

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI
Choice Based Credit System (CBCS)
Scheme of Teaching and Examination 2022 – 23
(Effective from the academic year 2022 – 23)

IV Semester

Sl. No.	Course and Course Code		Course Title	Teaching Department	Teaching Hours/Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	PC/BS	21CC41	Unit Operations	CCT Dept	03		--	03	50	50	100	3
2	PC	21CC42	Ceramic Processing and fabrication	CCT Dept	03		--	03	50	50	100	3
3	PC	21CC43	Whitewares and heavy clay wares	CCT Dept	03		--	03	50	50	100	3
4	PC	21CC44	Fuels and Furnaces	CCT Dept	03		--	03	50	50	100	3
5	HSMS	21KAK45	Samskrutika Kannada	Humanities	02	--	--	1.5	50	50	100	1
		21KAN45	Balake Kannada					OR				
		OR						03				
		21HU45	Constitution of India and Professional Ethics									
6	AEC	21CCA46A	Ability Enhancement Course (Life Sciences) (Biology for Ceramics)	CCT Dept					50	50	100	2
7	AEC	21CCA46B	Ability Enhancement Courses(Furnaces and equipment Drawing)	CCT Dept					50	50	100	1
8	UHV	21UHV46C	Universal Human Values-II			02		02	50	50	100	1
9	PC	21CCL41	Unit Operations Lab	CCT Dept	--	--	2	03	50	50	100	1
10	PC	21CCL42	Ceramic processing lab	CCT Dept	--	-	2	03	50	50	100	1
11	PC	21CCL43	Whitewares lab	CCT Dept	--	--	2	03	50	50	100	1
Total									550	550	1100	20

COURSE TITLE: UNIT OPERATIONS		
Course Code	21CC41	Maximum marks CIE: 50
Number of Lecture Hours/Week	03	Maximum marks SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
Prerequisite: <ol style="list-style-type: none"> 1. Class 10th standard knowledge of physics 2. Basic knowledge in differential & integral calculus 		
Course Objectives <ol style="list-style-type: none"> 1. To provide an exposure to the engineering application of the physical principles involved in various unit operations related to processing of ceramic raw materials. 2. Familiarizing the students with the major physical features and the working principles of the equipment for handling various kinds of materials and transport of heat through conduction, convection and radiation 3. To provide an understanding of practical problem-solving techniques for the physical processes. 		
Modules		Teaching Hours
Module I Introduction to unit operations for ceramic processes, Size reduction, characteristics of comminuted products, Energy and power requirement in comminution, Efficiency, Crushing law and work index, Equipment for size reduction, Jaw crusher, Gyratory crusher, Roll crushers, Grinders, Hammer mill and impactors, Roller mills, Attrition mill, Tumbling mill, Ball mill, Critical speed of Ball mill, Ultrafine grinders, Classifying hammer mill, Fluid energy mill, agitated mill, Colloid mill, Cutting machine, Open circuit and 14 closed circuit operation. [1]		9
Module II Properties of fluids and pressure concept. Variation of pressure with height, measurement of fluid pressure – manometers. Newton’s law of viscosity, Newtonian and non-newtonian fluids, types of flow. Laminar & turbulent flow. [2][3]		8
Module III Basic equations of fluid flow. Euler and Bernoulli’s equation, Correction factors. Pump work in Bernoulli’s equation. Measurement of fluid flow rate by orifice and venturi meter. Flow through weirs and notches. Dimensional homogeneity, Rayleigh’s and Buckingham’s pi methods. Dimensionless numbers. [2][3]		8
Module IV Various modes of heat transfer - Conduction, Convection and Radiation. Conduction: Fourier’s law, Steady state unidirectional heat flow through single and multiphase layers slabs, cylinders and spheres for constant thermal conductivity. [4][5]		8
Module V Heat Transfer by convection: Principles of heat flow in fluids, Countercurrent and parallel flows and related temperature profiles, Overall heat transfer co-efficient, Logarithmic mean temperature difference, Individual heat transfer coefficients, Calculation of overall coefficients, Heat transfer by forced convection. Heat Transfer by Radiation: Properties and definitions, Absorptivity, Reflectivity, Emissive power and intensity of radiation, Black body radiation, Gray body radiation, Stefan – Boltzmann law, Wien’s displacement law, Kirchhoff’s law, Radiation between surfaces [4][5]		9

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

Text books:

1. Anup K Swain, Hemlata Patra and G. K. Roy, "Mechanical Operations", McGraw Hill Education Indai.
2. Dr. R. K. Bansal, "Fluid Mechanics", Laxmi Publication India
3. K. A. Gavhane, "Unit Operations-I[Fluid Flow and Mechanical Operations]", Nirali Prakash publications.
4. Kern D.Q., "Process Heat Transfer", McGraw Hill., New York, 1965
5. McCabe W.L., et. al., "Unit Operations of Chemical Engineering", 5th ed., McGraw Hill International, Singapore, 2000.

Reference Books:

1. Rao Y.V.C., "Heat Transfer", 1st edn., Universities Press (India) Ltd., New Delhi, 2001. Dutta, Binay K., "Heat Transfer: Principles and Applications", PHI Learning., 2000
2. Brown G.G., et. al., "Unit Operations", 1st ed., CBS Publisher, New Delhi, 1995.
3. Foust A.S., et. al., Principles of Unit Operations", 3rd ed., John Wiley & Sons., New York, 1997.

E books and online course materials:

1. <https://www.scribd.com/document/443066819/UNIT-OPERATIONS-II-Heat-and-K-AGAVHANE-pdf>
2. <https://bookboon.com/en/engineering-fluid-mechanics-ebook>
3. <http://www.freebookcentre.net/physics-books-download/Fluid-Mechanics-lecturenotes.html>
4. <https://bookboon.com/en/engineering-fluid-mechanics-ebook>

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)	Blooms Level
21CC41	CO1	Apply the principles of comminution process to make rough estimate of energy requirement for crushing and grinding	L4
	CO2	Define fluids and their properties, calculate pressure and differential pressure exerted by fluids, classify types of fluids and fluid flow patterns.	L1, L4
	CO3	Perform calculations on open channel flow and closed channel flow using Euler and Bernoulli's equation	L4
	CO4	Apply the laws of heat conduction to calculate heat flow through successive layers of wall and pipes.	L4
	CO5	Apply concepts of convection and radiation to determine the amount of heat transfer by radiation	L4

THEORY COURSE TITLE: Ceramic Processing and Fabrication	
Course Code: 21CC42	CIE: 50
Number of Lectures Hours/Week: 03	SEE: 50
Total Number of Lecture Hours: 42	SEE Hours: 03
Modules	Teaching Hours
<p align="center">Module-I</p> <p>Classification of ceramic powder products, Ceramic products by functions, Objectives of ceramic processing, industrial ceramic processing, Common raw materials i.e., crude materials, industrial minerals, beneficiation of kaolin and industrial inorganic chemicals; Alumina by Bayer's process, SiC by Acheson process, sea water magnesia, Titania by chloride or sulphate process.</p>	8
<p align="center">Module-II</p> <p>Synthesis of ceramic powders by wet chemical routes such as precipitation, sol-gel techniques, solvent evaporation and extraction, powders from vapor phase reactions and powders from mechanical milling. Raw materials specifications, principles of spectroscopy techniques, microscopy characterization techniques, thermo-chemical and thermo-physical analysis, particle size and shape analysis techniques, powders density measurement and specific surface area measurement</p>	8
<p align="center">Module-III</p> <p>Processing additives: water, organic liquids, surfactants, Binder compositions; clay binders, molecular binders such as vinyl type and cellulose type. Waxes and glycols, Dissolving and admixing binders, general effect of binders. Role of plasticizers and lubricants. Particle packing characteristics; Characteristics of packing of uniform spheres, Packing efficiency by packing interstices among coarser particles and hindered packing. Granulation; Direct granulation and spray drying process.</p>	9
<p align="center">Module-IV</p> <p>Fabrication methods: Rheological behavior of slurries; Slip casting in permeable mould, examples of compositions of casting slurries and tape casting. Plastic-Forming processes; Equipment and material variables in extrusion and examples of composition of extrusion bodies. Pressing; Process variables in dry pressing, processing additives used in industrial pressing powders, compaction behavior, control of compact defects, isostatic compaction and its significance.</p>	9
<p align="center">Module-V</p> <p>Drying and Firing; The drying process, drying mechanism, drying shrinkage and defects and modes of drying. Firing systems, Pre-sintering processes, solid-state sintering and liquid-phase sintering, cooling and Hot pressing.</p>	8
<p>Question paper pattern: Question paper shall contain five modules, each module containing two questions. Students shall answer any one question from each module.</p>	

Text books:
James S. Reed “Introduction to the Principles of Ceramic Processing” John Wiley & Sons Publication New York

Reference Books:
M. N. Rehman, “Ceramic Processing and Sintering” 2nd Edition, Engineering and Technology; Physical Sciences, CRC Press 2003

E-books and online course materials:
1. M. N. Rehman Ceramic Processing and Sintering, Second Edition Marcel Dekker Inc. USA
https://www.academia.edu/5600888/Ceramic_Processing_and_Sintering_Rahaman_PDF

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

CO #	Course Outcome (CO)
CO1	Objectives of ceramics processing and powder products
CO2	Synthesis of ceramic fine powders and interpretation of their characteristics
CO3	Identify appropriate additives for batch compositions and particle packing efficiency
CO4	Selection of appropriate fabrication method based on product applications
CO5	Analysis of drying and sintering schedules for densification

THEORY COURSE TITLE: White wares and Heavy clay wares	
Course Code: 21CC43	CIE: 50
Number of Lectures Hours/Week:	SEE: 50
Total Number of Lecture Hours: 42	SEE Hours: 03
Modules	Teaching Hours
<p>Module-I: Definition, Scope and division of field, geological formation, occurrence, raw materials- plastic raw materials , non plastic raw materials, non clay plastic raw materials .mining and treatment of ceramic raw materials. Triaxial composition, crystal structure and Properties of important ceramic raw materials.</p>	9
<p>Module-II: Auxiliary raw materials, Particulate solids and water role in different ceramic raw materials and in bodies. Batch calculation, inter-conversion of batch composition to formula and batch formula to composition. Rheology and types of fluids.</p>	8
<p>Module-III: Important shaping methods like jiggering, jollying, slip casting, tape casting, extrusion, isostatic pressing, hot pressing, soft mud processes, plastic forming. Finishing, drying and firing of wares. Glazes: Definition, types of raw materials, coloring ingredients, decorating methods, compounding and firing of glazes, blending, preparation Of glaze slip, glaze application.</p>	9
<p>Module-IV: Heavy Clay Wares: Definition of raw materials, classification of building materials, their chemical and mineralogical composition, clay preparation and shaping. Manufacture of common building bricks and roofing tiles, hollow bricks, sewer pipe, salt glazing. Microstructure of structural clay products</p>	8
<p>Module-V: Fine ceramics: Characteristics, Manufacture and properties of floor tiles, wall tiles, art ware, dental porcelain, bone china, abrasion resistance, porcelain, chemical stone wares, chemical porcelain, insulators, and metalized ceramics. Testing: Loss on ignition, plasticity, thermal shock, corrosion resistance, abrasion resistance, refraction, optical absorption, and crazing, lead solubility. General Plant Layout of white wares industries.</p>	8
<p>Question paper pattern: Question paper shall contain five modules, each module containing two questions. Students shall answer any one question from each module.</p>	
<p>Text books:</p> <ol style="list-style-type: none"> 1. Industrial Ceramics – Singer and Singer, Springer Netherland publisher edition-1. 2. Ceramic Raw Materials – Ryan, William Ryan Pregamon Press, 1978. 3. Ceramic batch calculations – A.I. Andrews. 4 Ceramic Glaze Technology – Bull & Taylor, Pregamon press, 1986 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Fine Ceramics – F.H. Norton, Krieger pub. Co (June 1978) 2. Introduction to Ceramics – W.D. Kingery, vol. 18, Wiley press, 1960.. 3. Elements of Ceramics – Norton, Addison-Wesley Longeman publisher, 1974. 4. Introduction to White wares – Jackson Mac laren and sons Lt.publisher, London 1969. 5. Ceramics – P. William Lee, Reinhold publisher, 1961. 6 Ceramic white wares – Rexford Newcomb, Pitman publishing Corporation 1947. 7. Heavy Clay wares – F.H. Clews, ACS publication, Academic Press, Newyork. 	

E-books and online course materials:

1. https://www.goodreads.com/book/show/2269166.Whitewares_Production_Testing_And_Quality_Control
2. https://books.google.com/books/about/Ceramic_Whitewares.html?id=vtWIAAAACAAJ
3. <https://phoenix.overdrive.com/phoenix-33/content/media/290620>
4. <https://www.routledge.com/Ceramic-Processing-Industrial-Practices/Sarkar/p/book/9780367727062>
5. https://books.google.com/books/about/Elements_of_Ceramics.html?id=bzvxAAAIAAJ
6. <http://www.hsbttutor.org.in/CeramicEngineering.html>
7. <https://www.worldcat.org/title/modern-ceramic-engineering-properties-processing-and-use-in-design-fourth-edition/oclc/1034612383>
8. <https://www.skillshare.com/browse/clay>
9. <https://www.skillshare.com/browse/pottery>
10. <https://www.britannica.com/art/whiteware>
11. <https://www.youtube.com/watch?v=PSHQxlbMNpE>
12. <https://www.facebook.com/JohnBrittPottery/videos/free-online-glaze-course-here-are-titles-of-videos-you-may-have-to-search-but-6-/466799357583201/>
13. <https://www.teachinart.com/glazing-made-easy.html>
14. <https://claystation.com/tag/online-glaze-course-pottery-ceramics-glazes-john-britt-johnbrittpottery-throwing-videos/>
15. <http://www.lifeandart.in/online-ceramic-glazing-courses.html>

Course outcomes:

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

CO #	Course Outcome (CO)
CO1	Describe occurrence, formation, Structure and properties of ceramic raw materials.
CO2	Explain role of water, rheology, and batch calculations.
CO3	Illustrate shaping methods , glaze preparation and glaze application
CO4	Discuss Characteristics, raw materials, manufacture heavy clay ware products
CO5	Explain manufacture of fine ceramics and testing of white ware products

Course Title: Fuels and Furnaces		
Subject Code	21CC44	CIE: 50
Number of Lecture Hours/Week	3(Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
Modules		Teaching Hours
<p align="center">Module-1</p> Fuels and general classification made on fuels, features and characteristics of fuels Solid fuels: Wood and charcoal. Coal and theories behind coal formation, ranking and distribution of coals in India, washing of coal and its importance. High and low temperature coal carbonization. Coke manufacture and its applications. Pulverized coal and its applications, determination of calorific value of solid fuels. (8 hrs)		8
<p align="center">Module-2</p> Liquid fuels: Petroleum, its origin theories and occurrence, production of petroleum, pretreatment of petroleum, refining and distillation of crude petroleum, byproducts of crude petroleum and their applications, cracking of petroleum, purification of petroleum, properties of petroleum products Determination of calorific value of liquid fuels. (08 hrs)		8
<p align="center">Module-3</p> Gaseous fuels: Natural gas, gobar gas, LPG, coal gas, producer gas, water gas, blast furnace gas – Manufacture and their applications. Nuclear fuels: nuclear fuels resources in India, nuclear reactors: basic components of nuclear reactors, classification and types of nuclear reactors(08hrs)		8
<p align="center">Module-4</p> Furnaces: General classification of furnaces, furnace auxiliaries, Different types of heating elements used in furnaces waste heat recovery from furnace flue gases by using regenerator and recuperators, Control of furnace atmosphere, kilns and furnaces used in ceramic industries: Rotary kilns, Tunnel kiln, Intermittent and Continuous kiln, Glass tank furnaces, muffle furnace, ovens (10 hrs)		10
<p align="center">Module-5</p> Furnaces used in metallurgical industries: Sintering furnace, Blast furnace, L.D. Converter, open hearth furnace Regenerators and recuperates furnaces, Electric furnaces (resistance, induction, arc, and dielectric heating), annealing furnace, soaking pits. Calculations pertaining to furnaces and kilns (08 hrs)		8
<p>Question paper pattern: Student has to answer five full questions choosing one question from each module.</p>		
<p>Text books: 1. Glass melting tank furnace – Rudolf Gunthar, Society of Glass Sheffield publisher, 1958. 2. Elements of Fuels, Furnaces and Refractories – O.P. Gupta, Khanna publishers, Delhi 2005. 3. Pyrometry – W.P. Wood & J.M. Cork, McGraw-Hill, 1941. 4. Industrial Furnaces – W. Trinks, John wiley and sons publisher, 2004. 5. Fuels, Furnaces and Refractories – J.D. Gillchrist, Pergamon press, Newyork, 1977. 6. Modern Furnace Technology – H. Etherington, London, Griffin publisher, 1961. 7. Handbook of Glass manufacture – F.V. Tooley, Vol. 2, 3rd ed., Ashlee publishing, Newyork, 1974.</p>		

8. Efficient use of fuels – HMSO – Brime and King

E books and online course materials: Fuels, furnaces and refractories- James Ducan Gilcris,
<https://www.askiitians.com/iit-jee-chemistry/physical-chemistry/fuel-cell.aspx>
<https://en.wikipedia.org/wiki/Fuel>
<https://en.wikipedia.org/wiki/Furnace>
<http://www.madehow.com/Volume-7/Furnace.html>

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)	Blooms Level
	CO1	Interpret about solid fuels and able to outline their applications in process industries.	L2
	CO2	Explain petroleum by- products formation and apply the by -products for different applications.	L2,L3
	CO3	Classify different types of gaseous fuels. Formation and assessment of gaseous fuels applications in process industry. (L2, L6)	L2, L5
	CO4	Explain and understand about furnaces and their types and furnaces used ceramic industries	L2,L5
	CO5	Learn about different types of furnaces used in metallurgical industries and will be in a position to solve calculation related to heat balance sheet	L2, L5

B.E. III/IV SEM.

CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS

Subject Code	Subject	Stream	Th- Tut-Pr	Credits
21HU45	CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS	Humanities and Social Sciences (H.S.S)	2 - 0 - 0	01

CIE : 50

SEE : 50

SEE : 03 hours

Total : 28 Hours

Course Objectives : To enable the students to obtain the basic knowledge about The Constitution of India and Professional Ethics in the following topics:-

- . Introduction and Fundamental Rights
- . Directive Principles of the State Policy and the State Executive
- . The Union Executive
- . Constitutional Provisions for women, Children & SC/ST 'S , Emergency Provisions and Election Process
- . Engineering Ethics

MODULE – I

Introduction and Fundamental Rights : The Constitution of India. Evolution of the Constitution. The Constituent Assembly of India. Sources and Features of the Indian Constitution. Preamble to the Constitution of India. Salient Features of Fundamental Rights and their classification. General exercise of Fundamental Rights and their limitations. RTI (Right to Information Act of 2005 Under Article 19(1)) and The Right of Children to Free and Compulsory Education Act or Right to Education Act (RTE) Under Article 21-A of the Constitution. Special Provisions (Article 370.371 & 371J) for some States

6 hrs.

MODULE – II

Directive Principles of the State Policy and The State Executive: Under Article 36 to 51 of The Constitution and their Relevance. Fundamental Duties Under Article 51A of The Constitution and their Relevance. State Government - The Governor- Appointment, Powers and Functions of the Governor. The Appointment of Chief Minister, his Powers and Functions. The State Council of Ministers and their Functions. The State legislature and The State Council. The High Court of the State, its Powers and Jurisdiction. Appointment and Qualifications of High Court Judges.

6 hrs.

MODULE – III

The Union Executive: Central Government. The President of India, his Election, Powers and Functions. The Vice-President of India, his Election, Powers and Functions. The Supreme Court of India and its Structure. Appointment and Qualification of Supreme Court Judges. Their Powers and Functions. The Structure of Judiciary in India. The Parliament of India. The Prime Minister, his Appointment, Powers and Functions. The Union Council of Ministers their Powers and Responsibilities. Concept of Public Interest Litigation (PIL) **6 hrs.**

MODULE – IV

Constitutional Provisions and Emergency Provisions and Election Process : Constitutional for Women, Children, Backward Classes and Scheduled Caste and Scheduled Tribes under different Article of The Constitution. Different types of Emergencies under Article 352, 356 and 360 of the Constitution of India. The Election Commission of India- its Powers and Functions. The State Election Commission **5 hrs.**

MODULE – V

Engineering Ethics : Its Aims and Scope, Responsibilities of Engineers, Impediments to their Responsibilities, Honesty, Integrity, Reliability, Risk and Safety Measures, Liabilities of Engineers. **5 hrs.**

Pre requisites: None

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

CO 1	Explain the evolution and features of constitution, fundamental rights and their classification L 2
CO 2	Describe the directive principles of state policy, fundamental duties and The State Executive L 2
CO 3	Describe about The Union Executive and concept of Public Interest Litigation L 2
CO 4	Explain the Constitutional Provisions for women, children, SC/ST'S, Emergency Provisions and Election Process L 2
CO 5	Identifies the qualities required for an professional engineers to be ethical L 4

COURSE ARTICULATION MATRIX

CO	COURSE OUTCOME STATEMENT	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P0 10	PO11	PO12
CO 1	Explain the evolution and features of constitution, fundamental rights and their						3	2	3				3

	classification												
CO 2	Describe the directive principles of state policy, fundamental duties and The State Executive						3	2	3				1
CO 3	Describe about The Union Executive and concept of Public Interest Litigation						3	2	3				1
CO 4	Explain the Constitutional Provisions for women, children, SC/ST'S, Emergency Provisions and Election Process						3	2	3				1
CO 5	Identifies the qualities required for an professional engineers to be ethical						2	2	3				3
	Program Articulation Matrix(PAM)						2.8	2	3				1.8

Pattern of question paper

- Solve five full questions selecting atleast one question from each Module

Text Books :

- An introduction to the constitution of India and Profession Ethics.
By B. R. Venkatesh and Merunandan K. B. Publisher : Idea International Publication Bangalore.
- The Constitution of India and Professional Ethics.
By K. R. Phaneesh. Publisher : Sudha Publication Bangalore.
- Professional Ethics.
By S. Chand. Publisher : S. Chand & Company Ltd. Ram Nagar, New Delhi - 110055.

Reference Books :

- Constitution of India and Professional Ethics
By : M Raja Ram. Publisher : New Age International(P) Limited, New Delhi.
- The Constitutional law of India
By : J.N.Pandhey . Publisher : Central Law agency , Allahabad.

Course Title: Ability Enhancement Course (Life Sciences) (Biology for Ceramics)		
Course Code	21CCA46A	CIE: 50
Number of Lecture Hours/Week	2	SEE: 50
Total Number of Lecture Hours	25	SEE Hours: 03
Prerequisite		
<p>Course Objectives:</p> <p>To impart knowledge and enable students to understand:</p> <ol style="list-style-type: none"> 1. Bio materials and structure and properties of biological cells. 2. Structure of blood and its interaction with implant 3. Structure of bone, heart and tooth, and their problems. 4. Testing the Cellular viability and Cellular adhesion of bio implants 5. Classification and applications of bio Ceramic Materials 		
Modules		Teaching Hours
<p>Module I</p> <p>Property requirement of biomaterials: concept of biocompatibility, some definitions related to biomaterials. General classification of Biomaterials: Bioinert, bioactive, bioresorbable materials. Structure and properties of biological cells and tissues; natural bones structure and properties. Cell material interactions and foreign body response, Assessment of biocompatibility of biomaterials cell signaling process cell migration, cell differentiation cell apoptosis.</p>		5
<p>Module II</p> <p>Hemo compatibility, Structure of Blood as a Tissue, Interaction of a implants with blood elements, Types of bacteria, Bactria adhesion and bio film formation, Protocol for Bacteria culture formation,</p>		5
<p>Module III</p> <p>Structure, properties and types of bones and Teeth. Bone forming Cells, Cardiovascular system Heart structure and function. Common Cardio problems Stricture.</p>		5
<p>Module IV</p> <p>In vitro Tests (cellular adhesion, cellular viability using MTT test ontogenetic differentiation using ALP assay, Invivo testing.</p>		5
<p>Module V</p> <p>Bioceramics, Categories of ceramic biomaterials, historical perspective of</p>		5

bioceramics, merits of ceramic biomaterials over metals and polymers, desired properties of implantable bioceramics. Bio-inert bio ceramics: alumina, zirconia, calcium aluminates and pyrolytic carbon.

Bio-active glasses and glass ceramics, novel bio-medical materials based on glasses,

Question paper pattern:

Two questions with sub divisions to be set from each module. Students shall answer one question from each module. Mixing of questions in the module is allowed.

Text books:

1. Human biomaterials application – Donald L. Wise et al.(ISBN 0-089603-337-6 (alk. Paper)

Reference Books:

1. Biomaterials Science Ratner, Hoffman, Schoen, Lemons (Elsevier; ISBN 0-12-582461
2. Advanced Biomaterials Fundamentals Processing and Applications Edited By Bikramjit Basu,
3. Dhirendra Katti, Ashok Kumar A JOHN WILEY & SONS INC. PUBLICATION HOBOKEN,
4. NEWJERSY 2009
5. SKINNER’S Science of Dental Materials – Ralph W. Phillips, A PRISM Indian Edition 9th
6. Ed. 1992 PRISM BOOKS PVT LTD Bangalore.
7. Human biomaterials application – Donald L. Wise et al.
8. Biomaterials: Principles and applications – Ed. By Joon B. Park et al., CRC Press
9. Bioceramics: Applications of Ceramic and Glass Materials in Medicine – Ed. James F.
10. Shackelford. An introduction to bioceramics – Ed. Larry L. Hench

E books and online course materials:

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)	Blooms Level
	CO1	Define bio materials and explain structure and properties of biological cells	3
	CO2	Explain structure of blood and its interaction with implant	3
	CO3	Explain structure of bone, heart and tooth, and their problems.	3
	CO4	Test the Cellular viability and Cellular adhesion and Cellular viability	4
	CO5	Explain corrosion and its prevention and Extend chemical bond theory and structure of solids to determine mechanical properties	4

COURSE TITLE: FURNACES AND EQUIPMENT DRAWING		
Course Code	21CCA46B	Maximum marks CIE: 50
Number of Lecture Hours/Week	01	Maximum marks SEE: 50
Total Number of Lecture Hours	15	SEE Hours:
Prerequisite: 1. Student should have basic knowledge of excel		
Course Objectives To impart knowledge and enable students to draw 1. Steel making furnaces 2. Glass making furnaces 3. Various types of kilns 4. Rotary kiln and other equipments used in cement industries 5. Unit operation equipments		
Modules		Teaching Hours
Module I Drawing of Electrical Arc furnace, Induction furnace, pyrometers, Blast furnace, open hearth furnace, L.D.convertor, Bessemer Convertor, Laddles, Soaking Pit		3
Module II Pot furnace, Glass Tank Furnace, Regenerators and recuperators.		3
Module III Dryers, Modern Tunnel Kiln, DDKiln Updraft kiln Chamber Kiln Halfmanns Kiln,		3
Module IV Rotary Kiln, Preheater Precalciners Screw Conveyor Bucket Conveyor Stacking and reclaiming equipment Dust Collector air separator coolers		3
Module V Jaw Crusher, Gyrotory Crusher, Roller crusher Ball Mill Magnetic Separator Screens Frictional Screw press Counter current Intensive Mixer		3
Text books: 1. Industrial Ceramics – Singer and Singer, Springer Netherland publisher edition-1. 2. Handbook of Glass Manufacture – Vol 1,2, F.V. Tooley, Ogden Publication 3. McCabe W.L., et. al., “Unit Operations of Chemical Engineering”, 5 th ed., McGraw Hill International, Singapore, 2000. 4. Cement data book – Vol.I, II, III – W.H. Duda, Gmbh Germany.		
Reference Books: 1. Glass melting tank furnace – Rudolf Gunthar, Society of Glass Sheffield 2. publisher, 1958. Elements of Fuels, Furnaces and Refractories – O.P. Gupta,		

Khanna publishers, Delhi 2005.

3. Fuels, Furnaces and Refractories – J.D. Gillchrist, Pergamon press, Newyork, 1977.

E books and online course materials:

1.

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)	Blooms Level
21CCAE 46B	CO1	Draw steel making furnaces	
	CO2	Draw Glass making furnaces	
	CO3	Draw various types of kilns	
	CO4	Draw rotary kiln and other equipments used in cement industries	
	CO5	Draw Unit operation equipments	

UNIVERSAL HUMAN VALUES-II

Course Code	21UHV46C	Credits:1	CIE: 50
Number of Lecture Hours/Week	2hrs (Tutorial)		SEE: 50
Total Number of Theory Hours	14 hours		SEE Hours: 03
Course Objectives:			
<ol style="list-style-type: none"> To facilitate the students to understand harmony at all the levels of human living, and live accordingly. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life. 			
Modules			Teaching Hours
Module I			
Implications Of The Right Understanding: Providing The Basis For Universal Human Values And Ethical Human Conduct- Value In Different Dimensions Of Humanliving, Universal Values Naturally Emerging From The Right Understanding, Defintiveness Of Ethical Human Conduct, Identification Of <i>Svatva</i> Leading To <i>Svatantrata And Svarajya</i> , Development Of Human Consciousness, Implications Of Value-Based Living.			3hrs
Module II			
Basis For The Holistic Alternative Towards Universal Human Order: Identification Of Comprehensive Human Goal, Vision For The Holistic Alternative, Basis For Humanistic Education And Humanistic Constitution, Universal Human Order And Its Implications.			3hrs
Module III			
Professional Ethics In The Light Of Right Understanding: Profession-In The Light Of Comprehensive Human God, Ensuring Competence In Professional Ethics, Issues In Professional Ethics-The Current Scenario, Inherent Contradictions And Dilemmas And Their Resolutions.			3hrs
Module IV			
Vision For Holistic Technologies, Production Systems And Management Models: The Holistic Criteria For Evaluation, A Critical Appraisal Of The Prevailing Systems, Learning From The Systems In Nature And Traditional Practices, Holistic Technologies And Systems- Typical Case Studies.			3hrs
Module V			
Journey Towards the Holistic Alternative- The Road Ahead: Appreciating The Need For Self-Exploration, Facilitating The Understanding Of Harmony At Various Levels, Steps For Evaluation At The Individual Level, Steps For Transition At The Level Of Family, Society And Profession, Promoting Mass Awareness And Moving Towards Humanistic Education, Evolving Holistic Models Of Living, Amending Policies, Programs And Social Systems In Tune With Comprehensive Human Goal, Is The Transition Too Difficult?, Concluding Remarks.			2hrs
Text Books:			
<ol style="list-style-type: none"> The Text Book R.R Gaur, R Sangal, G P Bagaria, A Foundation Course In Human Values And Professional Ethics, Excel Books, New Delhi, 2010, ISBN 978-8-174-46781-2. The teacher's manual R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics – Teachers Manual, Excel books, New Delhi, 2010 			
Reference Books:			
<ol style="list-style-type: none"> B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991 Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, Universe Books. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati. A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak. 			

8. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.

9. A.N. Tripathy, 2003, Human Values, New Age International Publishers.

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

Course Code	CO	Course Outcome (CO)
21UHV4X	CO1	The students are able to visualize the co-relation between lack of human values and the prevailing problems.
	CO2	They are also able to visualize tangible steps and a roadmap for moving in the cherished direction.
	CO3	The students are able to visualize an appropriate utilization of the knowledge in their respective streams to ensure mutually enriching and sustainable systems.
	CO4	The students are able to sincerely evaluate the course and the transformation achieved in this process.
	CO5	They are also able to make use of this understanding for moving towards happy and prosperous life including an ethical conduct of their profession.

COURSE TITLE: UNIT OPERATIONS LABORATORY		
Course Code: 21CCL41		CIE: 50
Number of Hours/Week: 2 hrs Lab		SEE: 50
Total Number of Hours: 28		SEE Hours: 03
List of experiments		
Fluid Mechanics experiments (Virtual experiments) (NITK Suratkal, Virutal labs link: http://fm-nitk.vlabs.ac.in/#) <ol style="list-style-type: none"> 1. Friction loss in pipes 2. V - Notch apparatus 3. Rectangular notch apparatus 4. Venturimeter 5. Impact of Jet 		
Mechanical operations (Physical experiments) <ol style="list-style-type: none"> 1. Sieve analysis (Differential and cumulative analysis) 2. Efficiency of screen 3. Ball milling and determination of various average particle size 4. Effect of milling on PSD (Open ended experiment) 5. Batch sedimentation 		
Course outcomes: On completion of the course, the student will have the ability to:		
CO #	Course Outcome (CO)	
CO1	Demonstrate concepts of Fluid mechanics and Mechanical operations through a number of experiments	
CO2	Analyze and interpret experimental results	
CO3	Share responsibilities in small teams of 4-5 members for operating equipment	
CO4	Write organized laboratory report presenting the results in a clear way	
CO5	Respond to technical viva on experiments	

21CCL42: CERAMIC PROCESSING AND FABRICATION LABORATORY

Subject / Course Code: 21CCL42		Credits: 01
CIE: 50 Marks	SEE: 50 Marks	Total Marks: 100
Hours / Week: 3 (Practical)		Total Hours: 48
Course objectives: To impart knowledge and enable students to understand:		
1. Effect milling on properties of materials		
2. Slip casting and frit preparation		
3. Preparation of conventional ceramics		
4. Synthesis of ceramics		
Syllabus: Any Eight experiments to be carried out		
1. Effect of milling time on particle size of grog.		
2. Effect of milling time on particle size of clinker.		
3. Effect of De-flocculent on viscosity of whiteware slip.		
4. Effect of milling on viscosity of slip.		
5. Preparation of shear amorphous solids by milling.		
6. Preparation of plaster of paris moulds.		
7. Slip casting of white wares bodies.		
8. Glaze frit preparation and slip preparation.		
9. Application of glazes on white ware bodies.		
10. Decoration of white ware bodies.		
11. Tile pressing and firing.		
12. Jiggering and jolleying operation to fabricate tablewares and potteries.		
13. Preparation of insulating refractory brick.		
14. Preparation and testing of glass fibers.		
15. Synthesis of ceramic powders by solid state & co-precipitation methods		
16. Synthesis of ceramic powders by solgel, combustion methods		
17. Synthesis of ceramic powders by hydrothermal and precursor methods		
Course outcomes: At the end of the course students will be able to:		
CO1	Demonstrate effect of milling on material properties	
CO2	Perform (work) with and develop ceramic materials	
CO3	Preparation of Ceramic bodies	
CO4	Preparation of glazes and frits	
CO5	Preparation of ceramic powders	

