P D A College of Engineering **B.E. in Respective branch Name**

Scheme of Teaching and Examinations 2022

Outcome Based Education (OBE) and Choice Based Credit System(CBCS)

(Effective from the academic year2023-24)

IIISEMESTER

Sl.No	Course	Course Code	Course Title	Teaching Department (TD)and Question Paper Setting Board(PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC /BSC	22MATC31	Mathematics	TD-Respective Dept. PSB- Respective Dept.	2	2	0		03	50	50	100	3
2	IPCC	22CC32	Introduction to Ceramic Technology	TD-Respective Dept. PSB- Respective Dept.	3	0	2		03	50	50	100	4
3	IPCC	22CC33	Principles of Ceramic Processing	TD-Respective Dept. PSB- Respective Dept	3	0	2		03	50	50	100	4
4	PCC	22CC34	Geology	TD-Respective Dept. PSB- Respective Dept	2	2	0		03	50	50	100	3
5	PCCL	22CCL35	Geology Lab	TD-Respective Dept. PSB- Respective Dept	0	0	2		03	50	50	100	1
6	ESC	22CC36A	Introduction to Materials Science	TD: Respective Dept. PSB: Respective Dept.	3	0	0		03	50	50	100	3
7	UHV	22UHV37	UHV(social connect and responsibilities)	Any Department	0	0	2		02	50	50	100	1
8	AEC /SEC	22CCAE381	Data analysis using charts and Graphs		If the course is a Theory				02	50	50	100	1
					0	2	0						
					If a course is a laboratory				03				
					0	0	2						
9	NCMC	22NS39	Mandatory Course	NSS	0	0	2			50	---	50	0
		22PE39	Mandatory Course	Physical Education Director									
		22YO39	Mandatory Course	Yoga									
									Total	**450**	**400**	**850**	**20**

Course Title: Introduction to Ceramic Technology			
Course Code	22CC32	CIE Marks	50
Credits		SEE Marks	50
Course Type Theory	Theory		
Lecture Hours/Week	3	Total Marks	100
Total Hours	Hours: 52	SEE Hours	03

Course Objectives:

MODULES	Hours
Module-1 Definition, classification, applications, properties and scope of ceramics, ceramics versus metals and organics, historical perspective on the development of ceramics and ceramic industries. General flow diagram of preparation of ceramic articles with equipments used in making of ceramic articles. Newer ceramics versus traditional ceramics.	08+2 (T or L)
Module-2 Structure, classification and properties of Clays (Kaolin Montmorillionite) and feldspars. Structure, properties and polymorphism of quartz. Brief study of Cornish stone, nepheline syenite, talc, steatite, pyrophyllite, sericite pyrophyllite, mica and synthetic raw materials. Calculation of percentage oxide content in clays, feldspar and other raw materials (9 hours)	09+2 (T or L)
Module-3 Preparation of ceramic powders, mixing, preliminary idea of various shaping methods of ceramic articles; dry and semi dry uniaxial pressing, extrusion, jiggering and jollying, injection molding, slip casting, isostatic pressing, hot pressing, hot isostatic pressing, tape casting, machining methods. Drying of ceramics, biscuit firing and glost firing, action of heat on triaxial body. (9 hours)	08+2 (T or L)
Module-4 Elementary ideas of classification, manufacture, properties and applications of conventional ceramics; Refractories, glass, whitewares, bulk density, apparent porosity determination and manufacture of and Portland cement. .	09+2 (T or L)
Module-5 Newer ceramics: Classification – cermets and abrasives, electro-ceramics, bio-ceramics, space ceramics, super conducting ceramics, automotive ceramics.	08+2 (T or L)
Practical component of 22CC32 (ICT) 1. Determination of density of ceramic and metal component and their comparison 2. Preparation of general flow chart (drawing) for preparation of ceramic articles. 3. Determination of adsorbed Moisture content in different types of clays and their comparison 4. Determination of water of plasticity in clays and their comparison 5. Shaping of ceramics by hand molding, jiggering and Jollying 6. Determination of loss of moisture in different types of clays and their comparison 7. Comparison of given samples of refractory, glass, whitewares, based on Moh's hardness 8. Comparison of loss on ignition of clays.	

Question paper pattern:

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

Textbook:

1. Industrial ceramics - F. Singer and Singer S.S. Publisher Springer ISBN 978902752596

2. Cement data book – Vol.I, II, III – W.H. Duda, Gmbh Germany
   Cement Engineer's Handbook – Von Ottolabahn, McGraw Hill, N.Y.
   Industrial Ceramics – Singer and Singer, Springer Netherland publisher edition-1.

Reference Book:

1.Elements of Ceramics – F.H. Nortan Publisher: Longman Higher Education; 2nd Revised edition edition (1 June 1974) ISBN-10:0201053063, ISBN-13:978-0201053067

2.Introduction to ceramics – W.D. Kingery et al, Publishers Wiley and Sons. ISBN-13: 978- 0471478607 2nd edition.

3.What every engineer should know about ceramics? – Solomon Mushikant Publisher Marcel and Dekker New york 1992.

4.Properties of Ceramic Raw Materials– W . Rayon Publishers Elsevier 2003

5.Ceramic whitewares – Rexford Newcomb, Jr., Pitman Pub. Corp., NY

6.Refractories – Manufacture, Properties and Applications – A. Rashid Chesti, Prentice Hall of India Pvt. Ltd.

7.Technology of Portland and blended Cements, Banerjee H.N published by A.H. Wheeler Publishing, Allahabad, Ed. 1980.

8.Abrasives – L. Coes Jr, Springer-Verlag 1971.

9.Modern Glass Practice – Samuel Ray Scholes, Charles H. Greene Publisher: Canners books 1975.

Advanced Technical Ceramics – Shigeyuki Somiya, Academic Press Inc., Harcourt Brace Jovanovich Publishers, 1984

E-books and online course materials:

1. http://shodhganga.inflibnet.ac.in/bitstream/10603/108074/12/12_chapter%204.pdf
2. http://www.scielo.br/pdf/mr/v20s2/1516-1439-mr-1980-5373-MR-2016-0915.pdf

Course outcomes:

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

CO #	Course Outcome (CO) with blooms levels
CO1	Describe ceramic materials and differentiate from other engineering materials (L2)
CO2	Explain characteristics and calculate oxide content of various pure and natural and synthetic ceramic raw materials(L3)
CO3	Explain and compare various shaping methods of ceramic articles(L5)
CO4	Construct and explain flow charts for manufacture of conventional ceramics and explain properties applications of conventional ceramics (L3)
CO5	Explain applications of various newer ceramics and tests conducted on ceramic and ceramic raw materials (L5)

Course Title: Principles of Ceramic Processing			
Course Code	22CC33	CIE Marks	50
Credits		SEE Marks	50
Course Type Theory	Theory		
Lecture Hours/Week	3	Total Marks	100
Total Hours	Hours: 42	SEE Hours	03

Course Objectives:

MODULES	Hours
Module-1 Brief history of ceramic technology, 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, and industrial inorganic chemicals, clay minerals and beneficiation of kaolin	8
Module-2 Comminution equipments like jaw crusher, gyratory crusher, roller crusher, hammer mill, ball mill, industrial vibratory mills and planetary mills. Loading and fracture of particles, milling performance, particle size distributions and milling efficiency	8
Module-3 Batching and mixing, mixing mechanisms, mixing equipment and practices like slurries and pastes plastic bodies, granular materials and powders. Mixing performance. Particle sizing, classification techniques and centrifuging	9
Module-4 Filtration and washing processes; Liquid permeability, Filtration and other particle concentration process. Direct granulation, Spray drying process; concurrent spray dryer with centrifugal atomizer and mixed flow spray dryer with a nozzle atomizer, granule characters	9
Module-5 Particle packing characteristics; Characteristics of packing's of uniform spheres, packing in interstices among coarser particles, packing of continuous size distributions and hindered packing. Change in consistency on admixing a liquid and particle interactions	8

Practical component of Principles of Ceramic Processing (22CC33)

1. Determination of chemically combined water of clay
2. Estimation of volatility of clay
3. Analysis of particle size distribution for milled materials
4. Preparation of plaster of paris mould
5. Preparation of ceramic slip and shaping ceramic by slipcasting
6. Preparation of triaxial ceramic body
7. Preparation of ceramic engobe and its application on ceramic ware
8. Preparation of ceramic Glaze and its application on ceramic ware
9. Preparation of calcium/ barium/ strontium glaze and its application over a ceramic ware
10. Determination of packing density with coarse, medium and fine particles by tapping method

Question paper pattern:

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

Textbook:

James S. Reed "Introduction to the Principles of Ceramic Processing" John Wiley & Sons Publication New York

Reference Book:

M. N. Rehman, "Ceramic Processing and Sintering" 2nd Edition, Engineering and Technology; Physical Sciences, CRC Press 2003

E-books and online course materials:

1. http://shodhganga.inflibnet.ac.in/bitstream/10603/108074/12/12_chapter%204.pdf
2. http://www.scielo.br/pdf/mr/v20s2/1516-1439-mr-1980-5373-MR-2016-0915.pdf

Course outcomes:

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

CO #	Course Outcome (CO)
CO1	Describe ceramic materials and differentiate from other engineering materials C2
CO2	Explain characteristics and calculate oxide content of various pure and natural and synthetic ceramic raw materials C3
CO3	Explain and compare various shaping methods of ceramic articles
CO4	Construct and explain flow charts for manufacture of conventional ceramics and explain properties applications of conventional ceramics C3
CO5	Explain applications of various newer ceramics and tests conducted on ceramic and ceramic raw materials

Course Title: GEOLOGY OF CERAMIC RAW MATERIALS			
Course Code	22CC34	CIE Marks	50
Credits	3	SEE Marks	50
Course Type Theory	Theory		
Lecture Hours/Week	3	Total Marks	100
Total Hours	Hours: 42	SEE Hours	03

Course Objectives:
To Impart knowledge on and to enable students to understand
1. General Geology and various branches of geology
2. Identify various types of minerals and their Crystallographic characteristics.
3. Identify the various types of rocks and their physical properties of rocks.
4. Structural features of the earth.
5. Processes of formation of Economic minerals and their availability.

MODULES	Hours
Module-1 **Introduction**: Branches of Geology, Internal structures of the Earth. Applications the geological background cement and ceramic field Definition and characteristic features of crystals. Symmetrical characters and six crystallographic systems	8
Module-2 **MINERALOGY**: Definition of mineral, Importance of study of minerals, Different methods of study of minerals. Advantages of study of minerals by physical properties. Role of study of physical properties of minerals in the identification of minerals. Study of physical properties of following common rock forming minerals: Feldsper, Quartiz, Flint, Jasper, Olivine, Augite, Hornblende, Muscovite, Biotite, Asbestos, Chlorite, Kyanite, Garnet, Talc, Calcite. Study of other common economics minerals such as Pyrite, Hematite , Magnetite Chrorite , Galena , Pyrolusite, Graphite, Magnesite, and Bauxite	8
Module-3 **PETROLOGY**: Definition of rock: Geological classification of rocks into igneous, Sedimentary and metamorphic rocks. Dykes and sills, common structures and textures of igneous. Sedimentary and metamorphic rocks. Their distinguishing features, Megascopic and microscopic study of Granite, Dolerite, Basalt, Pegmatite, Laerite, Conglomerate, Sand Stone, Shale, Limestone, Gneiss, Schist, Quartzite, Marble and Slate..	8
Module-4 **STRUCTURAL GEOLOGY:** Out crop, strike and dip study of common geological structures associating with the rocks such as Folds, Faults, Unconformities, and Joints – their important types **STRATIGRAPHY:** General principles of Stratigraphy, Standard Geological time scale .Tripartite physiographical divisions of India. Broad outline of the stratigraphy of India	8
Module-5 **ECONOMIC GEOLOGY AND INDUSTRIAL MINERAL DEPOSITS:** Rock forming and ore forming minerals, processes of formation of Economic mineral deposits. Simple classification of mineral deposits. Description, deposits, distribution of the important following mineral deposits of India. Mica, Gold, Clay, Feldspar, Quartz, Zircon Beryl, Kyanite, Magnetite, Dolomite, Limestone, Barite ,Bauxite	10

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.

Textbook:
1. N. Chennkesavulu, Engineering Geology, Mc Milan India Ltd., New Delhi, India, 12th Edition 2009.
2.Venkat Reddy ,Engineering geology, Vikas Publications, New Delhi, India, 2nd Edition 2011.
3. Parbin Singh., "Engineering and General Geology", Katson Publishers, 2009.

Reference Book:
1. K. V. G. K. Gokhale, Principles of engineering Geology, BS Publications, New Delhi,

India,3rd Edition ,2012.

2. F.G. Bell, Fundamental of Engineering geology butterwoths, Publications, New Delhi,3rd Edition, 1999

3. David George Price, "Engineering Geology: Principles and Practice", Springer, 2009.

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	Determine the role of the geology in ceramic field, and verious aspects of the earth.
CO2	Formation, classification and various physical properties of minerals.
CO3	Formation, classification and verious physical properties of rocks.
CO4	Make use of minerals and rocks in the ceramic field with respect to structural features
CO5	Know the deposits, distribution and uses of economic mineral deposits.

Course Title: Introduction to Material Science and Engineering (IMSE)			
Course Code	22CC36A	**CIE Marks**	**50**
Credits		**SEE Marks**	**50**
Course Type Theory	**Theory**		
Lecture Hours/Week	**3**	**Total Marks**	**100**
Total Hours	**Hours: 42**	**SEE Hours**	**03**

Course Objectives:

To impart knowledge and to enable students to understand:

1. Engineering materials classification, bonding and crystal geometry.
2. Structure of solids and structure determination by XRD, crystal imperfections
3. Phase diagrams and diffusion in solids

Mechanical and chemical behavior of materials.

MODULES	**Hours**
Module-1 Introduction: Classification of engineering materials, Structure of atom, Definition of ionization potential, electron affinity and electro-negativity. Crystal geometry: Geometry of crystals, the Bravais lattices, crystal directions and planes, the miller indices.	8
Module-2 Structure determination by XRD, Bragg's law, the powder method for structure determination. Surface Phenomena: Capillary rise, Pressure difference across curved surfaces, vapor pressure over curved surfaces, wetting and contact angle, angle of thermal etching and dihedral angle.	9
Module-3 Phase diagram: Binary phase diagrams, lever rule, typical phase diagrams for Al_2O_3-Cr_2O_3, iron-carbon systems. Al_2O_3-SiO_2 system (4h) Diffusion in solids: Ficks laws of diffusion, Temperature dependence of diffusion. Elementary idea of Spinodal decomposition, Homogenous Nucleation and Heterogeneous Nucleation, TTT diagram for glass ceramic formation.	9
Module-4 Crystal imperfections: Point imperfections, line imperfections, Surface imperfections. Notations used for atomic defects, definitions classifications, Frenkel and Schottky defects, reaction equations	8
Module-5 Mechanical behavior: Atomic model of elastic behavior, the modulus as a parameter in design Corrosion and its prevention: Principles of corrosion , Methods of control and prevention of corrosion	8

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.

Textbook:

1. M W Barsoum. Fundamentals of ceramics. Anal Standar Pelayanan Minimal Pada Instal Rawat Jalan di RSUD Kota Semarang. 2015;3:103–11.
2. Kingery WD, Bowen HK, Uhlmann DR. Introduction to ceramics. Second edi. Burke E, Chalmers B, Krumhansi J A, editors. John-Wiley and Sons, Inc; 1976. 448–507 p.
3. Materials Science and Engineering – A first course : Raghavan V., 3rd ed., Prentice Hall of India Pvt. Ltd., new Delhi, 1996

Reference Book:

1. Elements of Material Science – Van Vlack H.L., 2nd ed., Addision – Wesly Pub. Co., NY, 1964.

Additional readings 1.

Callister W. D Material Science and Engineering: An Introduction, 7th Edition, 2007, John Wiley and Sons

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	Define engineering materials and classify them and explain geometry of crystals
CO2	Determine Structure by XRD and explain surface phenomena
CO3	Describe relation among phases and explain Diffusion and time dependence of transformation in solids
CO4	To explain and compare various types of defect and to write defect reactions for a given system.
CO5	Explain mechanical behavior of solids and methods of prevention of corrosion

P D A College of Engineering

B.E. in Respective branch Name Scheme of Teaching and Examination 2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year2023-24)

IV SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD)and Question Paper Setting Board(PSB)	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/	TD:	Duration in hours	CIEMarks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC	22CC41	Powder synthesis and Fabrication	TD:ME PSB:ME	2	2	0		03	50	50	100	3
2	IPCC	22CC42	Glaze Technology	TD-Respective Dept. PSB- Respective Dept.	3	0	2		03	50	50	100	4
3	IPCC	22CC43	White wares and Heavy clay wares	TD-Respective Dept. PSB- Respective Dept.	3	0	2		03	50	50	100	4
4	PCCL	22CCL44	Ceramic Processing Lab	TD-Respective Dept. PSB- Respective Dept.	0	0	2		03	50	50	100	1
5	ESC	22CC45A	Unit operations	Respective Dept.PSB: Respective Dept.	3	0	0		03	50	50	100	3
6	BSC	22BSC46	Biology for Engineers	TD/PSB:BT, CHE,	3	0	0		03	50	50	100	3
7	UHV	22UHV47	Universal Human Value	Any Department	1	0	0		02	50	50	100	1
8	AEC/SEC	22CCAE481	Furnace and Equipment drawing	TD and PSB: Concerned department	If the course is Theory				02	50	50	100	1
					0	2	0						
					If the course is lab				03				
					0	0	2						
9	NCMC	22NS49	NSS	Mandatory course	0	0	2			50	---	50	0
		22PE49	Sports	Mandatory course									
		22YO49	Yoga	Mandatory course									
Total										**450**	**400**	**850**	**20**

PCC:ProfessionalCoreCourse,**PCCL**:ProfessionalCoreCourselaboratory,**UHV**:UniversalHumanValueCourse,**MC**:MandatoryCourse(Non-credit),**AEC**:Ability

THEORY COURSE TITLE: Powder synthesis and Fabrication	
Course Code: 22CC41	CIE: 50
Number of Lectures Hours/Week: 03	SEE: 50
Total Number of Lecture Hours: 42	SEE Hours: 03

Modules	**Teaching Hours**
Module-I Synthesis of ceramic powders by wet chemical routes such as precipitation, coprecipitation, sol-gel techniques, solvent evaporation and extraction, hydrothermal synthesis, combustion synthesis, powders from vapor phase reactions and powders from mechanical milling.	8
Module-II 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, specific surface area measurement and fourier transform infrared spectroscopy and mercury intrusion porosimetry	8
Module-III Processing additives: water, organic liquids, surfactants, Deflocculants and coagulants. Role of plasticizers and lubricants. Slurry preparation and rheological behavior of slurries; Slip casting in permeable mould, examples of compositions of casting slurries and tape casting.	9
Module-IV Binder compositions; clay binders, molecular binders such as vinyl type and cellulose type. Dissolving and admixing binders, general effect of binders. Plastic-Forming processes; Extrusion and examples of composition of extrusion bodies. Dry Pressing; Process variables in dry pressing, processing additives used in industrial pressing powders, compaction behavior, control of compact defects, isostatic compaction and its significance.	9
Module-V 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 after firing and Hot pressing.	8

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:
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	Synthesize ceramic powders by wet chemical route method
CO2	Interpretation of characteristics of ceramic powders
CO3	Identify appropriate additives for slurry preparation
CO4	Select suitable binders for semi-dry and dry pressing
CO5	Analysis of drying and sintering schedules for densification

Course Title: **Glaze Technology**		
Subject Code	22CC42	CIE: 50
Number of Lecture Hours/Week	3 (Theory)	SEE: 50
Total Number ofLecture Hours	42	SEE Hours: 03

Modules	**Teaching Hours**
Module 1 Introduction to glassy state, definition of glaze, types of raw materials used, coloring ingredients, study of properties of glaze. Glaze classification, fritting and frit manufacture.	**09**
Module 2 Glaze manufacture, study of glaze additives, glaze milling and slip control, batching and batchcalculations. Glaze fit, glaze body interface, glaze stress, glaze body reactions.	**07**
Module 3 Glaze application: Dipping, spraying, curtain coating,trailing, pressing, pouring, painting and brushing, etc. Drying and firing of glazes and defects in glazes.	**08**
Module 4 Lead and leadless glazes, strontium glazes,earthenware glazes, glazes for bone and vitreous china, low expansion glazes, sanitary ware glazes, stoneware glazes, colored, transparent and opaque glazes, etc. Measurement of glaze properties, modification of glaze properties. Glaze surface appearance and texture, opacification, sources of color in vitreous coatings, crystal chemistry of pigments, pigment manufacture, oxide pigments	**08**
Module 5 Engobes, glaze decoration methods, achieving artistic effects, ceramic paints. Matt gazes, satin or vellum glazes, crystalline glazes, low expansion glazes, glazes for electric and electronic applications, Textured tear glazes, crackle glazes, scratch and slip resistant glazes. Other important considerations i n glazing, problem areas, chemical resistance of glaze: mode of attack, attack by water, alkali and acid, effectof composition, methods of assessment. Glaze cost and Cost control.	**10**

Course outcomes:
After studying this course, students will be able to:

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

Text books:

Reference Books:

1. Industrial ceramics – S. Singer and F. Singer
2. Ceramics glaze technology – A.C. Bull and J.R. Taylor
3. Encyclopedia of Glass, Ceramic and Cement – Ed. Grayson Martin
4. Glazes and Glass Coatings – Richard A. Eppler & Douglas R. Eppler, ACS. 5. Ceramic Glazes – Kenneth Shaw. 6. Glazes & Glass Coatings - Richard R. Eppler, Douglas R. Eppler, ACS.

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

Course Code	CO #	Course Outcome (CO)
22CC42	CO1	Define glaze and recall Traditional ceramic manufacture.
	CO2	Classify glazes and explain batch calculations
	CO3	Select glazeapplications methods and study how theseare applied.
	CO4	Compare various types of glazesand analyze their suitability.
	CO5	Explain importance of glazing fordeveloping special effects.

PRACTICAL COMPONENT OF IPCC	
S. No	Experiments
1	Identification of raw materials for glaze making with formula
2	Calculation of oxide supplied by glaze making raw materials
3	Identification of glaze additives their role with example with formula
4	Preparation of engobe
5	Calculation of empirical formula of glaze from chemical composition of glaze
6	Calculation of chemical composition from empirical formula of glaze
7	Preparation of lead glaze
8	Preparation of strontium glaze
9	preparation of barium glaze
10	Determination of density of glaze slip
11	Determination of density of engobe
12	Glaze application by dipping and spraying
13	Under glaze decoration of glaze
14	On glaze decoration of glaze
15	Preparation of frit
16	preparation of crystalline glaze
17	Preparation of transparent glaze
18	Determination of density of glaze
19	Identification of various glaze defects and identification of their causes and their remedies.

Course Title: Whitewares and heavy clay wares			
Subject Code	22CC43	CIE: 50	
Number of Lecture Hours/Week	3(Theory)	SEE: 50	
Total Number of Lecture Hours	42 hrs	SEE Hours: 03	

Modules	Teaching Hours
Module-I Introduction: Basic definitions of Whitewares, heavy claywares and fine ceramics. Clay plastic raw materials: Geology of clays, types of minerals-kaolinite, Montmorillonite, chlorite, hallosyte etc, mineralogy of clays, classification of clays. Crystal structure; Kaolin, pyrophyllite, talc, mica. Mining and treatment of clays, Non-clay plastic raw materials, non plastic materials :sand, feldspar, nepheline syanite, Cornish stone and quartz etc	8
Module-2 Properties of clays: placticity ,cation exchange capacity, isomorphous substitution , flow properties , thixotropy dry strength , green strength etc. beneficiation of clay, auxiliary raw materials, particulate solids and water role in different ceramic raw materials and in bodies. Mechanical body preparation :crushing ,grinding , mixing , filtering, wedging Shaping methods: Slip casting, hollow casting, hand molding, making plastic bodies on potters wheels, jiggering and jollying, extrusion, plastic forming, drying of ceramic wares, firing of ceramic wares	8
Module-3 Heavy clay wares and fine ceramics: Manufacture of building bricks, hollow bricks, sewer pipes, roofing tiles. Floor tiles: product classification Raw materials for bodies and glazes, body composition, glaze composition, Processes of manufacture of floor tile, Technical features, aesthetic features, basic technological parameters, plant engineering solutions. Machines.	8
Module-4 Wall Tiles: product classification, Processes of manufacture of wall tiles, aesthetic features, raw materials for bodies, plastic raw materials, complimentary raw materials, body composition, product features, raw materials glazes, basic technological parameters, plant engineering solutions, machines: weighing systems, mills, spray dryers, presses, driers, glazing machines, kilns, sorting, handling and storage systems. Accessories and trimming: materials organization, trims, production lines, machines, the production process, decoration and firing. Types of tile defects: Causes and remedies.	8
Module-5 Porcelain tiles: Raw materials for bodies, compositions, processes of porcelain tile production, basic technological parameters, technical outlook and aesthetic outlook. Fine Ceramics, insulators, Bone china, chemical stone wares and porcelains. Testing: Loss on ignition, water of absorption, bulk density, true specific gravity, plasticity, thermal shock, corrosion resistance, abrasion resistance, refraction, optical absorption, etc Testing of glazes, coherence test, receptivity test, glaze pick up test, crazing, lead solubilityetc Plant lay outs.	10

Question paper pattern:
Student has to answer any five full questions, selecting one from each module.

Text Books:

1) Felix Singer and Sonja S. Singer “Industrial Ceramics” Mohan Primlani, Oxford & IBH Publishing Co.

Pvt Ltd New Delhi 1963

2) W Ryan "Properties of Ceramic Raw Materials" 2nd edition ELSEVIER 1978

E books and online course materials: Applied Ceramic Technology https://documents.pub/document/sacmi-vol-1-inglese-ii-edizione.html?page=1

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

Course Code	CO #	Course Outcome (CO)	Blooms Level
	CO1	**Describe occurrence, formation, Structure and properties of ceramic raw materials.**	C1
	CO2	**Explain mechanical body preparation, shaping and glazing.**	C2
	CO3	**Explain heavy clayware manufacture and floor tile manufacture**	C3
	CO4	**Explain wall tile manufacture ,trimming of tiles and tile defects**	C4
	CO5	**Explain porcelain and fine ceramic manufacture, testing methods and plant layouts.**	C5

PRACTICAL COMPONENT OF IPCC	
S. No	**Experiments**
1	Identification of raw materials for preparation of heavy clay ware , white ware and fine ceramics with formula
2	Identification of suitability of clays for specific applications
3	Determination of water of plasticity of clays
4	Identification of various processes of beneficiation of clays
5	Analysis of structures of clay and other minerals
6	Determination of batch to prepare heavy clay ware
7	Preparation of common brick
8	Determination of water of absorption of common brick
9	Determination of batch to prepare triaxial body
10	preparation of triaxial body
11	Determination of drying shrinkage
12	Determination of firing shrinkage
13	Determination of adsorbed moisture , chemically combined water , loss on ignition of clays
14	Determination of apparent porosity , bulkdensity of clay bodies and triaxial bodies

COURSE TITLE: UNIT OPERATIONS		
Course Code	22CC45A	Maximum marks CIE: 50
Number of Lecture Hours/Week	03	Maximum marks SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03

Prerequisite:

1. Class 10th standard knowledge of physics
2. Basic knowledge in differential & integral calculus

Course Objectives

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 closed circuit operation.	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.	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 orificeand venturi meter. Flow through weirs and not ches. Dimensional homogeneity, Rayleigh's and Buckingham's pimethods. Dimensionless numbers.	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.	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 co-efficients, 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, Stefen – Boltzmann law, Wein's displacement law, Kirchhoff's law, Radiation between surfaces	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, HemlataPatra 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 HillInternational, 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
22CC45A	**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

UNIVERSAL HUMAN VALUES-I			
Course Code	**22UHV47**	**Credits:1**	**CIE: 50**
Number of Lecture Hours/Week	**2hrs (Tutorial)**		**SEE: 50**
Total Number of Theory Hours	**14 hours**		**SEE Hours: 02**

Course Objectives:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Modules	**Teaching Hours**
Module I **Introduction To Value Education:** Understanding Value Education, Need Of Value Education, Basic Guidelines For Value Education, The Content Of Value Education, The Process Of Value Education. **Self- Exploration As The Process For Value Education:** Starting To Observe Inside, What Is Self-Exploration? What Is Its Purpose?, Content Of Self-Exploration, Natural Acceptance, What Is The State Today?, What Is The Way Out? What Do We Need To Do?	**3x2hrs**
Module II **The Basic Human Aspirations- Continuous Happiness And Prosperity:** Continuous Happiness And Prosperity- Our Basic Aspiration, Exploring Happiness And Prosperity, A Look At The Prevailing Notions Of Happiness And Prosperity, Some Possible Questions/ Confusions. **The Program To Fulfill Basic Aspiration:** Basic Requirements For Fulfillment Of Human Aspirations, What Is Our State Today?, Why Are We In This State?- Living With Wrong Assumptions, What Is The Solution?- The Need For Right Understanding, Our Program: Understand And Live In Harmony At All Levels Of Living, Our State Today?, Our Natural Acceptance For Harmony At All Levels Of Our Living, Human And Animal Consciousness.	**3x2hrs**
Module III **Understanding The Harmony At Various Levels:** Understanding The Human Being As Co-Existence Of Self(I) And Body, Human Being Is More Than Just The Body, Understanding Myself As Coexistence Of Self And The Body, Understanding The Needs Of The Self And Needs Of The Body, Understanding The Self(I) As A Conscious Entity, The Body As The Material Entity, Exercise On Distinguishing Needs Of The Self(I) And The Body, Exercise On Distinguishing Activities Of The Self(I) And Body, Understanding The Body As An Instrument Of 'I'(I Being The Seer, Doer And Enjoyer).	**3x2hrs**
Module IV **Harmony In Self(I)- Understanding Myself:** Why Should I be aware of Myself?, Getting To Know The Activities In I Related?, The Activities In I Are Continuous, What Is The Problem Today?, Effects Of The Problem, What Then Is The Solution?, Result Of Realization And Understanding- Living With Definiteness. **Harmony With The Body- Understanding *Sanyama* And *Svashtya:*** Our Body- A Self-Orgnaised Unit, Harmony Of I With The Body: *Sanyama* And *Svashtya*, What Is Our State Today?, What Is The Way Out?, Understanding And Living With Sanyama, Correct Appraisal Of Our Physical Needs.	**3x2hrs**
Module V **Harmony In The Family- Understanding Values In Human Relationships:** Family As The Basic Unit Of Human Interaction, Harmony In The Family, Justice*(Nyaya)*, What Is The State Today?, Values In Human Relationships, Trust(*Visvasa*),Respect(*Sammana*), The Basis For	**3x2hrs**

Respect, Assumed Bases For Respect Today, The Problem Due To Differentiation, Difference Between Attention And Respect, What Is The Way Out?, Affection (*Sneha*), Care(*Mamata*), Guidance(*Vatsalya*),Reverence(*Shraddha*),Glory(*Gaurava*),Gratitude(*Kritagyata*),Love(*Prema*), Harmony From Family To World Family: Undivided Society.

Text Books:

1. 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.
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:

1. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
2. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, Universe Books.
6. Subhas Palekar, 2000, How to practce Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
7. A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
8. E.F. Schumacher, 1973, small is Beautful: a study of economics as if people mattered, Blond & Briggs, Britain.
9. A.N. Tripathy, 2003, Human Values, New Age International Publishers.

Question paper pattern:

1. The question paper will have 30% of MCQ questions covering the entire syllabus, students need to answer all the questions.
2. 70% of descriptive questions consist of 2 questions from each module of 14 marks each; students need to answer FIVE full questions, selecting ONE full question from each module.

Course outcomes:

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

Course Code	CO	Course Outcome (CO)
22UHV47	CO1	Develop a universal approach to value education by the right understanding of reality (i.e. a worldview of the reality "as it is") through the process of self-exploration.
	CO2	Develop a Holistic perspective towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence.
	CO3	Proficient to understand the harmony at various levels.
	CO4	Evaluate the need of right understanding to live with the harmony at the level of human being (self and body).
	CO5	Recognize and fulfill the requirement of harmony at the level of family.

Course Title: **Fuels and Combustion**

P D A College of Engineering

B.E. in Respective branch Name Scheme of Teaching and Examinations 2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

V SEMESTER

Sl .No	Course and Course Code		Course Title	Teaching Department (TD)and Question Paper Setting Board(PSB)	Teaching Hours/Week				Examination				Credits
					Theory Lectur	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	CIEMarks	SEEM arks	Total Marks	
					L	T	P	S					
1	HSMS/PC	22HU51	Humanities	TD-Respective Dept. PSB- Respective Dept.	3	0	0		03	50	50	100	3
2	IPCC	22CC52	Refractories	TD-Respective Dept. PSB- Respective Dept.	2	2	2		03	50	50	100	4
3	PCC	22CC53	Cement technology-1	TD-Respective Dept. PSB- Respective Dept.	4	0	0		03	50	50	100	4
4	PCCL	22CCL54	Cement Lab	TD-Respective Dept. PSB- Respective Dept.	0	0	2		03	50	50	100	1
5	PEC	22CC55X(A,B,C)	Fuels and combustion/ Material technology/Smart materials	TD-Respective Dept. PSB- Respective Dept.	3	0	0		03	50	50	100	3
6	PROJ	22CCMP56	Mini Project	TD-Respective Dept. PSB- Respective Dept.	0	0	4		-	50		50	2
7	AEC	22RMI57	Research Methodology and IPR	Any Department	2	2	0		03	50	50	100	3
8	BSC	22ES58	Environmental Studies	TD:CV/Env/Chem PSB:CV	2	0	0		03	50	50	100	2
9	NCMC	22NS59	Mandatory Course	NSS	0	0	2			50		50	0
		22PH59	Mandatory Course	Sports									
		22YO59	Mandatory Course	Yoga									
									Total	**450**	**350**	**800**	**22**

Professional Elective Course

22CC55A	Fuels and combustion	22CC55C	Smart materials
22CC55B	Material technology	22XX55D	

PCC:ProfessionalCoreCourse,**PCCL**:ProfessionalCoreCourselaboratory,**UHV**:UniversalHumanValueCourse,**MC**:Mandatory Course(Non-credit),
AEC: Ability

Subject Code	22CC551	CIE: 50
Number of Lecture Hours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03

Modules	**Teaching Hours**
Module-1 Fuels and general classification made on fuels, features and characteristics of fuels Solid fuels: Coal and theories behind coal formation, ranking and distribution of coals in India, Coal cleaning and its importance, Coke manufacture and its applications. Pulverized coal and its uses.	8
Module-2 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	8
Module-3 Gaseous fuels: Natural gas, gobar gas, LPG, coal gas, producer gas, water gas, blast furnace gas – production, storage and their applications.	8
Module-4 Combustion: Combustion definition, Gross calorific value, net calorific values, factors influencing rate of combustion, Combustion reactions and calculations of Solid fuels and liquid fuels. Determination of calorific value of solid fuels and liquid fuels in laboratory. Determination of theoretical calorific values (Dulong's formula).	
Module-5 Ceramic Green Energy technologies: Principle of photo-catalytic hydrogen production using ceramic semiconductors, Solid electrolytes and Fuel Cells (SOFCs). Effect of Carbon dioxide (CO_2) on climate change, need of carbon dioxide capture and storage, Carbon dioxide capture methods. CO_2 emissions in cement Industry, Government policies and initiatives for CO_2 capture.	10

Question paper pattern: Student has to answer five full questions choosing one question from each module.

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

E books and online course materials: Fuels, furnaces and Refractories- James Ducan Gilcrist,

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	**Categorize coals and** able to **outline** their processes to use them in process and metallurgical industries.	**L2**
	CO2	**Explain** petroleum products formation and **apply** various petroleum products for different energy applications.	**L2,L3**
	CO3	**Classify** different types of gaseous fuels. Formation and **assessment** of gaseous fuels applications in process industry.	**L2, L5**
	CO4	**Summarize** combustion process, calculate calorific values of solid and liquid fuels and outline determination of calorific values of solid and liquid fuels.	**L2,L5**
	CO5	Summarize green technologies, explain principle of hydrogen production, working of SOFC and Outline need for CO_2 capture and Government initiatives for reduction of CO_2 emissions.	**L2, L5**

Course Title: **REFRACTORIES**		
Subject Code	22CC52	CIE: 50
Number of Lecture Hours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	52	SEE Hours: 03
Modules		**Teaching Hours 08**

Module-I 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. Preparation, properties and applications of Alumino-silicate refractory bricks (fire clay, silliminite, kyanite, andulsite, high heat duty, moderate heat duty, low heat duty refractories)	**12**
MODULE -II Silica and semi silica. Preparation, properties and applications of magnesite, dolomite, chrome and chrome magnesite, insulation bricks. Carbon and graphitized Refractories, Mag-carbon refractories, fusion cast refractories. Sialon refractories.	08
Module-III Heat setting and air setting, bonding mortar, ramming masses castables, gunning material, gunning tar mixes. Testing of Refractories: PCE tests, compression, torsional and creep properties. RUL test, reheat shrinkage, spalling resistance, slag resistance, reaction between refractories and glasses, heat transmission, behavior of Refractories in different environment, carbon monoxide disintegration. Specification of different kinds of bricks,	**12**
Module-IV Phase diagrams related to the manufacture of conventional Refractories, two and three-component systems for refractory manufacturing. 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.	**10**
Module –V 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 Refractoriness in non-ferrous industries, refractories in generation of steam, power, nuclear power refractories used in glass, coke-ovens, cement industries, gas production, etc.	**10**

Question paper pattern: Question paper shall contain FIVE modules, each module containing TWO questions. Students shall answer any ONE full questionfrom 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

E books and online course materials:

Course outcomes:

On completion of the course, the student will have the abilityto:

Course Code	CO #	Course Outcome (CO)	Blooms Level
	CO1	Defend and Describe the classification, general preparation, properties, applications and the scope of refractories, drying of refractories and preparation and applications of aluminosilicate refractories .	C1 Al
	CO2	Describe the preparation, properties and applications acidic , basic , insulating , carbon based refractories .	C2 A2
	CO3	Describe monolithic refractories and testing of refractories and specification of refractories .	C3 A3
	CO4	Explain phase diagram and sintering of refractories.	C4 A4
	CO5	Describe applications of refractories in various industries..	C5 A5

PRACTICAL COMPONENT OF IPCC	
S. No	**Experiments**
1	1 Identification of raw materials for refractory making and about drying shrinkage of glass
2	2 Identification of properties of refractories –PCE, RUL, APP Porosity, Bulk Density, sp gravity, thermal conductivity, spalling resistance etc
3	3 Preparation of grog
4	4 Preparation of fireclay refractory
5	5 Preparation of insulating refractory
6	6 Determination of properties of refractories - PCE, RUL, APP Porosity, Bulk Density, sp gravity, thermal conductivity, spalling resistance
7	9 Determination of packing density of coarse, medium and fine refractory particles configuration

THEORY COURSE TITLE: CEMENT TECHNOLOGY – I	
Course Code: 22CC53	CIE: 50
Number of Lectures Hours/Week:04	SEE: 50
Total Number of Lecture Hours: 42	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	08 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	10 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	08 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	08 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. Testing 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.	08 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	**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 : CEMENT LABORATORY	
Subject Code: **22CCL54**	Credits : 01
Number of Lecture Hours per Week: 3hrs	CIE Marks: 50
Total Number of Lecture Hours: 42	SEE Marks: 50

List of Experiments

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 Code	CO #	Course Outcome (CO)
21CCL55	**CO1**	Determine physical properties of cement
	CO2	Determine setting time and, soundness of cement
	CO3	Perform chemical and technical analysis of cement
	CO4	Determine mechanical properties of cement
	CO5	Determine thermal properties of cement

P D A College of Engineering

B.E. in Respective branch Name

Scheme of Teaching and Examinations 2022

Outcome Based Education (OBE) and Choice Based Credit System(CBCS)

(Effective from the academic year 2023-24)

VI SEMESTER

Sl.No	Course and Course Code		Course Title	Teaching Department (TD)and Question Paper Setting Board(PSB)	Teaching Hours/Week				Examination				Credits
					Theory Lectur	Tutorial	Practical /Drawin	Self-Study	Duration in hours	CIEMarks	SEE Marks	Total Marks	
					L	T	P	S					
1	HSMS/PC	22CC61	Cement-II	Respective Dept.	2	2	2		03	50	50	100	4
2	PCC	22CC62	Glass technology-I	Respective Dept.	3	2	0		03	50	50	100	4
3	PEC	22CC63(A,B,C)	Iron and steel making Instrumental methods of analysis Biomaterials	Respective Dept. .	3	0	0		03	50	50	100	3
4	OEC	22CCOE641	Non Destructive Testing	Respective Dept.	3	0	0		03	50	50	100	3
5	PROJ	22CC65	Project Phase-I	Respective Dept	0	0	4		03	50	--	50	2
6	PCCL	22CCL66	Glass Lab	Respective Dept.	0	0	2		03	50	50	100	1
7	AEC/SDC	22CCAE671	Indian knowledge system	Respective Dept.	If the course is offered as a Theory: 0	2	0		02 03	50	50	100	1
					If a course is offered as a practical: 0	0	2						
8	NCMC	22NS68		NSS	0	0	2			50	--	50	0
		22PE68		Sports									
		22YO68		Yoga									
									Total	**400**	**300**	**700**	**18**

COURSE TITLE: CEMENT TECHNOLOGY – II	
Course Code: 22CC61	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.
2.

E-books and online course materials:
1.
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 handling equipments
CO4	Determine process parameters affecting kiln performance
CO5	Recognize burning techniques and instrumentation

COURSE TITLE: GLASS TECHNOLOGY-I(Integrated)	
Course Code : 22CC62	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 and glass making reactions**
CO4	**Outline glass making machines and glass manufacture**
CO5	**Generalize types of glasses and their applications**

PRACTICAL COMPONENT OF IPCC	
S. No	**Experiments**
1	Identification of raw materials for glass making with formula
2	2Calculation of percentage composition from raw materials
3	3 Identification of various processes of glass manufacture
4	Calculation of weight of raw materials from chemical composition of soda lime silicate glasses
5	Calculation of weight of raw materials from chemical composition of soda lime silicate glasses
6	preparation of soda lime silicate glass
7	Calculation of weight of raw materials from chemical composition of borosilicate glass
8	preparation of borosilicate glass
9	Calculation of weight of raw materials from chemical composition of lead alkali silicate glass
10	Calculation of weight of raw materials from barium borate glass
11	Preparation of barium borate glass
12	Calculations of weight of raw materials from chemical composition of glass ceramics
13	preparation of glass ceramics
14	Procedure for preparation of sheet glass ,float glass , plate glasses
15	procedure for preparation of fiber glass and optical glasses
16	Determination of T_g and T_G and T_L

THEORY COURSE TITLE: Industrial Elective (Iron and Steel Making Technology)	
Course Code: 22CC631	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 for Iron and Steel making I: Coke** Availability of Coking Coal, Types and Chemical Characteristics of Coals, Proximate Analysis Ultimate Analysis Petrographic, Selection of Coals for Coke making Assessment of Coke Quality. Processes Used for Coke making Conventional By-product Coke Ovens Non-recovery Ovens Pre-carbonisation Techniques Pre-heating of Coal Briquette Blending of Coal, Selective Alternative Coking Methods	09
Module-II **Raw Materials II: Iron Ore and Agglomerates** Iron Ore Reserves of India, Beneficiation of Iron Ore The Sinter making Process, Bedding and Blending Granulation, Sintering Feed Preparation and Product Handling, Fundamentals of Sintering of Iron Ores, Sinter Productivity Structure of Sinter Influence of Sinter Chemistry Pelletisation Physical and Chemical Characterization of Lump Ore/Sinter/Pellets Thermal Analysis Metallurgical Tests Compression and Tumbler Strength, Reduction Behavior 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 , ,Charging of Solid Materials from the Top ,Blast Furnace Plant and Accessories, Hot Blast Stoves ,calculations relating to blast furnace technology.	08
Module-III Alternative iron making processes : sponge iron ,Smelting reduction BOF Operation, BOF Shop Layout and Individual Converter Components ,BOF Vessel Design, 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 General Comments on Pre-treatment	09
Module-IV: Alternate steel making methods Electric Steelmaking Electric Arc Furnace (EAF) Electric Induction Furnaces Ladle Stirring **Secondary Steelmaking** Inert Gas Purging (IGP) Deoxidation of Liquid Steel. Thermodynamics of Deoxidation of Molten Steel Kinetics of Deoxidation of Molten Steel The Ladle Furnace (LF)	08

Problem of Slag Carryover The CAS-OB Process Degassing and Decarburisation of Liquid Vacuum Degassing Processes Manufacture of Ultra-Low Carbon (ULC) Steel by RH-OB Process Desulphurisation in Secondary Steelmaking Injection Metallurgy (IM) Clean Steel Technology Inclusion Modification Temperature Changes during 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	
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** .Continuous 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 and scope of Iron and Steel Industries.**
CO2	**Describe working, operation construction design aspects and calculations connecting to Blast furnace and raw materials used in blast furnace**
CO3	**Describe working, operation construction design aspects and calculations connecting to Basic oxygen furnace steel making and sponge iron making**
CO4	**Describe working, operation construction design aspects and calculations connecting to Electric arc furnace and secondary steel making**
CO5	**Summarize methods of casting of steels and Suggest refractories for lining of various furnaces used in Iron and steel Industries**

COURSE TITLE: Non Destructive Testing	
22CC641OE	CIE: 50
Number of Lectures Hours/Week:03	SEE: 50
Total Number of Lecture Hours: 42	SEE Hours: 03

Modules	**Teaching Hours**
Module 1 Introduction to NDT**:** Selection of NDT methods. Visual inspection, leak testing, Liquid penetration inspection- advantages and limitations.	8
Module 2 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	8
Module 3 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 4 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	8
Module 5 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.	8

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. Non-Destructive Testing Techniques- by Ravi Prakash, firstrevised edition, new age international publications.
2. Basics of Non-Destructive testing- by Lari and Kumar, S.K. Kataria & Sons publication.

Non-Destructive Test and Evaluation of Materials- by J. Prasad and C.G.K.Nair,2nd edition, McGraw Higher Ed publication.

Reference Books:

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	Find the basic differences between NDT and destructive testing and liquid penetrant NDTmethods.
CO2	Illustrate magnetic particle and leak testing and handle the both tests.
CO3	Utilize Ultrasonic testing tools and outline their advantages and limitations
CO4	Examine the components for defects using X-ray, Gamma ray and by Neutron radiographic non destructive testing tools and outline their advantages and limitations
CO5	Explain the Optical Holographic, Acoustic holographic and microwave NDT methods and assesstheir applications and limitations

Course Title: Glass laboratory		
Course Code	22CCL66	CIE: 50
Number of Lecture Hours/Week	6 hrs/week	SEE: 50
Total Number of Lecture Hours	54	SEE Hours: 03

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) De coration of glass.
6) Identification of defects.

1 preparion of glass from glass formers (26)
2 preparation of soda lime silicate glass(1)
3 Determination of density of soda lime silicate glass by Archimedes principle(2)
4 preparation of borosilicate glass(3)
5 Determination of density borosilicate glass by archemedes principle (4)
6 preparation of phosphate glass(5)
7 Preparation of lead alkali silicate glass(6)
8 Determination of density of lead alkali silicate glass(8)
9 Decoration of glass etching (7)
10 Identification of glass defects by visual inspection(10)
11 preparation of glass ceramics (9)
12 Determination of MOR of glass ceramics (25)
13 preparation of photosensitive glass(15)
14 preparation of photo chromic glass(14)
15 Determination of chemical durability of glass (11)
16 Determination of glass transition temperature and softening point of glass by DTA/TGA(22)
17 Preparation of barium borate glass .(12)
18 Detection of strain in glass (20)
19 Determination of density of glassby sink and float method(23)
20 Determination of mechanical properties of glass(19)
21 Technical analysis of glass (12)
22 Determination of viscosity of glass(18)
23 Technical analysis of glass (25)
24 prepartion of of foam glass (16)
25 Prepartion of vycor glass (96%) silica glass (17)
26 preparation of nanoglass (24)

27 Decoration of glass by sand blasting.(27)			
Course outcomes: **On completion of the course, the student will have the ability to:**			
Course code	**CO #**	**Course Outcome (CO)**	**Blooms Level**
	CO1	CO1Prepare glasses, special glasses and glass Ceramics	**C3,P3**
	CO2	Codetermine physical properties of glass.	**C4,P3**
	CO3	**Determine mechanical properties of glass**	**C4 p3**
	CO4	Perform decoration of glass	**P4**
	CO5	Identify glass defects	**C1,p4**

Course Title: **INDIANKNOWLEDGESYSTEMS**			
Course Code	**22IKSAE67**	**CIE**	**50Marks**
Credits :L:T:P	**1:0:0**	**SEE**	**50Marks**
Total Hours	**15L**	**SEE Duration**	**02Hours**

Course Learning Objectives: The students will be able to

1	To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
2	To make the students understand the traditional knowledge and analyze it and apply it To their day-to-day life.

Modules	**Teaching Hours**
Module-I **Introduction to Indian Knowledge Systems(IKS):** Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-à-vis indigenous knowledge, Traditional knowledge vs. western knowledge.	05Hrs
Module–II **Traditional Knowledge in Humanities and Science**s: Linguistics, Number and Measurements - Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology.	05Hrs
Module-III **Traditional Knowledge in Professional domain:** Town planning and architecture-Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.	05Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1:	Provide an overview of the concept of the Indian Knowledge System and its importance.
CO2:	Appreciate the need and importance of protecting traditional knowledge.
CO3:	Recognize the relevance of Traditional knowledge in different domains.
CO4:	Establish the significance of Indian Knowledge systems in the contemporary world.

Reference Books	
1	**Introduction to Indian Knowledge System-concepts and applications**, B Mahadevan, VinayakRajatBhat,NagendraPavanaRN,2022,PHILearningPrivateLtd,ISBN-978-93-91818-21-0
	Traditional Knowledge System in India, AmitJha,2009,AtlanticPublishersandDistributors (P)Ltd.,ISBN-13:978-8126912230,
2	**Knowledge Traditions and Practices of India**, KapilKapoor, AvadeshKumarSingh,Vol.1, 2005,DKPrintWorld(P)Ltd.,ISBN81-246-0334,
	Suggested WebLinks:
1.	**https://www.youtube.com/watch?v=LZP1StpYEPM**
2.	**http://nptel.ac.in/courses/121106003/**
3.	http://www.iitkgp.ac.in/department/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63(Centre of Excellence for Indian Knowledge System, IIT Kharagpur)
4.	https://www.wipo.int/pressroom/en/briefs/tk_ip.html
5.	https://unctad.org/system/files/official-document/ditcted10_en.pdf
6.	http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf
7.	https://unfoundation.org/what-we-do/issues/sustainable-development-goals/?gclid=EAIaIQobChMInp-Jtb_p8gIVTeN3Ch27LAmPEAAYASAAEgIm1vD_BwE