POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI

B.E. in CERAMICS AND CEMENT TECHNOLOGY

Choice Based Credit System (CBCS)

Scheme of Teaching and Examination 2021 – 2022

(Effective for students admitted in 2019-2020**)**

VI Semester

Sl. No.	Course and Course Code		Course Title	Teaching Department	Teaching Hours/Week			Self Study	Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing		Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	PC	19CC61	Glass Technology II	CCT	03	-	--	0.5	--	50	50	100	2.5+0.5
2	PC	19CC62	Refractory II	CCT	04	--	--	--	--	50	50	100	4
3	PC	19CC63	Cement Technology II	CCT	03	--	--	--	--	50	50	100	3
4	PE	19CC641	Instrumental Methods of Analysis	CCT	03	--	--	--	--	50	50	100	3
		19CC642	Process Calculations										
5	IE	19CC65	Industrial Elective		03	--		--	--	50	50	100	3
6	OE	19CC66	Non Destructive Testing	CCT	03	-	--	--	--	50	50	100	3
7	HU	19HU02	Aptitude	Humanities	--	02	--	--	--	50	50	100	1
8	PC	19CCL61	Instrumental data interpretation Lab	CCT	--	-	02	--	--	50	50	100	1
9	PC	19CCL62	Equipment Drawing - I	CCT	--	--	02	--	--	50	50	100	1
10	MP	19CCMP63	Mini-project	CCT				--	--	50	50	100	2
			Total		**19**	**02**	**04**	**0.5**	**--**	**500**	**500**	**1000**	**24**

Note: PC: Professional core, PE: Professional Elective, OE: Open Elective, MP: Mini-project, INT: Internship

Internship: All the students admitted to III year of BE/B.Tech has to undergo mandatory internship of 4 weeks during the vacations of VI and VII semesters and /or VII and VIII semesters.

Note Management and Entrepreneurship course shall be offered by CV, ME, IP, Auto and CCT Departments at V semester level and E&CE, CSE, IS, IT and E&E departments at VI semester level

THEORY COURSE TITLE: Glass technology-II	
Course Code: 19CC61	CIE: 50
Number of Lectures Hours/Week: 03	SEE: 50
Total Number of Lecture Hours: 42	SEE Hours: 03

Modules	**Teaching Hours**
Module-I: Fundamental concepts of glassy state, glass formation, structure of glass, annealing - introduction, generation and release of strain, temporary and permanent strain, dependence of strain on cooling rate, detection and measurement of strain, special problems in annealing of glass wares, stress optical coefficient, the lehr, toughened glass, strengthening of glass.	09
Module-II: Phase diagrams of glass forming systems, water glass, attack of water on glass, tests for resistance to chemical attack, composition and durability of glass, acid attack, alkali attack, significance of durability, strength of glass, forms of fracture, elastic properties of glass, liquidus temperature of glass.	08
Module-III: Viscosity variation with temperature and composition,characteristics point on viscosity curves, relation between viscosity and crystallization, viscosity and plaining, viscosity and strain, viscosity and working processes, measurement of viscosity of glass, surface tension of glass, heat transmission in glass, measurement of refractive index and optical properties of glass, electrical properties of glass	09
Module-IV: Density and specific gravity of glass, thermal expansion of glass, hardness, thermal endurance, thermal conductivity, heat capacity and specific heat of glass, theory of colorization, and decolorization of glass, control of degree of oxidation and decolorizing agents, acid base concept of glass, decorative processes and surface coatings.	08
Module-V: Manufacture of laminatedsafetyglass, photosensitive glass, photosensitive opal, photo-form glass, photoceram glass, opal and alabaster glasses, photo chromic glass, foam glass, hubbed glass, patterned glass, glass metal seals, defects and testing of glass wares, general idea about glass house refractories, testing of glass wares, plant lay out and elementary idea of manufacturing scheme.	08

Question paper pattern:
Question paper shall contain five modules, each module containing two questions. Students shall answer any one question from each module.

Text books:

1. . Modern Glass Practice – S.R. Scholes, Industrial Publications, 1952

2. Handbook of Glass Manufacture – Vol 1,2, F.V. Tooley, Ogden Publication
3 Glass – Amol Paul, Mac Millan India Ltd., Bangalore

Reference Books:

1. . Technical Glasses – N.B. Volf, Pitman Publishing.
2.. Glass Research Methods – R.K. Day
3.. Encyclopedia of Glass, Ceramic and Cement, Ed. Martin Grayson, John Wiley 4.. Properties of Glasses – G.W. Moorey
5.. Glass Engineering Handbook – E.B. Shand, McGraw Hill Pub.
6. Glass Technology – Charan
7.. Glass Science – Robert H. Doremus, John Wiley & Sons.
8.. Physical properties of glass - J.E. Stanworth

.

E-books and online course materials:

1. https://sgt.org/page/books
2. https://books.google.co.in/books/about/Introduction_to_Glass_Science_and_Techno.html?id=ZeF_QLW6-xsC
3/ https://go.koppglass.com/properties-of-glass-ebook
4.https://www.koppglass.com/blog/definitive-ebook-thermal-optical-and-mechanical-properties-glass
5.https://onlinelibrary.wiley.com/doi/book/10.1002/9781119506003
6. https://www.springer.com/gp/book/9780387733616
7/https://www.elsevier.com/books/handbook-of-glass-properties/bansal/978-0-08-052376-7
8. https://onlinecourses.nptel.ac.in/noc20_ce46/preview
9.https://ocw.mit.edu/courses/materials-science-and-engineering/3-091sc-introduction-to-solid-state-chemistry-fall-2010/amorphous-materials/21-introduction-to-glasses/
10.https://freevideolectures.com/course/4452/nptel-glass-processing-technology
11. http://www.glass-academy.com/
12. https://www.collegechalo.com/news/course-on-glass-science-and-technology/
13. https://www.classcentral.com/course/swayam-glass-processing-technology-14099
14.https://www.elantechnology.com/about-us/glass-science-course/
15.https://www.elantechnology.com/about-us/glass-science-course/

Course outcomes:

On completion of the course, the student will have the ability to:

CO #	Course Outcome (CO)
CO1	**Describe glassy state annealing of glass , strengthening of glass.**
CO2	**Explain phase diagram, liquidus temperature of glass, chemical durability, strength and elastic properties of glass.**
CO3	**Asses properties of glass**
CO4	**Outline properties, colorizing, decolorizing, surface coating and decoration of glass.**
CO5	**Explain glass house refractories, testing of glass ware, glass plant layout and manufacture of glass.**

19CC62: REFRACTORIES – II

Subject / Course Code: 19CC62		Credits: 03
CIE: 50 Marks	SEE: 50 Marks	Total Marks: 100
Hours / Week: 3 (Lecture)		Total Hours: 42

Course objectives: To impart knowledge and enable students to understand

1. Sintering
2. High temperature oxide ceramics
3. Phase diagrams
4. Blast furnace, open hearth furnaces, etc
5. Refractories for non ferrous industries

Syllabus

Module	Contents	No. of hrs.
Module 1	Sintering: Introduction, definition, types of sintering processes, study of driving force, mechanisms. Modes of material transport, topology of solid state sintering, liquid phase sintering and vapor phase sintering, parameters for control of sintering processes.	9
Module 2	Preparation, properties and applications of high temperature oxide ceramics such as magnesia, alumina, zirconia, titania, urania and beryllia. Non oxide refractories such as carbides and nitrides. Cermets.	8
Module 3	Phase diagrams related to the manufacture of conventional refractories, two and three-component systems for refractory manufacturing. Heat setting and air setting, bonding mortar, ramming masses castables, gunning material, gunning tar mixes.	9
Module 4	Blast furnace, design and installation of blast furnace, carbon lining, modification of hot blast for high temperature. Operation of basic and acidic open hearth furnaces, soaking pits, reheating furnaces, hot metal mixer, ladles, steel melting furnaces by electricity.	8
Module 5	Refractories in non-ferrous industries, refractories in generation of steam, power, nuclear power production, refractories used in glass, coke-ovens, cement industries, gas production, etc.	8

Course outcomes: At the end of the course, students will be able to:

CO1	Define and explain different types sintering	C1, C5
CO2	Appraise high temperature oxide ceramics	C4
CO3	Analyze phase diagrams	C4
CO4	Evaluate refractories for furnaces	A3
CO5	Appraise refractories for non ferrous industries	C4

Text / Reference books:

1. Refractories - F.H.Norton
2. Refractories: Properties & application - J.H.Chester
3. Refractories - Kenneth Shaw
4. Monolithic Refractories - W.D.Kingery
5. Refractories - M. L. Mishra
6. Introduction to Ceramics - W. D. Kingery

Question paper pattern:

Question paper shall contain FIVE modules, each module containing TWO questions. Students shall answer any ONE full question from each module.

THEORY COURSE TITLE: CEMENT TECHNOLOGY – II	
Course Code:19CC63	CIE: 50
Number of Lectures Hours/Week: 04	SEE: 50
Total Number of Lecture Hours: 52	SEE Hours: 03

Modules	Teaching Hours
Module-I: Crushing of raw materials, open and closed circuit crushing, construction and working features of different types of crushers, drying-grinding, energy consumption, laws of size reduction and its applications, types of air separators.	10 Hours
Module-II: Prehomogenization, blending and homogenizing of raw mixes in wet and dry processes, clinkerization, rotary kiln design and constructional features, types of refractories applied, installation of refractories, recent advances in cement manufacture.	10 Hours
Module-III: Principle of operation of pre-heaters and their structural features, the preheater by pass system, principle of precalcination, advantages of pre calcination, different types of pre-calcinator systems and their applications.	08 Hours
Module-IV: Kiln burning - types of burners used for gas, oil and coal, improved burners for coal firing, firing systems for coal, control of primary and secondary air flow rate and temperature, control of flame shapes and length, excess and false air and their effect on fuel consumption, hard and soft burning, process parameters affecting kiln performance and clinker quality, burning techniques, instruments for control of kiln operation	12 Hours
Module-V: Clinker coolers: need for clinker cooling, various types of coolers, effect of cooling on characteristics of clinker, Grinding of cement: equipment used, grinding aids, coating of grinding media, effect of chemical and potential compounds on grindability, control of fineness, external and internal water cooling of cement grinding media. Varieties of dust, dust collector systems, material handling equipments. storage practice in cement plant	12 Hours

Question paper pattern:
Question paper shall contain five modules, each module containing two questions. Students shall answer any one question from each module.

Text books:
1. Cement data book – Vol.I, II, III – W.H. Duda, Gmbh Germany.
2. The rotary cement kiln – K.E. Perry, J.J. Wadell, Chemical Public. Co., N.Y. 1972
3. Process technology of cement manufacture – Bauverlag, Gmbh Germany.
4. Cement Engineer's Handbook – Von Ottolabahn, McGraw Hill, N.Y.
5. Cement – Perry

Reference Books:
1. Cement data book – Vol.I, II, III – W.H. Duda, Gmbh Germany.
2.

Course outcomes:
On completion of the course, the student will have the ability to:

CO #	Course Outcome (CO)
CO1	**Explain working of crushers and air separators**
CO2	**Describe blending and homogenizing methods**

CO3	**Explain working of burners, coolers, material handlingequipments**
CO4	**Determine process parameters affecting kiln performance**
CO5	**Recognize burning techniques and instrumentation**

THEORY COURSE TITLE: INSTRUMENTAL METHODS OF ANALYSIS	
Course Code: 19CC641	CIE: 50
Number of Lectures Hours / Week: 03	SEE: 50
Total Number of Lecture Hours: 42	SEE Hours: 03

Modules	**Teaching Hours**
Module-I: Introduction to instrumental methods of analysis. Classification of Instrumental methods. Electromagnetic spectrum. Infrared and Ultraviolet spectroscopes - instrumentation, working principle, single and double beam spectrometers, applications and its limitations	07 hours
Module-II: Visible Spectrophotometer and colorimeter- Introduction, differences between spectrometer, photometer, and colorimeter. Instrumentation of Visible spectrophotometer, working principle, single and double beam Visible spectrometers, applications and limitations. Mass spectrometer introduction, instrumentation, working principle, applications and limitations.	07 hours
Module-III: Flame spectroscopy / Photometry - Introduction, instrumentation, working principle, applications and limitations. Atomic absorption spectrometer- Introduction, Instrumentation, working principle, applications and limitations. Advantages of Atomic absorption spectrometer over Emission Flame spectroscopy. Measurement of pH.	09 hours
Module-IV: X-Ray Diffraction methods - Introduction, production of XRays, studies on different types diffraction methods, their applications and limitations. Study on Scanning electron microscopy and Transmission electron microscopy- Introduction, Instrumentation, working, applications and, limitations. Fourier transform infrared spectroscopy-Introduction, instrumentation, working, applications and limitations.	09 hours
Module-V: Thermal methods – Introduction to thermal analysis. Thermogravimetry: Introduction, recording results, factors affecting thermogravimetric curves, Instrumentation, working principle, applications. Differential thermal analysis: Introduction, factors affecting the curves, Instrumentation, working principle, applications. Differential scanning colorimetry: Instrumentation, working, applications and limitations. Chromatographic techniques: Introduction, Thin layer chromatography, paper chromatography, liquid and gas chromatography.	10 hours
Question paper pattern: Question paper shall contain five modules, each module containing two questions. Students shall answer any one question from each module.	

Text books:

1. Instrumental methods of analysis- N.Gray, CBS 1ST edition (2009).
2. Instrumental methods of chemical analysis – G.R.Chatwal and Sham Anand, Himalyaya publishing house.
3. Instrumental methods of Chemical Analysis, G.W. Ewing, 5th Edition, McGraw-Hill, New York, 1988.
4. Instrumental Methods of Chemical Analysis, K. Sharma, Goel Publishing House Meerut 2000

Reference Books:

1. Instrumental Methods of Analysis" by D Skoog.
2. Principles of Instrumental Analysis" by D Skoog.

E books and online course materials:

1. Principles of Instrumental Analysis ByDouglas A Skoog; F James Holler; Stanley R Crouch

Course outcomes:

On completion of the course, the student will have the ability to:

CO #	Course Outcome (CO)
CO1	**Classify and compare instrumental methods of analysis**
CO2	**Compare spectrometer photometer and colorimeter and explain their instrumentation, working principle and applications**
CO3	**Apply spectroscopy methods for ceramic characterization**
CO4	**Make use of X-ray to characterize the ceramic materials and explain its instrumentation, working principle and applications**
CO5	**Explain instrumentation, working, principle and application of various thermal analysis techniques**

THEORY COURSE TITLE: Industrial Elective (Iron and Steel Making Technology)	
Course Code: 19CC65A	CIE: 50
Number of Lectures Hours/Week: 03	SEE: 50
Total Number of Lecture Hours: 42	SEE Hours: 03

Modules	**Teaching Hours**
Module-I: History and Evolution of Iron and Steel Making, Scope of Iron and steel Industry in India and World Classification of Iron and steels, Phase diagram of Iron and Iron Carbide Phase Diagram Structure and properties of Iron and steel, Types of Iron and STEEL making List of major steel and iron industries in India **Raw Materials I: Coke** Introduction Availability of Coking CoalTypes of Coal Available Chemical Characteristics of Coals for Cokemaking Proximate Analysis Ultimate Analysis Petrographic Characteristics of Coals for Cokemaking Macerals and Mineral Matter Reflectance (Rank) of CoalOther Important Characteristics Selection of Coals for Cokemaking Assessment of Coke Quality Room Temperature Strength High Temperature Characteristics Processes Used for Cokemaking Conventional By-product Coke Ovens Non-recovery Ovens Pre-carbonisation Techniques Pre-heating of Coal Briquette Blending of Coal Selective Crushing of Coal Stamp-chargingAlternative Coking Methods	09
Module-II **Raw Materials II: Iron Ore and Agglomerates** Occurrence of Iron Ore Iron Ore Reserves of India Beneficiation of Iron Ore The Sintermaking Process Bedding and Blending Granulation Sintering Feed Preparation and Product Handling Fundamentals of Sintering of Iron Ores Sintering Phenomena Heat Transfer during Sintering Sinter ProductivityStructure of Sinter Influence of Sinter ChemistrPelletisation Physical and Chemical Characterisation of Lump Ore/Sinter/Pellets Physical Testing Chemical Characterisation Thermal Analysis	08

Metallurgical Tests Compression and Tumbler Strength Reduction Behaviour Reducibility Reduction under Load Softening–Melting Test Recycling of Materials in the Blast Furnace Blast Furnace Technology ,Blast Furnace Reactions and Process in a Nutshell ,General Constructional Features of the Furnace, Different Regions within a Blast Furnace ,Size of Blast Furnace ,Performance of Blast Furnace , ,Charging of Solid Materials from the Top ,Blast Furnace Plant and Accessories, Hot Blast Stoves ,calculations relating to blast furnace technology.	
Module-III Alternative iron making processes : sponge iron ,Smelting reduction BOF Operation, BOF Shop Layout and Individual Converter Components ,BOF Vessel Design and Refractory Lining, The Lance, Gas Cleaning System, Engineering Features of BOF Shops ,Refining Major Inputs for BOF Steelmaking ;-Hot Metal Coolants Flux Materials Oxygen Pre-treatment of Hot Metal Prior to Steelmaking Objectives of Pre-treatment Removal of Silicon Desulphurisation Dephosphorisation Reagents Used for Pre-treatment Soda-ash Mixture of Soda-ash and Sodium Sulphate Mill Scale, Sinter Fines, etc. Calcium Carbide and Magnesium Granules Injection of Desulphurising Agents,Hot Metal Pre-treatment Station(s) Desiliconisation Desulphurisation Simultaneous Removal of Sulphur and Phosphorus General Comments on Pre-treatment **Overview of Modern Steelmaking**	09
Module-IV: Introduction Methods Presently Used for Steel Production Oxygen Steelmaking Top-blown Converter Process Bottom-blown Converters (Q-BOP/OBM) Bath Agitated Processes Electric Steelmaking Electric Arc Furnace (EAF) Electric Induction Furnaces Secondary Steelmaking Ladle Stirring Injection Processes Vacuum Processes Reheating Processes Continuous Casting **Secondary Steelmaking** Inert Gas Purging (IGP) Deoxidation of Liquid SteelThermodynamics of Deoxidation of Molten Steel Kinetics of Deoxidation of Molten Steel The Ladle Furnace (LF) Problem of Slag Carryover The CAS-OB Process Degassing and Decarburisation of Liquid SteelThermodynamics of Degassing Reactions Kinetics of Desorption and Absorption of Nitrogen by Liquid Steel Vacuum Degassing Processes Manufacture of Ultra-Low Carbon (ULC) Steel by RH-OB Process Desulphurisation in Secondary SteelmakingThermodynamic Aspects Kinetic Aspects Injection Metallurgy (IM) Clean Steel Technology Introduction Cleanliness Control during Deoxidation Cleanliness Control during Teeming Tundish Metallurgy for Clean Steel Miscellaneous Topics Inclusion Modification Temperature Changes during Secondary Steelmaking Refractories for Secondary Steelmaking **Stainless Steelmaking** Introduction Melting and Refining of Stainless Steels for Scrap and Ferroalloy-Based Processes Melting The AOD Converter Process Thermodynamics of Reactions in the AOD Process Other Processes for Stainless Steel making Direct Stainless Steelmak	08
Module-V: **Casting of liquid steel;-**Ingot Casting of Steel**,** Classification of Steel Ingots Ingot Defects and Their Remedies Continuous Casting of Steel**;** Comparison of Continuous Casting with Ingot Casting,, **construction ,working and design of tundish** .Continous casting defects and their remedies. Near-Net Shape Casting;- Thin Slab Casting Strip Casting, Beam Blank Casting. Refractories for lining of various furnaces and heat treatment equipments used in iron and steel making	08
Question paper pattern: Question paper shall contain five modules, each module containing two questions. Students shall answer any one question from each module.	
Text books: 1. A first course in iron and steel making, Dipak Mazumdar, Orient Blackswan Pvt. Ltd., (2015) 2. Iron making and steelmaking: Theory and Practice, Ghosh Ahindra, Chatterjee Amit, Phi Learning Private Limited, (2001)	
Reference Books: 1. Extractive Metallurgy 2: Metallurgical Reaction Processes, Alain Vignes (ISTE Ltd.,) 2. Extractive Metallurgy 3: Processing Operations and Routes, Alain Vignes (ISTE Ltd.,) 3. An introduction to modern steel making, R. H. Tupkary, Khanna Publishers (2000)	

4. An introduction to modern iron making, R. H. Tupkary, Khanna Publishers (2004)

E-books and online course materials:

Course outcomes:
On completion of the course, the student will have the ability to:

CO #	Course Outcome (CO)
CO1	**Summarize the history, evolution, scopeo ,classification ,phase diagram of Iron and steel Industry .**
CO2	**Explain working, operation construction design aspects and calculations connecting to Blast furnace and raw materials used in blast furnace**
CO3	**Asses properties of glass**
CO4	**Outline properties, colorizing, decolorizing, surface coating and decoration of glass.**
CO5	**Suggest refractories for lining of various furnaces used in Iron and steel Industries**

THEORY COURSE TITLE: NON DESTRUCTIVE TESTING	
Course Code: 19CC66OE	CIE: 50
Number of Lectures Hours / Week: 04	SEE: 50
Total Number of Lecture Hours: 42	SEE Hours: 03

Course Objectives: To impart knowledge and enable students to understand

1. Basic differences between destructive and non destructive testing. how to handle visual, leak and liquid penetration NDT methods
2. Magnetic particle and Eddy current inspection methods , their advantages and limitations
3. Ultrasonic NDT working methodology, their advantages and limitations
4. Radiographic, Neutron and Thermal NDT methods, their applications and limitations
5. Optical, Acoustic and Microwave NDT working methodology their applications and limitations

Modules	**Teaching Hours**
Module-I: Introduction to NDT**:** Selection of NDT methods. Visual inspection, leak testing, Liquid penetration inspection- advantages and limitations.	O6
Module-II: Magnetic particle inspection**:** Methods of generating magnetic field, types of magnetic particles and suspension liquids, steps in inspection, applications and limitations of the test. Eddy current inspection**:** principle of operation, process variables , inspection coils- applications and limitations the test	08
Module-III: Ultrasonic inspection**:** Basic equipment, characteristics of ultrasonic waves, variables during ultrasonic inspections. Inspection methods, normal incident pulse echo, angle beam pulse echo and transmission type. Method of display- A,B and C scan mode. Transducer elements, couplets, search units, contact type and immersion types inspection methods, inspection of products like casting, extrusions, rolled product, weld set- applications and limitations of the test	10
Module-IV: Radiography inspection**:** Principles, radiation sources. X-Rays and their generation, gamma rays and their generation. Radio graphic films. X-ray filters, image intensifiers. Industrial radiography. Image quality indicators, radiography sensitivity- applications and limitations of the test. Neutron radiography: working methodology its application and limitations. Thermal NDT**:** principle, inspection methods,applications and limitations of the test	10

Module-V: Optical Holography**:** Basics of Holography, recording and reconstruction-info metric techniques of inspection, procedures of inspection, typical applications. Acoustical Holography: working principle, applications and limitations. Microwave NDT: Working principle, applications and limitations. Indian Standard for NDT.	08

Course Outcomes: At the end of the course, students will be able to:

Question paper pattern:

Question paper shall contain FIVE modules, each module containing TWO questions. Students shall answer any ONE full question from each module.

Text books: 1. Non Destructive Test and Evaluation of Materials- J Prasad and C. G. Krishnadas Nair, Tata McGraw Hill Education

2. Non Destructive Testing- Nagesh S.N and Jyothilakshmi R., Subhas Stores

Reference books:

1. Non Destructive Testing - Mc Gonnagle JJ – Garden and reach New York.
2. Non Destructive Evolution and Quality Control - volume 17 of metals hand book 9 edition Asia internal 1989.
3. The Testing instruction of Engineering materials - Davis H.E Troxel G.E wiskovil C.T - McGraw hill

Course outcomes:

CO #	Course Outcome (CO)
CO1	**Find the basic differences between NDT and destructive testing and examine visual, leak and liquid NDT methods**
CO2	**Illustrate magnetic particle and eddy current testing and handle the both tests.**
CO3	**Utilize Ultrasonic testing tools and outline their advantages and limitations**
CO4	**Examine the components for defects using radiographic Non destructive testing tools and outline their advantages and limitations**
CO5	**Explain and use Optical, Acoustic and Microwave testing methods and assess their applications and limitations**

Course Title: INSTRUMENTAL DATA INTERPRETATION LABORATORY/ ADVANCE REFRACTORIES LAB		
Subject Code:	**19CCL61**	CIE: 50
Number of Hours / Week	**02**	SEE: 50
Total Number practical Hours	28	SEE Hours: 03
List of experiments		

1 Electromagnetic radiation and electromagnetic spectrum
2 Origin of spectrum /arrangement for obtaining Emission and absorption spectra
3 Single beam and double beam infrared spectrophotometers
4 Double beam ultra violet spectrophotometer.
5 Visible Spectrophotometer
6 Colorimeter.
7 Magnetic deflection mass Spectrometer.
8 Arrangement for atomic absorption Spectrometry
9 Single and double beam atomic absorption spectrophotometer.
10 a) Block diagram of flame photometer.
b) Schematic diagram of modified flame photometer.
c) Schematic of internal standard photometer X-ray difractometer
11 Measurement of Ph
12 Scanning electron microscopy
13 Transmission electron microscopy
14 Fourier Transform infrared Spectroscopy
15 Thermogravimetry
16 Differential thermal analysis
17 Differential scanning colorimetry
18 Thin layer chromatography
19 Paper chromatography
20 Liquid and gas chromatography.
21 Determination of surface area by BET Method shape of building bricks for construction
22 Synthesis of engobe

Course outcomes:
On completion of the course, the student will have the ability to:

CO #	Course Outcome (CO)
CO1	Understanding about electromagnetic spectrum and electromagnetic radiation
CO2	Understanding about infrared , ultra volet , visible spectrometer
CO3	Understanding about colorimeter, flame photometer
CO4	Understanding about x-ray difractometer
CO5	Understanding about TG,DTA, FTIR , Chromatography

19CCL62: EQUIPMENT DRAWING - I

Subject / Course Code: 19CCL62		**Credits: 01**
CIE: 50 Marks	**SEE: 50 Marks**	**Total Marks: 100**
Hours / Week: 2 (Practical)		**Total Hours: 28**

Course objectives: To impart knowledge and enable students to understand:

1. Drawing of ceramic equipment
2. Elementary design of ceramic equipment

Syllabus: Drawing of the following equipment & elementary design wherever possible:

1. Crushers
2. Grinders
3. Ultrafine grinders
4. Mixing Machine
5. Blast furnace / refractory lining
6. Bessemer / LD converter
7. Open hearth furnace
8. Pyrometers
9. Filter press
10. Powder blenders

Course outcomes: At the end of the course students will be able to:

CO1	Sketch ceramic equipment	C3
CO2	Perform equipment calculations	C4