refractories are highly essentials. So, ceramic students must aware of the process of testing of refractories in the laboratory.

### B. OBJECTIVE:

After completion of course the student will able to know :

1. physical properties of refractories.
2. Thermal properties of refractories.
3. Pyrochemical properties of refractories.

### MINIMUM TEN NUMBERS OF TESTS TO BE PRACTICED BY THE STUDENTS

1. Determine the B.D. and Apparent porosity.
2. Determine C.C.S. of refractory bricks.
3. Determine thermal expansion of refractory shapes.
4. Determine permeability of refractory bricks.
5. Determine PCE value of refractory
6. Testing of Refractory Castables.
7. Determine PLCR of refractory bricks.
8. Study Of Mineralogical Microscope.
9. Preparation of sample to study under micro scope.
10. Determination of RUL of refractory samples.
11. Determination of slag resistance of refractory.
12. Determine the thermal conductivity of refractories.

### Pr3. FUELS TESTING LAB

<b>Name of the Course : Diploma in ceramic Technology</b>			
Course Code		Semester	4 <sup>th</sup>
Total period	90	Examination	3 hours
Practical Period	6 period of week	Seasonal	50 marks
Maximum marks	100	End semester Examination	50marks

#### A. RATIONALE :

Energy conservation is the main objective of present day environment ,Fuel testing lab experiment shall aware the quality of fuel by which proper use of fuel in kiln & furnaces can be made so, student of ceramic must have the testing of fuel as the firing cost of the ceramic is more than cost of total cost.

#### B. OBJECTIVE:

After completion of course student will be able to know :

1. Proximate analysis of coal.
2. Calorific value of solid liquid fuel.
3. Different types of cores used in refractory.

#### MINIMUM EIGHT NUMBERS OF JOBS TO BE PRACTICED BY THE STUDENT

1. Determine 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.
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.



## Pr.4 -TECHNICAL SEMINAR

<b>Total Periods</b>	<b>60</b>	<b>Maximum Marks</b>	<b>50 Marks</b>
<b>Lab. Periods:</b>	<b>04Periods /week</b>	<b>Term Works</b>	<b>50Marks</b>
<b>Examination</b>		<b>End Semester Examination</b>	<b>--</b>

### A. Objective:

Each student has to select a recent topic of latest technology in the area of Computer Science and present a seminar in front of all students of the class. He/She has to prepare a PowerPoint presentation of the selected topic of minimum 10 slides are the total presentation will be approximately 10 minutes duration .There will be interactive session between the presenter and rest of the students including the faculty members of the dept at the end of presentation .A student has to present at least 2 nos.of seminar during a semester and to submit the report for evaluation.

## Equipment List 4<sup>th</sup> sem

SI.NO	EQUIPMET
1.	PCE Furnace
2.	Mineralogical microscope
3.	Lapping machine
4.	Mineralogical microscope with camera
5.	Vibrating Compaction
6.	Vibrating screen
7.	Sieve Shaker
8.	Radiation Pyrometer
9.	Thermo Couple
10.	Flash Point Apparatus
11.	Viscometer
12.	MOR Testing Machine
13.	Thermal Expansion Testing Equipment
14.	Permeability apparatus
15.	Slag resistance testing Furnace
16.	Metal mould for refractory shapes.
17.	Friction screw press
18.	Vibrating tube
19.	Thermometer 200degC, 240degC
20.	Orsat apparatus
21.	Optical Pyrometer
22.	Calorimeter
23.	Muffle furnace 1000deg C
24.	Density meter