POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI
Choice Based Credit System (CBCS)
Scheme of Teaching and Examination 2018 – 19
(Effective for students admitted in the year 2018 – 19)

V Semester

Sl. No.	Course and Course Code		Course Title	Teaching Department	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical /Drawing	Self Study	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	HU	18HU51	Management and Entrepreneurship / Professional Core	Humanities/ Program	3	-	--	--	03	50	50	100	3
2	PC	18CC52	Physical Ceramics (AR/BNS)		3	-	--	1	03	50	50	100	3
3	PC	18CC53	Glass Technology 1 (GRK)		4		--	--	03	50	50	100	4
4	PC	18CC54	Cement Technology 1 (PR)		4		--	--	03	50	50	100	4
5	PC	18CC55	Refractories 1 (MG/BNS)		4	-	--	--	03	50	50	100	4
6	HU	18HU01	Soft Skill Training	Humanities	1		--	--	02	50	50	100	01
7	PC	18CCL51	Cement testing Laboratory		1	--	2	--	03	50	50	100	1
8	PC	18CCL52	Refractory Laboratory		1	--	2	--	03	50	50	100	1
9	PC	18CCL53	Glass Technology Lab		1		2					100	1
Total					**22**		**6**		**23**	**450**	**450**	**900**	**22**

Note: Hu: Humanities, PC: Professional core, NCMC: Non-credit mandatory course.
Note: Management and Enterpreneurship 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: Physical Ceramics	
Course Code: 19CC52	CIE: 50
Number of Lectures Hours/Week: 03	SEE: 50
Total Number of Lecture Hours: 42	SEE Hours: 03

Modules	Teaching Hours
Module-I: Elementary idea about characteristics of crystalline and non-crystalline ceramics. Defects in crystals: Notations used for atomic defects, definitions classifications, Frenkel and Schottky defects, reaction equations, stoichiometric and non-stoichiometricc solids.[1]	9
Module-II: Capillary rise, Pressure difference across curved surfaces, vapor pressure over curved surfaces, wetting and contact angle, spreading, phase distribution, angle of thermal etching and dihedral angle, equilibrium and surface morphology. Adsorption on solids: Physical adsorption, Chemisorption, adsorption isotherm, Frendluich, derivation of Langmuir, and BET equation.[1]	8
Module-III: Definition of colloidal state, Lyophilic and lyophobic sols, Gels, Kinetic, Optical, electrical properties of colloids. Clay colloids: The proportion of material of colloidal size in clays. Physical and rheological properties of clay colloids as function of their colloid content such as Volumetric shrinkage, viscosity of clay suspensions. Practical significance of clay colloids, beneficiation of clays, casting slips.[2]	8
Module-IV: Atomic diffusion mechanism, Diffusion and Fick's Laws, The Nernst-Einstein Equation, Diffusion as thermally activated process, Numerical problems.[3] [1]	8
Module-V: Spinodal decomposition, Homogenous Nucleation and Heterogeneous Nucleation. [1] Glass formation and Glass-Ceramics: Glass Formation, Typical TTT curve. Synthesis of ceramics by combustion processes, Main types of combustion synthesis processes based on chemical nature. [4][5]	9

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] W. D. Kingery, H. K. Bowen, and D. R. Uhlmann, *Introduction to ceramics*, Second edi. John-Wiley and Sons, Inc, 1976.

[2] "The Colloid Matter of Clay," *Dir. United states Geol. Surv.*, 1909.

[3] W. D. Callister, "Materials Science and Engineering." p. All Pages, 1997.

[4] A. Varma, A. S. Rogachev, A. S. Mukasyan, and S. Hwang, "Combustion Synthesis of Advanced Materials: Principles and Applications," *Adv. Chem. Eng.*, vol. 24, no. C, pp. 79–226, 1998, doi: 10.1016/S0065-2377(08)60093-9.

[5] K. C. Patil, S. T. Aruna, and T. Mimani, "Combustion synthesis: An update," *Curr. Opin. Solid State Mater. Sci.*, vol. 6, no. 6, pp. 507–512, 2002, doi: 10.1016/S1359-0286(02)00123-7.

Reference Books:

1. https://ocw.mit.edu/courses/chemical-engineering/10-626-electrochemical-energy-systems-spring-2014/study-materials/MIT10_626S14_S11lec38.pdf
2.

E-books and online course materials:

1. https://pubs.usgs.gov/bul/0388/report.pdf
2.https://ocw.mit.edu/courses/chemical-engineering/10-626-electrochemical-energy-systems-spring-2014/study-materials/MIT10_626S14_S11lec38.pdf

Course outcomes:

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

CO #	Course Outcome (CO)
CO1	Recognize crystalline and noncrystalline material and definitions, classification and calculations of equilibrium defect concentration
CO2	Explain surfaces and interfaces and derive equations for various situations and calculations of surface tension and surface energy
CO3	Comparison of colloidal systems and describe their properties and relate properties of clays with their colloid content
CO4	Explain atom mobility mechanisms, estimation of diffusion and compare diffusivity of ceramics and glasses
CO5	Rewrite theory of phase transformation, summarize glass and glass-ceramic formation and apply phase transformation for opacified glasses, photo-sensitive and photo-chromic glasses, summarize principles and types of combustion synthesis of ceramics

THEORY COURSE TITLE: GLASS TECHNOLOGY-I	
Course Code: 19CC53	CIE: 50
Number of Lectures Hours/Week:04	SEE: 50
Total Number of Lecture Hours: 52	SEE Hours: 03

Modules	Teaching Hours
Module-I: Origin of glass, definition of glass, fundamental concepts of glass, glassy and crystalline states, glass formation, glass making oxides, principal glass making batch materials, minor ingredients and their functions, general glass manufacture, Zachariasen rules on structure of glass, devitrification of glass.	12
Module-II: Cullet, factors influencing choice of batch materials, batch material handling and preparation - Raw materials specifications, receiving and storage, shipment, unloading the raw materials, conveying to storage, storage of raw materials in silos, general storage problems, bin segregation, handling and storage of cullet, collecting, weighing, mixing, conveying the batch to furnace, furnace charging, Chemical composition of different types of glasses, calculation of batch from glass composition vice versa, calculation of empirical formula of glass.	10
Module-III: Pot furnaces, tank furnaces - Day tank, continuous furnaces, bride wall tank furnace, unit melters etc, furnace instrumentation, convection currents, mechanism of melting, physical and chemical reactions occurring during melting, fining, heat conditioning and Homogenization	10
Module-IV: Electric melting of glass, Fore hearth, the gob feeder, rings and boots, blow pipe, marveling and blocking, puffing, off hand working, etc., finishing operations. Glass forming machines – hallow wares, bulbs, bottles, flat glasses.	10
Module-V: Tubing, pressed ware, heat absorbing glasses, amber glass, optical glass, fiberglass, optical glass fibre, sintered glass, vycor glass, processing, properties and applications of glass ceramics	10

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

2. Hand book of Glass Manufacture – F.V. Tooley

Reference Books:

1 Glass Engineering Hand Book- E.B Shand

2. Technical Glasses – M.B. Volf
3.. Glass: A Handbook for students and Technicians – Dickson et.al.
4. Properties of glass – G. W. Moorey
5. Chemistry of Glass – Amul Paul
6.. Glass Research Methods – R.K Day

7. Glass Technology – Charan
8.. Glass Science – Robert H. Doremus, John Wiley & Sons.

E-books and online course materials:

1. http://www.digitalbookindex.com/_search/search010artglassa.asp
2.https://books.google.com/books/about/The_Handbook_of_Glass_Manufacture.html?id=ZvweAQAAIAAJ
3 .https://www.researchgate.net/publication/236517898_e-book
4. https://sites.google.com/celup.42web.io/bonbooko12/pdfepub-download-introduction-to-glass-science-and-technology-by-j-e-shelby-book-in-english
5. https://freevideolectures.com/course/4452/nptel-glass-processing-technology
6.https://ocw.mit.edu/courses/materials-science-and-engineering/3-071-amorphous-materials-fall-2015/
7. https://www.classcentral.com/course/swayam-glass-processing-technology-14099
8. https://onlinecourses.nptel.ac.in/noc20_ce46/preview
9. http://www.icglass.org/home/education/
10. https://www.naukri.com/learning/glass-manufacturing-plant-certification

Course outcomes:

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

CO #	Course Outcome (CO)
CO1	**Describe glassy state , glass making batch materials ,structure of glass**
CO2	**Illustrate glass batch material handling and glass batch calculations**
CO3	**Assess glass making furnaces andglass making reactions**
CO4	**Outline glass making machines and glass manufacture**
CO5	**Generalize types of glasses and their applications applications**

THEORY COURSE TITLE: CEMENT TECHNOLOGY – I	
Course Code: 19CC54	CIE: 50
Number of Lectures Hours/Week:04	SEE: 50
Total Number of Lecture Hours: 52	SEE Hours: 03

Modules	Teaching Hours
Module-I: Origin and development of cement industries, lime and other building materials, different classes of lime and their properties. Cement manufacture - wet , dry , semi-dry processes, classification of cement. Raw materials, their selection and proportioning, calcareous and argillaceous materials, quality requirements, corrective materials and additives, industrial wastes and by products	10 Hours
Module-II: Study of phase diagrams of binary, ternary and phase relations of clinker material. Proportion of different phase constituents and their ultimate effect on the properties of cement. Significance of moduli values of HM, SM, AF, LSF etc. Guide lines for selection of raw materials for different purposes, raw material quality and burnability factors for clinkerization	12 Hours
Module-III: Reactions occurring in cement burning, effect of cooling on cement properties and phases, effect of minor constituents and mineralizers on raw mix burning and cement characteristics. Thermo-chemistry of cement formation, sequence of reactions, reaction products, calculation of potential phase composition and liquid phase temperature	10 Hours
Module-IV: Hydration of portland cement - hydration mechanisms and related theories for C_3S phase and mechanisms of C_2S and C_3A.etc. Setting and hardening of portland cement, set regulations and gypsum, calcium sulphate - water system, false set, alternative set regulators, air setting of portland cement, carbonation, hydration characteristics of different types of portland cements	10 Hours
Module-V: Types of cement and their use: Quick setting cement, rapid hardening cement, low heat cement, blast furnace slag cement, pozzolona and pozzolonic cement, high alumina cement, sorel cement, hydrophobic cement, water proof cement, expanding and stressing cement, sulfate resisting cement, super sulphate cement, trief cement. Testng of cement: particle size analysis by different methods, initial and final setting time, density of cement, soundness of cement, strength test etc, ISI Specifications for different types of cement. Gypsum and plaster of Paris, manufacture of plaster of Paris and its uses.	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. Text book of Cement and Concretes - Lee
2. Advances in Cement technology – S.N. Ghosh, ABI Books Pvt. Ltd., NewDelhi.
3. Cement Engineer's Handbook – Von Otto Labahn, McGraw Hill.
4. Cement – Banerjee
5. Cement – Chatterjee

Reference Books:

1. Cement Chemistry – Harold F W Taylor
2. Cement-data-book by Walter H. Duda

E-books and online course materials:

1. Advances in Cement Technology(1st Edition): Critical Reviews and Case Studies on Manufacturing, Quality Control, Optimization and Use
2.Cement Production Technology(1st Edition):Principles and Practice

Course outcomes:

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

CO #	Course Outcome (CO)
CO1	**Define, classify and compare various types building materials and cement manufacturing processes**
CO2	**Analyze thermo-chemical reactions and calculate the potential phase compositions of various types of cement**
CO3	**Interpret the reaction occurring in cement manufacturing and explain its effect on cement properties**
CO4	**Explain the hydration mechanism of different cement phases**
CO5	**Evaluate properties of various types of cements**

Course Title: Refractories – I		
Subject Code	**19CC55**	**CIE: 50**
Number of Lecture Hours/Week	**3 (Theory)**	**SEE: 50**
Total Number of Lecture Hours	**42**	**SEE Hours: 03**
Modules		**Teaching Hours**
Module1 Definition, Classification and properties of Refractories, raw materials, scope of refractory industries in India, Review of raw materials for different Refractories. Drying shrinkage, processing variables for controlling drying shrinkage, drying in hot floors and other types of dryers.		**8 Hours**
Module2 Preparation, properties and applications of Alumino-silicate refractory bricks (fire clay, silliminite, kyanite, andulsite, high heat duty, moderate heat duty, low heat duty refractories) silica and semi silica. Alumina-Silica phase diagram.		9
Module3 Preparation, properties and applications of magnesite, dolomite, chrome and chrome magnesite, insulation bricks.		**8**
Module4 Preparation, properties and applications of oxide refractories (MgO, ZrO_2, Al_2O_3) carbon and graphitized refractories, Mag-carbon refractories, fusion cast refractories. Sialon refractories		9
Module15 Specification of different kinds of bricks, PCE tests, compression, torsional and creep properties. RUL test, reheat shrinkage, spalling resistance, slag resistance, reaction between refractors and glasses, heat transmission, behavior of refractories in different environment, carbon monoxide disintegration		8
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. Refractories - Rashid Chesti

Reference Books:

1. Refractories – F.H. Norton
2. Refractories - Properties & application – J.H. Chesters.
3. Refractories – M.L. Mishra
4. Refractories Properties & application – Kenneth Shaw
5. Refractories – Nandi

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

Course Code	CO #	Course Outcome (CO)	Blooms Level
	CO1	Defend and Describe the classification, general preparation, properties, applications and the scope of refractories	**C1 C2**
	CO2	Describe the preparation, properties applications of acidic refractories and formulate the refractory batches	**C2 C3 C4**
	CO3	Describe the preparation properties applications of basic and insulation refractories	**C2 C3 C4**
	CO4	Describe the preparation properties applications of neutral and advanced /special refractories	**C2 C4 C5**
	CO5	Explain the concepts of testing /evaluation of refractory properties and their calculations	**C2 C3 C4**

PRACTICAL COURSE TITLE: CEMENT TESTING LAB		
Course Code: 19CCL51		CIE: 50
Number of Hours/Week: 03		SEE: 50
Total Number of Hours: 72		SEE Hours: 03

List of experiments

Minimum EIGHT experiments to be performed out of the following:

1. Determination of fineness of cement by sieve analysis.
2. Determination of fineness of cement by Blains air permeability method.
3. Study of Vicat apparatus and determination of consistency of cement.
4. Determination of initial setting time of cement.
5. Determination of Final setting time of cement.
6. Determination of Soundness of cement by Le Chatelier's apparatus.
7. Determination of Soundness of cement by autoclave method.
8. Determination of specific gravity and true density of cement by pycnometer method.
9. Determination of specific gravity and true density of cement by pycnometer method.
10. Determination of specific gravity and true density of cement by Le Chatelier's flask.
11. Determination of compressive strength of cement concrete.
12. Determination of heat of hydration of cement.

Course outcomes:

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

CO #	Determine physical properties of cement
CO1	Determine setting time and , soundness of cement
CO2	Perform chemical and technical analysis of cement
CO3	Determine thermal and mechanical properties of cement
CO4	Determine physical properties of cement
CO5	

Course Title: REFRACTORIES LABORATORY		
Course Code	**19CCL52**	**CIE: 50**
Number of Practical Hours/Week	**2 hrs/week**	**SEE: 50**
Total Number of Practical Hours	**28**	**SEE Hours: 3**

Minimum eight experiments to be carried out from the following experiments

0. Batch preparation of different refectory composition from available rejected and other raw materials
1. Preparation of high density and insulation Refractory Samples.
2. Estimation of SiO_2, Al_2O_3, Cr_2O_3, Fe_2O_3, TiO_2, CaO, MgO Na_2O in refractory material.
3. Determination of apparent and true Porosity in Refractory material.
4. Determination of Bulk density of regular shaped refractory bricks.
5. Determination of Bulk density of irregular shaped refractory bricks
6. Determination of specific gravity in refractory material.
7. Determination of drying shrinkage in refractory material.
8. Determination of firing shrinkage in refractory material.
9. Determination of Cold Crushing Strength in refractory material.
10. Determination of R.U.L. of refractory material.
11. Determination of Thermal Expansion of refractory material.
12. Determination of Refractoriness (PCE) of refractory material.
13. Determination of Thermal Spalling Resistance of refractory material.
14. Determination of Thermal conductivity in refractory material.
15. Determination of Modulus of Rupture of refractory material.
16. Determination of Reversible Thermal Expansion of refractory Material.
17. Determination of Creep Resistance of refractory material.
18. Determination of carbon-monoxide disintegration test for refractory Material.
19. Determination of loss on ignition.
20. Determination of adsorbed moisture.
21. Determination of chemically combined water.

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

CO #	Course Outcome (CO)
CO1	Demonstrate the experiment related to determination RUL and PCE
CO2	Determine the physical properties of Refractory samples
CO3	Determine dried properties of refractory samples
CO4	Determine drying and firing shrinkage of refractory samples
CO5	Demonstrate the experiment related to thermal properties of refractory samples

Course Title: Glass Technology laboratory		
Course Code	**19CCL53**	**CIE:50**
Number of Lecture Hours/Week	**3 hrs/week**	**SEE: 50**
Total Number of Lecture Hours	**48 hrs**	**SEE Hours: 06**

Prerequisite

Course Objectives: To impart knowledge and enable students to understand

1) Glass preparation
2) Glass ceramic preparation.
3) Special glass preparation.
4) Properties of glasses.
5) Decoration of glass.
6) Identification of defects.

1 Glass batch preparation of given glass
2 Preparation of sand moulds
3 Preparation of soda lime silicate glass
4 Preparation of Barium borate glass
5 Preparation of borosilicate glass
6 Decoration of glass by itching method
7 Determination of density of glass
8 Examination of glass for glass defects
9 Preparation of advanced glass ceramics
10 Determination of chemical durability of glass
11 Determination of viscosity of glass
12 Determination of softening point of glass

	CO #	Course Outcome (CO) On completion of the course, the student will have the ability to:	
	CO1	Plan and prepare glasses, special glasses and glass ceramics	
	CO2	Demonstrate determination of mechanical properties of glass and compare them	

	CO3	Write laboratory report based on experimental results and compare with literature data	
	CO4	Analyze glass and glass ceramic specimen for chemical durability	
	CO5	Inspect glass defects present in a glass specimen	

MANAGEMENT AND ENTREPRENEURSHIP

Subject Code	Subject	Stream	Th– Tut-Pr	Credits
19HU51	MANAGEMENT AND ENTREPRENEURSHIP	Humanities	3 - 0 - 0	03

CIE: 50 SEE: 50 SEE : 03 hours Total : 42 Hours

Course Objectives :

To enable the students to obtain the basic knowledge about Entrepreneurship and Management and finance in the following topics:-

. The Meaning, Functions, Characteristics, Types, Role and Barriers of Entrepreneurship,. Government Support for Entrepreneurship
. Management – Meaning, nature, characteristics, scope , functions, role etc and Engineers social responsibility and ethics
. Preparation of Project and Source of Finance
. Fundamentals of Financial Accounting
. Personnel and Material Management, Inventory Control

Module - I

ENTREPRENEUR : Meaning of Entrepreneur; Functions of an Entrepreneur; Characteristics of an entrepreneur , Types of Entrepreneur; Intrapreneurs – an emerging class ; Role of Entrepreneurs in economic development; Barriers to entrepreneurship, Government Support for Innovation and Entrepreneurship in India - Startup-India, Make-in-India, PMMY, AIM , STEP, BIRAC, Stand-up India, TREAD

8 HOURS

Module – II

MANAGEMENT: Introduction – Meaning – nature and characteristics of Management, Scope and functional areas of management, Roles of Management, Levels of Management, Henry Fayol - 14 Principles to Management , Engineers Social responsibility and Ethics

8 HOURS

Module -III

PREPARATION OF PROJECT AND SOURCE OF FINANCE:

PREPARATION OF PROJECT: Meaning of project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents;

SOURCE OF FINANCE: Long Term Sources (Equity, Preference, Debt Capital, Debentures, loan from Financial Institutions etc) and Short Term Source(Loan from commercial banks, Trade Credit, Customer Advances etc)

8 HOURS

Module -IV

FUNDAMENTALS OF FINANCIAL ACCOUNTING: Definition, Scope and Functions of Accounting , Accounting Concepts and Conventions: Golden rules of Accounting, Final Accounts - Trading and Profit and Loss Account, Balance sheet

9 HOURS

Module - V

PERSONNEL MANAGEMENT, MATERIAL MANAGEMENT AND INVENTORY CONTROL:

PERSONNEL MANAGEMENT: Functions of Personnel Management, Recruitment, Selection and Training, Wages, Salary and Incentives

MATERIAL MANAGEMENT AND INVENTORY CONTROL: Meaning, Scope and Objects of Material Management. Inventory Control- Meaning and Functions of Inventory control ; Economic Order Quantity(EOQ) and various stock level (Re-order level, Minimum level, Maximum level, Average level and Danger level)

9 HOURS

Pre requisites: None

Course Outcomes: At the end of the course the students are able to

CO 1	Develop Entrepreneurship skills
CO 2	Apply the concepts of management and Engineers Social responsibility & Ethics practice
CO 3	Prepare project report & choose different Source of Finance.
CO 4	Apply Fundamentals of Financial Accounting and interpret the final accounts
CO 5	Apply personnel management skills, Material and inventory control techniques

Pattern of question paper

1. Solve all five full questions selecting atleast one question from each module

Text Books :

1. Financial Accounting -B S RAMAN- United Publishers Manglore, Maheswar S N & Maheswari S K-Vikas Publishing House. January 2018
2. Management & Entrepreneurship- K R Phaneesh- Sudha Publications January 2018 ,Prof Manjunatha & Amit kumar G – laxmi Publication , January 2011. Veerbhadrappa Havina -Published by New Age International (P) Ltd., 2009.
3. Principles of Management First Edition (English, G. Murugesan), Laxmi Publications – New Delhi

Reference Books :

1) Industrial Organization & Engineering Economics-T R Banga & S C Sharma- Khanna Publishers, Dehli.

NPTEL : ENTREPRENEURSHIP: PROF. C BHAKTAVATSALA RAO Department of Management Studies IIT Madras https://nptel.ac.in/courses/110/106/110106141/

https://www.businessmanagementideas.com/notes/management-notes/notes-on-management-in-an-organisation/4669

COURSE ARTICULATION MATRIX

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1	2.00					2.00	2.00	3.00	3.00	2.00	3.00	3.00
CO 2	2.00	1.00				1.00	2.00	3.00	3.00	3.00	3.00	2.00
CO 3	2.00					1.00	1.00	2.00	3.00	3.00	3.00	2.00
CO 4	2.00					1.00	1.00	2.00	3.00	3.00	3.00	2.00
CO 5	2.00					1.00	1.00	2.00	2.00	2.00	2.00	3.00
Average	2	1				1.20	1.40	2.40	2.80	2.60	2.80	2.40