Scheme

	SEMESTER-III								
	2/4, 1st Semester	L	T	P	C	SESSIONALS	EXT.EXAM	TOTAL	CREDITS
BTCT211	Maths III	3	1	0	4	30	70	100	4
BTCT212	**Material science for cermaics**	3	0	0	3	30	70	100	3
BTCT213	**Elements of ceramics**	3	0	0	3	30	70	100	4
BTCT214	**Electrial drives & control**	4	0	0	4	30	70	100	4
BTCT215	Mechanical engg	3	0	0	3	30	70	100	4
BTCT216	Mechanics of solids	3	0	0	3	30	70	100	4
BTCT217	Material science -Lab	0	0	3	3	50	50	100	2
BTCT218	Electrical lab&Mechanical engg. Lab	0	0	3	3	50	50	100	2
									27
	SEMESTER - IV								
	2/4, 2 nd semester								
BTCT221	**Maths -IV**	3	1	0	4	30	70	100	4
BTCT222	**Ceramic powder processing**	3	1	0	4	30	70	100	4
CHE223	Chemical process calculations*****	3	1	0	4	30	70	100	4
CHE224	Fluid mechanics*****	3	1	0	4	30	70	100	4
BTCT225	**Ceramics raw materials**	3	0	0	3	30	70	100	4
CHE-226	**Environmental studies**	3	1	0	4	30	70	100	2
BTCT227	**Chemical & Instrumental analysis of raw materials lab**	0	0	3	3	50	50	100	2
BTCT228	**Ceramic powder processing Lab**	0	0	3	3	50	50	100	2
									26
	Semester V								
	3 rd year 1 st semester								
CHE311	Chemical engg.thermodynamics-I*****	3	1	0	4	30	70	100	4
CHE312	Mass transfer- I*****	3	1	0	4	30	70	100	4
CHE313	Heat transfer *****	3	1	0	4	30	70	100	4
BTCT314	**Whiteware and heavy clayware**	3	0	0	3	30	70	100	4
BTCT315	**Ceramic fabrication process**	4	1	0	4	30	70	100	4
BTCT316	**Ceramic science & Phase Equilibria in Ceramics**	4	1	0	5	30	70	100	4
BTCT317	**Whiteware and heavy clayware lab**	0	0	3	3	50	50	100	2
CHE318	Heat transfer lab*****	0	0	3	3	50	50	100	2
CHE-319	**Soft Skills**			3	3	100		100	1
									29
	Semester VI								
	3 rd year 2nd semester								
CHE321	Chemical engg.thermodynamics-II*****	3	1	0	4	30	70	100	4
CHE322	Mass transfer- II*****	3	1	0	4	30	70	100	4
BTCT323	**Glaze technology and coatings**	3	1	0	4	30	70	100	4
BTCT324	**Glass engineering**	3	1	0	4	30	70	100	4
BTCT 325	**General Chemical Technology**	4	0	0	4	30	70	100	4
BTCT326	**Cement Technology and concrete**	3	1	0	4	30	70	100	4

CHE327	Mass transfer lab*****	0	0	3	3	50	50	100	2
BTCT328	**Glass and Glaze lab**	0	0	3	3	50	50	100	2
									28
	Semester VII								
	4 th year 1 st semester								
BTCT411	**Electro ceramics and abrasives**	4	0	0	4	30	70	100	4
BTCT412	**Refractories**	4	0	0	4	30	70	100	4
CHE413	Chemical reaction engg*****	4	0	0	4	30	70	100	4
CHE414	Industrial engg & Management*****	4	0	0	4	30	70	100	4
CHE415	Process dynamics and control*****	4	0	0	4	30	70	100	4
BTCT416	**Fuels & Energy engg.**	3	1	0	4	30	70	100	4

BTCT417	**Refractories lab**	0	0	3	3	50	50	100	2
CHE418	PDC lab*****	0	0	3	3	50	50	100	2
CHE419	Industrial Training					100		100	2
CHE-420	Seminar			3	3	100		100	3
									33
	Semester VIII								
	4 th year 2nd semester								
CHE421	CPED*****	4	1	0	5	30	70	100	4
BTCT422	**Furnace Technology**	4	1	0	5	30	70	100	4
CHE423	Process enng. Economics*****	4	0	0	4	30	70	100	4
CHE424	CPED Lab*****	0	0	6	6	50	50	100	2
BTCT425	**Project Work**	0	0	6	6	50	50	100	8
									22

***** = **Common with Chemical Engineering**

2/4 B.Tech 1st Semester

BTCT-211

MATHEMATICS- III

UNIT – I: PARTIAL DIFFERENTIAL EQUATIONS

Formation – Solution of equations – standard types – Lagrange's linear equation – integral surface passing through a given curve – solution of linear equations of higher order with constant coefficients

UNIT – II: FOURIER SERIES

Dirichlet's conditions – general Fourier series – odd and even functions – half range sine series and cosine series – parsevals identify – harmonic analysis.

UNIT – III: BOUNDARY VALUE PROBLEMS

Method of separation of variables – solutions of one dimensional wave equation – one dimensional heat equation – steady state solution of two dimensional heat equation – Fourier series solutions in Cartesian coordinates.

UNIT – IV: FOURIER TRANSFORM

Fourier integral theorem – Fourier transform pair, sine and cosine transforms- properties – transforms of simple functions – convolution theorem – parsevals identity.

UNIT – V: Z – TRANSFORM AND DIFFERENCE EQUATIONS

Z – Transform – elementary properties – inverse z- transform – convolution theorem - formations of difference equation s – solution of difference equations using z-transform

Text book

1. Grewal. B.S., Higher Engg Mathematics, 36th edn, Khanna publishers Delhi 2001.

References

1. Wylie C.Ray and Barrett Louis.C., Aadvanced Engg. Mathematics, 6th edn., McGraw Hill Inc. New York 1995.

2. Andrews, L.A and Shivamoggi, B.K., Integral Transforms for Engineering and Applied Mathematicians. Macmillan Newyork 1998.

3. Narayanan. S, Manicavachagom Pillay, T. K., and Ramanaiah, G., advanced Mathematics for Students, Volumes 2nd and 3rd, S. Viswanathan Pvt.Ltd Chennai 2002.

4. Churcill.R.V and Brown.J.W., Fourier series and boundary value problems 4th Edn, Mc.Graw hill book company Singapore 1987.

BTCT-212

MATERIALS SCIENCE FOR CERAMICS

UNIT – I: CHARACTERIZATION OF CERAMIC SOLIDS

Classification of engineering materials – structure property relationships – atomic structure – bonding – bond energy, bond type, bond length, ionic, metallic, covalent, VanderWaal's, secondary, variation in bonding character and properties – polymorphic forms and transformations – structure of ceramics – metallic and ceramic structures, binary ceramic structure , ternary ceramic structures, silicate structures.

UNIT – II: STRUCTURE OF SOLIDS AND IMPERFECTIONS

Crystalline and non crystalline states – inorganic solids – covalent, metals and alloys, ionic, polymers – classification, structure, crystallinity. Imperfections – point – vacancy, Schottky, Frenkel – line – dislocation – edge, screw, properties of dislocations – surface – grain boundary, interphase boundary, twin and twist boundary, stacking faults.

UNIT – III: PHASE DIAGRAMS AND PHASE TRANSFORMATIONS

Phase rule – single component system – binary phase diagrams – micro structural changes during cooling – lever rule – applications of phase diagram – phase transformations – time scale for phase changes – nucleation and growth – applications

UNIT – IV: DIFFUSION

Fick's law of diffusion – solution to Fick's second law – applications based on the second law solution – Kirkendall effect – atomic model of diffusion – other diffusion processes.

UNIT – V: PROPERTIES

Physical properties – density, specific gravity, melting behavior. Thermal properties – heat capacity, thermal conductivity, thermal expansion. Dielectric properties – polarization dielectric constant, dielectric strength, dielectric loss, capacitance.

Textbook:

1. V. Raghavan material science and engineering, Prentice Hall of India, New Delhi 2004

References:

1. W. D. Kingerey, H. K. Bowen and D. R. Uhlmann, Introduction to ceramics, Jhon Wiley& sons 1965.

2. David. W. Richersons, Modern Ceramic Engineering, Marcel Dekker Inc. New York 1992.

3. Michel W. Barsoun, Fundamentals of Ceramics, Mc Graw Hill Company New York 1997.

BTCT-213

ELEMENTS OF CERAMICS

UNIT – I: RAW MATERIALS

Tri axial bodies. Classification, impurities, physical properties – charged nature of clays, cation exchange capacity, plasticity, flow behavior, effect on heating.

UNIT – II: WHITEWARE

Introduction, raw materials, body composition, preparation, forming – slip casting, plastic forming, pressing, finishing, drying, firing, glazing, decoration, testing.

UNIT – III: COATINGS

Introduction, classification, opacity and opacifiers, glaze materials – selection, glaze maturing, preparation of glaze, application of glaze, glaze firing and glaze body interaction, glaze defects. Ceramic colors, enamels

UNIT –IV: GLASS

Introduction, classification, preparation – raw materials, mixing, charging, melting, processing. Manufacture of glass products – flatware, hollowware. Cullets

UNIT – V: REFRACTORIES

Importance and requirements, classification – fire clay, aluminosilicate, silica, magnesite, forsterite, dolomite, chromite, chrome, magnesite, zirconia ,carbon and graphite- refractory failures.

List of references:

1. Norton F.H. Fine Ceramics: Technology and Applications; Mc-Graw Hill, Co; NY, 1978.
2. F. Singer and S. Singer, Industrial Ceramics, Oxford & IBH Publishing Co; 1991.
3. Heinz G.P. Pfaender, Schott Guide to glass, Chapman and Hall; 1996.
4. Tailor, J.R and Bull, A.C., Ceramic Glaze Technology, Pergamon press, NY, 1986.
5. Sudhirsen, Ceramic Whiteware, Oxford & IBH publishing Co, New Delhi, 1992.
6. Ryan, W., Properties of ceramic raw materials, Pergamon Press, second edn, 1978
7. Budhikor, P.P., The Technology of Ceramics and Refractories, Cambridge MIT, 1964

BTCT-214
ELECTRICAL DRIVES AND CONTROL

UNIT – I: ELECTRIC CIRCUITS

Definition – Ohms law – series parallel circuits – parallel circuit – division of current – Kirchoff's law, super position and Thevinin's theorem, star delta transformation, simplification of networks.

UNIT – II: A.C. CIRCUITS

Alternating voltage, need for A.C. voltage, sinusoidal A.C. voltage, R.RL and RLC networks, impedance angle, power and power factor, actual and apparent power, resonance in A.C. circuits, series, parallel and series parallel resonance, vector diagram, complex algebra applied to sinusoidal, three phase circuits, three phase loading, balanced loads, simple problem.

UNIT – III: D.C. MACHINES

Lenz's law of electro magnetic induction, Fleming's rule, principle of operation of D.C. machines, kinds of D.C. machines, e.m.f equation of D.C. generators, speed control of D.C. motor, starters, application of D.C. machines

UNIT – IV: A.C. MACHINES

Principle of operation of A.C. machines: transformer, single and three phase induction motors, alternators, synchronous motor, equivalent circuit, regulation and efficiency of single phase transformer, slip – torque characteristics induction motors, starting of induction motors. E.m.f. equation, regulation and synchronization of alternators, synchronous condensers, hunting in synchronous motor, single phase induction motors and their applications.

UNIT –V: DRIVES

Industrial requirements and Ward Leonard System of drives. Servo motors, basic theory and application

Text Books:

1. Cotton, H., Electrical Technology; Pitman publishing press, 1975.
2. Uppal, S.L; Text book of Electrical Engg. Khanna publishers 1975.
3. Theraja, D.L.; Text book of Electrical Technology Nirja publishers 1995

BTCT-215
MECHANICAL ENGINEERING

UNIT –I: LAWS OF THERMODYNAMICS

Basic concepts and hints, zeroth law, first law of thermodynamics – statement and application, steady flow energy equation, second law of thermodynamic- statement, imitations, heat engine, refrigerator and heat pump, available energy, Kelvin – Planck's statement and Clausius statement, equivalence entropy, reversibility, entropy charts, third law of thermodynamics statement

UNIT – II: HEATING AND EXPANSION OF GASES

Expressions for work done, internal energy and heat transfer for constant pressure, constant volume, isothermal adiabatic and polytrophic processes, free expansion and throttling.

UNIT – III: AIR STANDARD EFFICIENCY

Carnot cycle, Stirling's cycle, Joule cycle, Otto cycle, Diesel cycle, Dual combustion cycle

UNIT – IV: I.C. ENGINES, STEAM AND ITS PROPERTIES AND STEAM TURBINES

Engine nomenclature and classifications, SI engine, CI engine, four stroke cycle, two stroke cycle, performance of IC engine, Brake thermal efficiency , indicated thermal efficiency, specific fuel consumption.

Steam – properties of steam, dryness fraction, latent heat, total heat of wet steam, dry steam, super heated steam. Use of steam tables, volume of wet steam, volume of superheated steam, external work of evaporation, internal energy, entropy of vapor, expansion of vapor, Rankine cycle.

Steam turbines – impulse and reaction types – principles of operation

UNIT – V: SIMPLE MECHANISM, FLYWHEEL, DRIVES AND BALANCING

Kinematic link, kinematic pair, kinematic chain, slider crank mechanism and inversions, double slider crank mechanism and inversions.

Flywheel – turning movement diagram, fluctuation of energy.

Belt and rope drives, velocity ratio, slip, creep, ratio of tensions, length of belt, power transmitted, simple and compound gear trains.

Balancing of rotating masses in same plane, balancing of masses rotating in different planes

Text books:

1. Nag.P.K., EngineeringThermodynamics, 2nd Edition Tata Mc Graw Hill publishing Co. Ltd.1995.

2. Rajput R.K, Thermal Engineering, Laxmi Publications Pvt., Ltd, 2001.

REFERENCES:

1. Smith, Chemical Thermodynamics, Reinhold publishing company, 1997.

2. Bhaskaran.K.A and Venkatesh.A., Engineering Thermodynamics, Tata MC Graw Hill 1973.

3. Khurmi.R.S and Gupta.J.K Theory of machines, Eurasia publishers 2004.

4. Pandya.A and Shah Theory of machines, Charatakar publishers 1975.Khurmi.R.S and Gupta.J.K, Thermal Engineering, S.Chand and Company Ltd 2001.

5. Kothandaraman and Dhomukundwar, A Course on Thermal Engineering,(SI units)
Dhanapat Rai & sons Delhi 2001.

BTCT-216

MECHANICS OF SOLIDS

UNIT- I: STRESS, STRAIN AND DEFORMATION OF SOLIDS

Rigid bodies and deformable solids- forces on solids and supports – equilibrium and stability – strength and stiffness – tension , compression and shear stresses – Hooke's law and simple problems – compound bars – thermal stresses – elastic constants and poission's ratio – welded joints – design.

UNIT- II: TRANSVERSE LOADING ON BEAMS

Beams – support conditions – types of beams – transverse loading on beams – shear force and bending moment in beams – analysis of cantilevers, simply – supported beams and over hanging beams – relationships between loading, S.F. and B.M. in beams and their applications – S.F. & B.M. diagrams.

UNIT – III: STRESS IN BEAMS

Theory of simple bending – assumptions and derivation of bending equation (M/I = F/Y = E/R) – analysis of stresses in beams – loads carrying capacity of beams – proportioning beam sections – leaf springs – flitched beam – shear stress distribution in beams – determination of shear stresses in flanged beams.

UNIT –I V: DEFLECTION ON BEAMS

Double integration method- Macaulay's method – area – moment theorems for computation of slopes and deflections in beams – conjugate beam method.

UNIT – V: TORSION

Torsion of circular shafts – derivation of torsion equation (T/J = C/R = G0/L) –stresses and deformation in circular and hallow shafts – stepped shafts – shafts fixed at both ends – stresses in helical springs – deflection on springs – spring constant.

UNIT – VI: COLUMNS

Axially loaded short columns – columns of unsymmetrical sections – Euler's theory of long columns – critical loads for prismatic columns with different end conditions – effect of eccentricity.

Text books.

1. Prasad I.B, Applied mechanics and strength of materials, Khanna Publishers, Delhi.

References.

1. Junarkar S.B, Mechanics of Structure vol.1, 21st Edn, Character Publishing House, Anand, India 1995.

2. William A., Nash , Theory and Problems of Strength of Materials, Schaum Outline Series, McGraw Hill International Edn.,1994.

3. Ramaurtham S., Strength of materials, Dhanapat rai Publishers 2004.

BTCT-217
MATERIAL SCIENCE LAB

PART-A

1. physical properties of ceramic raw materials

- determination of moisture content
- determination of loss on ignition

2. physical properties of ceramic body

- pressing of ceramic raw material
- determination of shrinkage of ceramic body – dry and fired, volume & linear
- determination of density – true and bulk
- determination of porosity
- determination of water absorption

PART-B

1. cement analysis

- determination of moisture content
- estimation of CO_2 in carbonates
- estimation of SiO_2
- estimation of mixed oxide
- estimation of calcia
- estimation of alkali oxides
- estimation of iron oxide
-

BTCT-218
ELECTRICAL ENGINEERING LAB& MECHANICAL ENGINEERING LAB

ELECTRICAL ENGINEERING LAB

1. Open circuit characteristics of D.C. shunt generator
2. Load characteristics of D.C. shunt generator
3. Load characteristics of D.C. compound generator
4. Load test on D.C. shunt motor
5. Study of D.C. motor starters
6. O.C. and S.C. tests on single phase transformer
7. Load test on single phase transformer
8. Load test on 3-phase squirrel cage induction motor
9. Study of 3-phase induction motor starters
10. Load test on 3-phase squirrel cage induction motor
11. O.C. and S.C. tests on 3-phase alternator
12. Synchronization and V-curves of alternator

MECHANICAL ENGINEERING LAB

1. Port timing diagram
2. Valve timing diagram
3. Study of 2, 4 stroke I C engines
4. load test on 4-stroke petrol engine
5. performance test on 4-stroke single cylinder diesel engine
6. Performance test on 4-stroke twin cylinder diesel engine
7. Heat balance test on diesel engines
8. Compression test
9. Deflection test
10. Hardness test (Rockwell and Brinnel)
11. Spring test
12. Study on behavior of columns
13. Torsion test
14. Impact test

2/4 B.Tech, 2nd semester

BTCT -221

Mathematics - IV

Unit-I NUMERICAL ANALYSIS:- Solution of non-linear equations of one variable using false position, Secant and Newton - Raphson methods, solution of linear algebraic equations using jacobi, Gauss – Seidel interactive methods, eigen values, eigen vectors
using power method, numerical integration using trapezoidal, Simson's and other quadrature formulae.

Unit-II NUMERICAL SOLUTION OF ODE'S: Numerical solutions of Ode's by picard's method, Euler's method, Runge – Kutta method and Numerical method for solution of PDE's (1) Elliptic (Liehmann iteration process). (2) parabolic (Schmidt explicit formula), (3) Hyperbolic and (4) Poisson's equations (Gauss-Siedel method).

Unit-III STATISTICAL METHODS: Review of probability theory. Addition law of probability, independent events, multiplication law of probability, Bay's theorem, random variable discrete probability distribution, expectation, Moment generation function, repeated trails, Binomial distribution, poisson distribution, normal distribution, probable error, normal approximation to Binomial distribution.
Sampling distribution, standard error, testing of hypothesis, Level of significance, confidence limits, Simple sampling of attributes, sampling of variable - large samples and small samples, students t-distribution, X^2 – distribution, F-distribution, fisher's Z- distribution.

Unit-IV Vector and Tensor Calculus: scalar, vector fields. Gradient, divergence, curl, directional derivative, identities, irrotational and solenoidal vector fields, line integral, surface integral and volume integral, introduction of orthogonal curvilinear coordinates: cylinder, spherical and polar coordinates, introduction of tensors, quotient law.

Unit V Complex analysis: Differentiability, cauchey – Riemann equations, analytic functions Cauchy theorem, Cauchy integral formula, Taylor and Laurent expansions,(without proofs), singularities, residue theorem, counter integration , geometric representation of f(z), conformal transformation, some standard transformation :
1) $w = z + c$ (2) cz, (3) $W= 1/zu =(az+d)$, $W= Z^2$ and $W= e^z$

Text Book:- Higher Engineering mathematics(34 th edition 1998) by B.S.Grewal.

References:-

1.A text book on Engineering mathematics by M.P.Bali et al.
2.Higher engineering Mathematics by M.K.Venkataraman
3.Advaced Mathematics of Engineering Students, Vol.2&3, by Narayanan et al.
4.Advanced engineering mathematics by Erwin Kreyszig.
5.Engineering mathematics by P.PGupta.
6.Advanced Engineering Mathematics by V.Pjaggi and A.Bmathur.
7.Engineering mathematics by S.S.Sastry.
8.Advanced Engineering Mathematics by M.LDass.

BTCT-222

CERAMIC POWDER PROCESSING

UNIT – I: QUARRYING OF CERAMIC RAW MATERIALS
Winning of clays, quarrying of non plastic materials – transportation – different clay washing methods – electro osmosis plan – beneficiation of non plastic materials – advantages – synthetic raw materials

UNIT – II: SIZE REDUCTION
Laws of size reduction. Mechanisms of size reduction. Primary and secondary crushers – jaw crusher, gyratory crusher, toothed rolls, hammer mill, edge runner mill, pan mill, jet mill, attrition mill, other mills – principles of working. Grinders, cutters

UNIT – III: MECHANISM SEPARATION
Screening and screening equipment – effectiveness of screen. Gravity settling – sedimentation, thickening. Magnetic separation. Filtration – theory of filtration, batch and continuous filters. Cyclone separation. Air classifier.

UNIT – IV: MIXING AND CONVEYING OF RW MATERIALS
Mechanism of mixing. Types of mixers – batch and continuous mixers-pan mixer, shaft mixer, U mixer, muller mixer and other mixers. Plungers, agitators. Conveying techniques of solids and liquids, conveyors and elevators. Different types of pumps. Storage methods of different ceramic powders.

UNIT – V: POWDER CHARACTERISATION
Powder size and size distribution analysis – Andreason pipette, hydrometer method, sedigraph, laser diffraction. Powder characterization – measurement of surface4 area – mercury porosimeter, bulk density – granulometry

Textbook:

1. Charles Burroughs Gills, Materials Benefication, Sspringer R,Verlag, 1991.

REFERENCES:

1. R. Singer & S. Singer, Industrial Ceramics, Oxford & IBH Publishing Co., 1991.
2. P.Vincenzini, Fundamentals of Ceramic Engg, Elsevier Applied Sciences, London, 1991.
3. Keishi gotoh powder technology hand book marcel Dekker inc.1997.
4. W. Ryan & C. Redford, White Wares Production Testing & Quality Control Pergamon Press., NY, 1987.

CHE223 - Chemical Processes Principles

(Common with chemical Engg.)

Stiochiometry and composition relationships, the gram-mole and pound-mole. Limiting reactant, excess reactant-degree of completion ,basis of calculation. Weight percent, volume percent and mole percent. Density and specific gravity: Baume and API gravity scale.

Behavior of ideal gases, application of the ideal-gas law. Dalton and Amagat law to gaseous mixtures. Composition of gases on dry basis and on wet basis.

Vapor pressures. Effect of temperature on vapor pressure. Antoine equations. Reference substance vapor pressure plots. Vapor pressure of immiscible liquids. Ideal solutions and Raoult's law. Non – volatile solutes.

Humidity: Percentage saturation. Relative saturation or relative humidity. Dew point, vaporization, condensation. Wet and dry bulb temperatures. Adiabatic vaporization and adiabatic saturation temperature.
Material balances. Tie substances, yields, conversion. Process involving chemical reactions. Material balance – calculations involving drying, dissolution ,and crystallization. Process involving recycle, bypass and purge.

Heat capacities of gases and gaseous mixtures. Effect of temperature on heat capacity of gas. Mean heat capacities of gas. Kopp's rule. Latent heat. Heat of fusion. Heat of vaporization. Trouton's rule. Kistyakowsky equations for non polar liquids. Estimation of latent heat of vaporization using clausius –clapeyron equation. Enthalpy of humid air, and humid heat capacity.

Standard heat of reaction. Standard heat of formation. Calculation of heat formation. Laws of thermo-chemistry. Standard heat of combustion. Calculation of heat of formation from heats of combustion. Calculations standard heat of reaction from heats of formation, and from heats of combustion. Standard integral heat of solution. Effect of temperature on heat of reaction. Kirchoff,s equation. Adiabatic and Non- adiabatic reactions. Theoretical and actual flame temperatures

Textbook:

1. chemical process principles part-I material and energy balances, by Olaf A houngen , Kwenneth M.Waston , and Roland A ragatz ,CBS publishers and distributors.(1995)

Reference books

1. Basic principles and calculations in chemical engineering by David m Himmelbalu, prientice. Hall of India pvt ltd(1995)
2. Stiochimetry, by B.L.Bhatt and S.M.Vora (third Ed) Tata McGraw hill publishing company limited, new Delhi.
3. Stiochimetry for chemical engineers, by Williams and Johnson, McGraw Hill.

CHE-224- Fluid mechanics

(Common with chemical Engg.)

Units and dimensions, dimensionless analysis, similarity, types of fluids, hydrostatic pressure, pressure distribution in a static, pressure measuring devices.
Introduction to fluids in motion, concept of streams lines, stream tubes, viscosity, types of fluids, flow in boundary layers, its formation and growth in tubes and on plates, basic equations of fluid flow: continuity, momentum ,Bernoulli's equation and Navier-stokes equation.
Flow of incompressible fluids in pipes, relation between skin friction –wall shear, laminar flow in pipes, hagen-poiselle equation, turbulent flow in pipes, velocity distribution equation, friction factor, friction form changes in velocity or direction , flow of compressible fluids, basic equations, flow through variable area conduits, adiabatic and isothermal frictional flow.
Flow past immersed bodies, drag, drag coefficient, friction in flow through beds of solids, motion of particles through fluids, its mechanics, terminal velocity, fluidization, mechanism of fluidization, pressure drop in fluidization, applications of fluidization.
Transportation and metring of fluids, pumps, fans,blowers and compressors, reciprocating, rotary and centrifugal types, characteristics and calculations regarding power and efficiency. Flow measuring devices, venture, orifice, Pitot tube, Rota meter, notches and weirs.

Text book

1. unit operations of chemical engineering., Warren L.Mccabe and julian C. Smith 5^{th} edition

References:

1. Unit operations Brown et al., Asian publishing house
2. Fluid dynamics and heat transfer., Knudsen and Katz

BTCT-225

CERAMIC RAW MATERIALS

UNIT – I : GENERAL GEOLOGY AND MINEROLOGY

Formation of rocks, their characteristics and classification into igneous, sedimentary and metamorphic group – formation of mineral deposits – physical and mineral characteristics of minerals – composition, color, streak, luster, fracture, cleavage, hardness, density and tenacity – elements of optical mineralogy

UNIT – II: CLAYS

Clay minerals – clay structure – kaolinite and montmorillonite groups – geology of clay deposits, their classification, china clay, ball clay, fire clay, building clay etc., - beneficiation of clays – mica chlorite, illite group – talc – pyrophyllite, wollastonite group – chemical properties – physical properties.

UNIT – III: FLUXES

Soda and potash feldspar – other feldspars – nephline syenite – geology of formation – physical and chemical properties – beneficiation.

UNIT – IV: SILICA AND SILICATE MATERIALS

Silica – polymorphic modification – silica structure – physical and chemical properties of silica – silicate chemistry – minerals –sillimanite, kyanite, andalusite – availability in India and their uses in ceramic industry.

UNIT – V: OTHER RAW MATERIALS

Geology of bauxite, magnesite, dolomite, chrome, limestone, rutile, zircon, beryllia minerals, alumina, carbides, nitrides – properties and uses

Textbooks &References:

1. Norton F.H., fine ceramics technology and applications McGraw Hill co;NY,1978.
2. Worrall W.E ceramic raw materials pergamon press, NY 1992.
3. Deer W.A Howie R.A. & J.Rock forming minerals Longman London 1967.
4. Ryan W. properties of ceramic raw materials pergamon press 2nd Edn, 1978.
5. Wilson M.J., clay minerology Chapman & Hall 1955

CHE-226

Environmental Studies

Common to All Branches

BTCT-227

CHEMICAL ANALYSIS OF CERAMIC RAW MATERIALS (lab)

1. Alumino Silicate Materials.
   Determination of
- Silica
- Alumina
- Iron oxide
- Alkali oxides
- Alkaline earth oxides

2. High Silica Materials
   Determination of
- Silica
- Alumina
- Iron oxide
- Alkali oxides
- Alkaline earth oxides

3. Feldspathic materials
   .Determination of
- Silica
- Alumina
- Iron oxide
- Alkali oxides
- Alkaline earth oxides

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BTCT-228 -CERAMIC POWDER PROCESSING (lab)

1. to take a representative sample from a bulk by two methods viz. riffle and cone & quartering and to find out the average size {volume-surface mean diameter} of the samples.
2. To determine the Grindabilty Index (GI) of coal by hardgrovee machine.
3. To determine the time of grinding in a ball mill for producing a product with 80% passing a given screen.
4. to verify the laws of crushing using any size reduction equipment like crushing rolls, ball mill or vibrating mill and to find out the work index (WI) of the material.
5. To compare open circuit and closed circuit grinding by means of a ball mill.
6. To determine the optimum time of sieving for a given sample of materials.
7. To find the effectiveness of hand screening of a given sample by a given screen.
8. To find the screen effectiveness of a trammel.
9. To separate a mixture of coal in to two fractions using sink and float method.
10. To separate a mixture of coal in to two fractions using froth floatation technique.
11. To find the size analysis of a given fine sample using beaker decantation method.
12. To separate a mixture of particle by jigging.
13. To concentrate a given material by means of tabling.
14. To obtain batch sedimentation data and to calculate the minimum thickener area under given conditions.
15. To determine the specific cake resistance and filter medium resistance of slurry in plate and frame filter press.

¾ B.Tech 1st semesters

.CHE 311- Chemical Engineering Thermodynamics –I

(Common with chemical Engg.)

The first law and other basic concepts: joule's experiments –internal energy – the first law of thermodynamics – thermodynamics state and state functions – enthalpy – the steady –state, steady –flow process – equilibrium – the phase rule- the reversible prices – constant -v and constant P process – heat capacity.

Volumetric Properties of pure fluids : PVT behavior of pure substances viral equations – the ideal gas-application of the viral equations- cubic equations of state – generalized correlations for gases-generalized correlations for liquids- molecular theory of fluids – second viral coefficient from potential functions .

Heat Effects: sensible heat effects – internal energy of ideal gases-microscopic view-latent heats of pure substance – standard heat of reaction – standard of heat of formation – standard heat of combustion –temperature dependence of heat effects of industrial reactions.

The Second law of thermodynamics: statement of the second law, heat engines, thermodynamics temperature scales, thermodynamics temperature and ideal-gas scale, entropy, entropy changes of an ideal gas, mathematical statement of the 2nd law. The 3rd law of thermodynamics, entropy from the microscopic viewpoint.

Thermodynamics properties of fluids: property relations for homogeneous phases, residual properties – two phase systems- thermodynamics diagrams- generalized property correlations of gases

Thermodynamics of flow processes: equations of balance-duct flow of compressible fluids- turbines (expanders) – compression processes.

Refrigeration and Liquefaction – the Carnot refrigerator – the vapor compression cycle- comparison of refrigeration cycles- the choice of refrigerant – absorption refrigeration-the heat pump- liquefaction processes.

Text book

1. Introduction to chemical engineering thermodynamics by J.M.Smith ,H.C.Van Ness and M.M.Abbott., 6th edition ,McGraw-hill international editions 2000

Reference books:

1. chemical engineering thermodynamics BF Dodge., McGraw –Hill, book co
2.Schaum outline of theory and problems of thermodynamics M.M.Abbott., and Hendrick C.Vanness Mc Graw – hill Internationalbook co Singapore,1981.

CHE 312- Mass transfer-I

(Common with chemical Engg.)

Introduction: mass transfer operations , molecular diffusion in fluids, binary solutions, fick's law, equation of continuity, steady state equimolal counter current diffusion, Stefan's diffusion , estimation of diffusivity of gases and liquids, applications of molecular diffusion, mass transfer coefficients in turbulent flow, theories of mass transfer, analogy between momentum, heat and mass transfer in laminar and turbulent flow, correlations for mass transfer coefficients in simple situations, diffusion in solids.

Inert phase mass transfer:

Concept of equilibrium, diffusion between phases, materials balances in steady state co-current and counter current stage processes.

Equipment for gas-liquid operations:

Spraged vessels, mechanically agitated vessels for single phase liquids and gas – liquid mixtures. Tray towers, sieve tray for design for absorption and distillation, design of batch distillation columns, venturi scrubbers, spray towers, and spray chamber, design of packed towers for absorption and distillation, tray tower vs packed towers.

Distillation

Principles of VLE for Binary systems, phase diagrams, relative volatility, ideal solutions, azeotropes, enthalpy concentration diagrams, flash vaporization, partial condensation, differential distillation, steam distillation, continuous distillation, McCabe method method, Ponchan - Savarit method , tray efficiencies , introduction to multicomponent distillation , azeotropic and extractive distillation.

Absorption

Solubility of gases in liquids, two components systems, multicomponents system,
Ideal and non ideal solutions, choice of solvent for absorption, single component absorption, material balance counter current multistage operations, dilute gas mixtures, non-isothermal operations, tray efficiency, continuous contact equipment, HETP,HTU,NTU concepts for single component absorption, graphical construction for transfer units, non- isothermal operations absorption with chemical reaction.

Text book:

1. Mass transfer operations , Rober E.Treybal , 3rd edition

Reference:

1. unit operation in chemical engineering McCabe ,WL smith JC and harriot .p 5th edition
2. chemical engineering hand book J H Perry

CHE – 313 Heat transfer

(Common with chemical Engg.)

Introduction: modes of heat transfer, basic laws of heat transfer. Analogy between heat flow and electrical flow.
Conduction: the Fourier heat conduction equation, steady state one dimensional heat conduction through plane wall, cylindrical wall, spherical wall, and composite structures. Heat transfer from extended surfaces. Three dimensional heat conduction equation. Numerically problems on unsteady state heat conduction through a semi-infinite slab, infinite cylinder, sphere, critical insulation thickness.
Convection: the convective heat transfer coefficient, introduction to thermal boundary layer. Dimensionless numbers in heat transfer and their significance. Dimensional analysis.
Forced convection: heat transfer by forced convection inside tubes and ducts in laminar transition flow. Analogy between momentum and heat transfer – Reynolds, colburn, and prandtl analogies. Heat transfer to liquids metals. Forced convection over exterior surfaces. Heat transfer to tubes in cross flow. Empirical relations in agitated vessels , packed beds.
Natural convection: Natural convection from vertical and horizontal surfaces, Grashoff number.
Heat transfer with heat phase change: heat transfer from condensing vapors. Filmwise and dropwise condensation. Derivation and practical use of nusselt equations. Condensation of superheated vapors, effect of non-condensable gases on rate of condensation.
Heat transfer by Boiling liquids: boiling of saturated liquid. Maximum heat flux and critical temperature drop-minimum flux and film boiling.
Heat transfer by Radiation : thermal radiation, Black body radiation, Kirchhoff's law, emissivity, gray body. Laws of black body radiation. Geometric (or shape) factor. Radiation in enclosures with black surfaces and gray surfaces. Large parallel plates. Concentric cylinders and spheres. Combined heat transfer by conduction, convection and radiation.
Heat exchangers : types of heat exchangers. LMTD, Energy balances. Overall heat transfer coefficients. Heat exchangers effectiveness. Fouling factors. Design and description of heat transfer equipment. Heat exchangers, condensers, boilers, and kettles. Extended surfaces equipment .
Evaporation : types of evaporators, capacity and economy of evaporators, boiling point elevation and Duhring's rule. Material and energy balances in single effect evaporators. Multiple effect evaporators. Methods of feeding – capacity and economy of multiple effect evaporators.
Textbook:
1. Unit operation in chemical engineering McCabe ,WL smith JC and harriot .p 5th edition
References:
1. heat transmissions by William H. Mc Adams.
2. Process heat transfer , by DQ Kern
3. fluid dynamics and heat transfer by James G.Kundsen and Donald L.kaatz.

BTCT-314

WHITEWARE AND HEAVY CLAYWARE

UNIT – I: CLAASSIFICATION OF WHITEWARE PRODUCTS
Body formulation and properties – tableware, earthenware talc bodies, vitreous bodies, high alumina bodies, porcelain, bone china, sanitary ware, stoneware, majolica, terracotta, artware – physical properties of mixtures – role of water.
UNIT –II: WHITEWARE
Classification, body composition, white wares at home, construction, electrical appliances, industrial uses – manufacturing and properties.
UNIT – III: HEAVY CLAYWARE
Raw materials – methods of winning and handling –classification of building materials – manufacture of building bricks, hollow bricks and other bricks – roof tiles, paving tiles – sewer pipes.
UNIT – IV: FINE CERAMICS
Packing of two component system – porosity – effect of grain size, unfired porosity – experimental verifications – wet to dry contraction – unfired strength – permeability and casting rate – dry to fired contraction.
UNIT – V: TESTS AND QUALITY CONTROL
IS inspection – LOI, plasticity, strength, MOR, thermal shock resistance, abrasion resistance, porosity, acid and alkali resistance – chipping resistance – chemical analysis – electrical and thermal conductivity?
Text books& References :

1. Allen Dinsdale, Pottery Science: Materials, Processes and Products, Ellis Horwood Ltd., NY, 1986.
2. Sudhir Sen, Ceramic White Ware, Oxford & IBH Publishing Co., New Delhi, 1992.
3. F. Singer and S. Singer, Industrial Ceramics, Oxford & IBH Publishing Co.,. 1991.
4. Ryan, W and Radford, C. Whitewares: Production, Testing and Qualist Control, Pergamon Press., NY, 1987.
5. Richard Zakin, Ceramic, A & C Black, 1990.

Terpstra, Ceramic Processing, Chapman and Hall, 1995

BTCT-315

CERAMIC FABRICATION PROCESSES

UNIT I: SLIP FORMING PROCESS

Introduction. Slip – selection of materials, particle size measurement, viscosity, surfactant concentration, binders, p^H, zeta potential, settling, solid recovery, slip conditioning and storage. Plaster mould- process, preparation. Slip casting – methods, mechanisms

UNIT II: PLASTIC FORMING PROCESS

Plastic mass preparation – pug mill, pugging defects. Shaping methods- extrusion, jiggering and jollying, injection moulding, roller machine, compression moulding.

UNIT III: DRY FORMING PROCESS

Theory of particle packing. Pressing- uniaxial pressing – stress distribution on green body – defects and remedies, vibration compaction, isostatic pressing, reactive hot pressing – advantages – defects and remedies.

UNIT IV :DRYING AND FINISHING

Mechanism of drying – transfer of heat – factors that control drying – types of dryers – intermittent and continuous dryers – process of drying – drying defects – finishing – cutting and trimming – sponging – fetting and towing – scumming

UNIT V :FIRING

Action of heat on ceramic bodies – physical changes, chemical changes. Firing equipments, firing schedules – fast firing, firing range, problems, and defects. Liquid phase sintering, vitrification microstructure control

Textbooks & References:

1. Alan G. King, Ceramic Technology & Processing, Noyes Publications, USA 2002.
2. James S Reed, Principles of Ceramic Processing, Jhon Wiely & Sons, NY 1988.
3. Sudeer sen Ceramic White wall, Oxford & IBH publishing co. New Delhi 1992.
4. Nortow F.H, Fine Ceramics Technology and Applications, Mc Graw Hill Co., NY 1978.
5.Terpstra, Ceramic Processing ,Chapman & Hall,1995.
6. I.J Mc Colm, N.J Clark forming, shaping and working of high performance ceramic Chapman & Hall 1988.

BTCT-316

CERAMIC SCIENCE &PHASE EQUILIBRIA IN CERAMICS

UNIT I :MECHANICAL PROPERTIES OF FINISHED WARE

Stress, strain, young's modulus, critical stain, strength, porosity. Effects of grain size on strength – fillers, higher Young's modulus- glazing – principal reason – stress in glaze and body due to thermal expansion difference, variation of modulus of rupture with temperature – impact strength – edge chipping.

UNIT II :THERMAL PROPERTIES

Specific heat capacity – thermal expansion – thermal conductivity – thermal diffusivity – thermal shock resistance – effect of temperature difference on firing the body – critical strain.

UNIT III :OPTICAL PROPERTIES

Basic relationship – loss of intensity – scattering of light by a spherical bubble – boundary reflectance and surface gloss – opacity and translucency – absorption and colour – applications.

UNIT IV: ELECTRIAL PROPERTIES& MAGNETIC PROPERTIES

Definitions – resistivity, composition of bodies – insulators – electronic conduction – variation of resistivity with temperature – Rasch-Hinrichsen equation – effect of porosity, moisture and frequency – dielectric strength – permittivity – dielectric loss – low thermal expansion bodies – conducting glazes.

Susceptibility – permeability – flux density – types of magnetism and their origin – electronic structure and magnetic moment – spinal structure and Ferro magnetism – exchange interaction and super exchange interaction – hysterisis loop and magnetic domain – domain structure.

UNIT – V: BINARY PHASE DIAGRAMS

Lever rule – complete solubility – eutectic and pritectic reactions – partial solid solubility - congruent and incongruent melting compounds – liquid immiscibility – binary diagrams – SiO_2 – Al_2O_3, SiO_2 - Na_2O, MgO - Al_2O_3, SiO_2 – ZrO_2

Different types – lever rule and crystallization paths – ternary diagrams - Na_2O - SiO_2 - Al_2O_3, K_2O – SiO_2 – Al_2O_3, MgO – Al_2O_3, CaO – Al_2O_3 – SiO_2

Diffusion controlled and diffusion less transformation – nucleation and growth – concept of critical nucleus size and critical free energy – effect of surface energy – free energies of homogeneous and heterogeneous nucleation – kinetics of nucleation, growth and overall transformation – devitrification of glass – single crystal growth – atomistic mechanism and kinetics of spinoidal decomposition

Text Books:

1. Barsoum M.W., Fundamentals of Ceramics, Mc. Graw Hill, 1997
2. Kingery W.D, Bowen H.K, & Uhlmann, D.R, Introduction to Ceramics, Jhon Weily & Sons 1991.
3. Floyd, A, Hanmel , Phase Eqilibiria in Ceramics Systems, Marcel Dekker ,1984.
4. Kingery W.D. Physical Ceramics Principles for Ceramic Sciences & Engineering, Jhon Weily & Sons ,1997.

References

1. Allen Dinsadle, Pottery Science, Materials, Process & products, Ellis Harwood Ltd, NY 1986.
2. M.W. Barsoum., Fundamental of Ceramics Mc Graw Hill 1997.
3. A. J. Moulson and H. M. Herbert, Electro Ceramics, Chapman Hall London 1990.
4. R.C. Buchanan, Ceramic Materials for Electronics, Marcel Dekker Inc, NY 1991.
5. W. D. Kingery, H. K. Bowen and D. R. Uhlman Introduction to ceramics Jhon Weily and sons 1991.

BTCT-317

WHITEWARE AND HEAVYCLAY WARE LAB

1. Preparation of ceramic slip in a pot mill
2. Determination of slip specific gravity.
3. Determination of slip viscosity.
4. Effect of water on viscosity of slip.
5. Effect of deflocculant on viscosity of slip.
6. Determination of residue in a slip.
7. Plaster mould making.
8. Making of solid slip cast article.
9. Making of drain slip cast article.
10. Biscuit firing.

CHE -318 Heat transfer lab

(Common with chemical Engg.)

1. Determination of total thermal resistance and thermal conductivity of composite wall.
2. Determination of the thermal conductivity of a metal rod.
3. Determination of the natural convective heat transfer coefficient for a vertical tube.
4. Determination of critical heat flux point for pool boiling of water.
5. Determination of forced convective heat transfer coefficient for air flowing through a pipe.
6. Determination of overall **heat** transfer coefficient in double pipe heat exchanger.
7. Study of the temperature distribution along the length of a pin fin under natural and forced convection conditions.
8. Estimation of unsteady state film heat transfer coefficient between the medium in which the body is cooled.
9. Determination of Stefan – Boltzmann constant.
10. Determination of emissivity of a given plate at various temperatures.
11. Determination of radiation constant of a given surface.

CHE- 319 SOFT SKILLS

Communication:
Importance of communication
Non verbal communication
Personal appearance
Posture
Gestures
Facial expressions
Eye contact
Space distancing

Goal setting:
Immediate, short term, long term,
Smart goals, strategies to achieve goals

Time management:
Types of time
Identifying time wasters
Time management skills

Leadership and team management:
Qualities of a good leader
Leadership styles
Decision making
Problem solving
Negotiation skills

Group discussions:
Purpose (Intellectual ability, creativity, approach to a problem, solving, tolerance, qualities of a leader)

Group behaviour, Analysing performance

Job interviews:
Identifying job openings
Preparing resumes & CV
Covering letter
Interview (Opening, body-answer Q, close-ask Q),
Types of questions

Reference books:

1. 'Effective Technical Communications' by Rizvi M. Ashraf, McGraw–Hill Publication
2. 'Developing Communication Skills' by Mohan Krishna & Meera Banerji, Macmillan
3. 'Creative English for Communication' by N.Krishnaswami & T.Sriraman, Macmillan
4. 'Professional Communication Skills' by Jain Alok, Pravin S.R. Bhatia & A.M. Sheikh, S.Chand & Co.

¾ B.Tech 2nd[t] semester

CHE321 – Chemical Engineering Thermodynamics-II

(Common with chemical Engg.)

Solution thermodynamics : theory : fundamental property relation – chemical potential as a criterion for phase equilibria - partial properties – ideal gas mixtures- fugacity and fugacity coefficient for a pure species- fugacity and fugacity coefficient for species in solution – generalized correlations for the fugacity coefficient- the ideal solution – excess properties – behaviors of excesses properties of liquid mixtures.

Solutions thermodynamics applications: liquid-phase properties from VLE data – models for the excess Gibbs Energy – property changes of mixing-heat effects of mixing processes- molecular basis for mixture behavior.

VLE at Low to moderate pressures: the nature of equilibrium – the phase rule – Duhems theorem VLE : Qualitative behavior – the gamma /'phi' formulation of VLE – dew point and bubble point calculations – flash calculations – solute (1)/solvent(2) systems.

Thermodynamics properties and VLE from Equations of state:- properties of fluids from the viral equations of state – properties of fluids from cubic equations of state – fluid properties from correlations of the Pitzer type- VLE from cubic equations of State.

Topics in phase equilibria : equilibrium and stability – liquid / liquid equilibrium (LLE) – vapor /liquid/liquid equilibrium (VLLE) – solid/liquid equilibrium (SLE)- solid/vapor equilibrium (SVE)- equilibrium adsorptions of gases on solids – VLE by Molecular simulation.

Chemical reaction equilibria : the reaction coordinate- application of equilibrium criteria to chemical reactions- the standard Gibbs energy change and the equilibrium constant – effect of temperature on the equilibrium constant – evaluation of equilibrium constants- relation of equilibrium constants to composition – equilibrium conversations for single reactions- phase rule and Duhem's theorem for reacting systems- multireaction equilibria .

Thermodynamic analysis of processes : calculation of ideal work- lost work- thermodynamics analysis of steady state flow process

Text book

1. Introduction to chemical engineering thermodynamics by J.M.Smith ,H.C.Van Ness and M.M.Abbott., 6th edition ,McGraw-hill international editions 2000

Reference books:

1. chemical engineering thermodynamics BF Dodge., McGraw –Hill, book co
2. Schaum outline of theory and problems of thermodynamics M.M.Abbott., and Hendrick C.Vanness Mc Graw – hill Internationalbook co Singapore,

CHE 322- Mass transfer-II

(Common with chemical Engg.)

Humidification operations : definitions of fundamental terms, psychometric charts, theory of adiabatic saturation and wet bulb temperature, lewis relation, gas liquid contact operations, water cooling with air, dehumidification of air – water vapor mixture, cooling towers, evaporative cooling.

Liquid – liquid extraction: operations: introduction, LLE, Analytical and graphical solutions for single and multi stage operations, continuous counter current operations without and with reflux, fractional extraction, and equipment for liquid –liquid contacting operations, single stage, multistage and continuous contacting equipments.

Leaching: preparation of solids, steady and unsteady state operations, equipment, analytical methods both theoretical and problematic approaches for single and multi stages operations.

Drying: euilibria, drying rate curve, batch and continuous drying, time of drying and calculations, mechanisms of batch drying, equipments for batch and continuous drying process.

Crystallization: equipment and analytical methods, factors governing nucleation and crystal growth rates, controlled rate of crystals, in corporation of principles into the design of the equipment.

Less conventional operations: separation of gases, separation of liquids, dialysis, membrane for liquid extraction, prevaporation, reverse osmosis.

Adsorption: theory of adsorption, industrial adsorbents, adsorption equilibria, frendlich equation, sinlge and multistage operations, unsteady state adsorption equipment for single stage and continuous contact , ion exchange .

Text book:

1. Mass transfer operations , Rober E.Treybal , 3rd edition

References:

1. unit operation in chemical engineering McCabe ,WL smith JC and harriot .p 5th edition
2. chemical engineering hand book J H Perry

BTCT-323

GLAZE TECHNOLOGY &COATINGS

UNIT – I: INTRODUCTION TO GLAZE

Definitions – compositions of glaze – classification of different types of glaze – engobe – frit preparation – frit rules – compounding of lead and leadless glazes, alkaline glazes, cal carious glazes and feldspathic glazes

UNIT – II: RAW MATERIALS AND PROCESSING

Glaze raw materials – effect of individual components – opacifiers – coloring agents – stains – mixed colors – metallic lustures – unit operations and process – glaze properties – grain size – specific gravity – viscosity – glaze control – additives – glaze suitability – fired properties of glazes

UNIT – III: GLAZING TECNIQUES AND SPECIAL GLAZES

Glazing techniques – dipping, pouring, spraying, brushing, dusting and other techniques – special glazes – matt glazes, snake skin glazes, cracked glazes, salt glazes and other glazes.

UNIT – IV: PROPERIES AND DEFECTS

Glaze body reactions – interface layers – thermal characteristics – glaze defects and remedies – crazing, peeling, crawling, rolling, blisters, pin holes, dunting – mechanical, optical and chemical properties of glazes.

UNIT – V: DECORATION

Classification of decoration methods – advantages – different decorating techniques – painting, spraying, stenciling, stamping, printing, lithographic transferring, silk screen printing, dusting, engobing, liquid gold decoration and decoration techniques.

Text books & References :

1. Kenneth Shaw, ceramic glazes, Elsevlen publishing CO., NY 1971.
2. Tailor J.R & Bull A.Cceramic glaze technology pergamon press NY, 1986.
3. Emmannel cooper, the potter book of glaze recipes B.T Batsford Ltd, London 1986.
4. Hiradki yanagida the chemistry of ceramics Jhon wiely & sons 1996.
5. Terpstra ceramics processing Chapman & Hall 1995.

BTCT-324

GLASS ENGINEERING

UNIT I

FORMATION AND STRUCTURE OF GLASS

Definition. Classification, glass formers, intermediates, network modifiers, stabilizers, glass formation – kinetics, criteria, structure of glass. Glass transition temperature – measurement, effect of composition. Viscosity – measurement, effect of temperature, effect of composition.

PROPERTIES OF GLASS

Zachariasen rule, mechanical properties – strength, elastic properties, hardness, thermal expansion, thermal endurance, thermal conductivity, heat capacity, specific heat, density, optical properties – refractive properties, abrasive properties, surface tension, electrical properties, chemical resistance of glass.

PREPARATION OF GLASS BATCH

Selection of glass composition - major and minor ingredients- melting and fabrication characteristics – property dependence on composition – effect of cullet content on quality and melting of glass, design and development of glass composition, role of cullets.

UNIT II

GLASS MELTING PROCESS

Physio – chemical reaction occurring during glass melting – dissolution of solids in melt – refining and solubility of gasses – homogenization – volatilization – effect of presnitering

TESTING AND QUALITY CONTROL

Raw materials – defects in glass – fabrication defects – testing of container glass – testing of flat glass.

UNIT – III:

LAYOUT OF THE GLASS PLANT

Flow diagram – site selection – storage of raw material – batch house – melting furnace – fabrication machine – annealing behavior – sorting and packing section –warehouse.

Batch preparation – crushing and grinding of raw materials – working principles of mixtures – handling and storage – briquetting and palletizing – charging

MELTING PROCESS

Pot furnace – construction, operation, tank furnace – design, construction, operation, regenerator, electric melting.

UNIT –IV:
MANUFACTURING PROCESS
Flat ware – float glass, sheet glass, plate glass, patterned glass, hollowware – press and blow, blow and blow, IS machines, bulb, tubes
ANNEALING
Introduction, nature of generation and release of strain, temporary and permanent strain –dependence of strain on cooling rate, detection and measurement of strain, annealing equation, problems in annealing, annealing plate glass, annealing optical glass, ideal annealing cycle, tempering, chemical strengthening
UNIT – V:
SPEACIAL GLASSES
Decorated glasses, fire resisting glass, antique glass, flashed glass, processed flat glass, safety glass, hollow structural glasses, lighting glass, finishing operations in hot and cold state, surface coating, fused silica glass, pharmaceutical glass, glasses for electronic applications, optical and ophthalmic glasses, micro spheres, glass fibers, glass ceramics
Textbooks &References:
1. F. V. Tooley, Hand Book of Glass Manufacture, Volume 1&2., Ogden Publishing company, NY 1960.
2. A. Paul, Chemistry of Glasses 2 nd Edn, Chapman and Hall NY 1990.
3. George. W. Mclellan and Erron. B. Shand, Glass Engineering Handbook, Mc Graw Hill, NY, 1984.
4. M. Cable and J.M Parker, High Performances Glasses, Chapman and Hall
NY 1992.
5. Hans Bach, low Thermal expansion glass ceramics, Springer, 1995.

BTCT-325
FUELS AND ENERGY ENGINEERING

UNIT – I: SOLID FUEL
Wood, charcoal and coal characteristics – formation of coal, grading of coal – handling of storage of coal – coal washing – hardness and grindability of coal – calorific value – manufacture of coal –coal analysis.
UNIT – II: LIQUID FUEL
Origin and composition of natural oil – refining process of liquid petroleum products - synthetic liquid products – calorific values – storage and handling liquid fuels.
UNIT – III: GASEOUS FUELS
Natural gas – composition and calorific values – liquefied petroleum gas – oil gas – coal gas – producer gas – water gas – other gaseous fuels
UNIT – IV: COMBUSTION PROCESSES
Air requirement – combustion process of solid, liquid and gaseous fuels – control of combustion process – testing of fuels.
UNIT V: HEAT TRANSFER
Heat transfer to charge by conduction, convection and radiation in a kiln – heat loss through kiln walls, opening, cooling etc, - heat balance and thermal efficiency – heat recovery – recuperator and regenerators.

Textbook:
1. A. K. Shaha., Combustion Enineeringg & Fuel Technology, Oxford & IBH Publishing Company, New Delhi, 1974.

References:
1. Wilfrid Francis & Matin C. Peter, Fuels & Fuel technology., Pergamon Press 1980.
2. Samir Sarkar, Fuels & Combustion, 2nd edn. Orient Longman, Bombay 1990.
3. J.D. Gillchrist , Fuels, Furnaces & Refractories,Pergamon Press, NY, 1977.
4. Om Prakash Guptha, Elements of fuels, furnaces & Refractories, Khanna Publishers 1995.
56. J.P Holman, Heat transfer, Mc Graw Hill 1997.

BTCT-327
CEMENT TECHNOLOGY AND CONCRETE

UNIT I CEMENT

Classification and processing, types of cement – compositions, raw materials and manufacturing process, cement components – selection, proportioning, blending, chemistry of cement and manufacturing.

UNIT II QUALITY CONTROL

Microscopic and X- ray investigation of clinker materials – effect of alkalies, fluorides, phosphates, sulphur compounds on the precalcined clinker constitution.

UNIT III DIFFERENT TYPES OF CEMENT

Quick setting cements – low heat cements – rapid hardening cement – blast furnace cement – slag cement – high alumina cement – Sorel cement – white and colored cement – oil well cement iron ore cement - hydrophobic cement – water proof cement – super sulphate cement – refractory cement – trief cement – Portland cement.

UNIT IV CONCRETE

Types of concrete aggregates – heavy, normal and light weights, light weight concretes – design, production, properties and uses- reinforced concrete – castables - polymer admixture – fly ash cement - fire resistant cement.

UNIT V PROPERTIES OF CEMENT AND CONCRETE

Strength, permeability, creep, thermal expansion, shrinkage, moisture movement, penetration of ray abrasion resistance, electrical properties, fire resistance of concrete.

Textbooks & References

1. A. Tretyakor and M. Rozhnenko, reinforced concrete Min publishers 1987
2. A. M. Neville, Properties of Concrete, Longmen, 1986.
3. Lee text book of cement and concrete 1975
4. M. Moukwa, Cement based materials ceramic transactions, volume 37 American ceramic society Ohio 1993.

BTCT-328
GLASS AND GLAZE LABORATORY

GLASS lab

1. Chemical Analysis of Glass
   - Determination of silica
   - Determination of barium oxide
   - Determination of R_2O_3
   - Determination of CaO
   - Determination of Na_2O
   - Determination of K_2O
   - Determination of Fe_2O_3
2. Melting behavior
   - Soda lime glass
   - Borosilicate glass
   - Amber glass
3. Development of colored glass

GLAZE lab

1. Preparation of Glaze slip
2. Formulation and melting of frits
3. Fusion studies
4. Particle size and particle size distribution of glaze
5. Determination of consistency of glaze slip
6. Preparation of color glazes
7. Application of glazes
8. Glost firing
9. Measurement of thickness of glaze
10. Abrasion resistance

CHE 326 Mass Transfer-lab *(Common with chemical Engg.)*

1. steam distillation
2. . differential distillation
3. height equivalent to a theoretical plate
4. vapor – liquid equilibria
5. determination of liquid diffusion coefficient
6. determination of liquid diffusion coefficient
7. surface evaporation
8. Height of a transfer unit.
9. ternary liquid equilibria(binodal curve)
10. LLE(liquid - liquid Extraction)
11. limiting flow rate in spray tower
12. hydrodynamics of perforated plate tower
13. Volumetric mass transfer coefficient in perforated plate towers.
14. dynamics of liquid drops
15. Studies of axial mixing characteristics in a packed bed.
16. Gas- liquid mass transfer in packed tower.
17. drying characteristics of a given material

4/4 B.Tech 1st semester
BTCT-411
ELECTRO CERAMICS AND ABRASIVES

ELECTRO CERAMICS:

UNIT 1 CERAMIC CAPACITOR TECHNOLOGY:

Ferroelectricceramic materials,Basic Ceramic Dielectric formulation for capacitors.Performance categories of ceramic capacitors,Grain Boundary Barrier Layer capacitors,Multiple Layer Capacitors,Relaxor ferroelectrics.

UNIT II: MAGNETIC CERAMICS :Super exchange interactions,spinel ferrites, Garnets and Hexagonal Ferrites.Effect of composition ,processing and microstructure on the magnetic properties.

UNIT III:IONICALLY CONDUCTING CERAMICS: Defect equilibria and Kroger-Vink diagrams for different systems. Diffusion in ionic solids.Ionic and Super conductivity. Classification of Super ionic solids.Agl based ,β-Alumina and oxide based Supersonic conductors and their processing, properties and applications.

ABRASIVES:

Abrasives,abrasive operations,natural abrasives,abrasives like aluminium oxides,silicon carbide,diamond and boron nitride,miscellaneous synthetic abrasives,raw materials for abrasives,their proportioning,processing,manufacture of abrasives,grinding wheels,their drying,firing,testing.The use of abrasives and grinding wheels in grinding.Evaluation of abrasives.Loose abrasive operations.The chemistry of grinding.

Text Book;

BTCT -412
REFRACTORIES

UNIT I

INTRODUCTION OF REFRACTORIES

Production, demand and growth of refractories in India – layout of modern refractory plant – fundamental properties of refractories – Indian and international standards – factors for selection and use of refractories – test and quality control procedures.

SILICA REFRACTORIES

Raw materials and composition – manufacturing process steps – quality of raw materials and process parameter on quartz inversion – glassy phase and other micro structural features – porosity, strength, RUL dependence on micro structure – specifications of silica refractories.

ALUMINA – SILICA REFRACTORIES

Al_2O_3 – SiO_2 phase diagram – clay, pyrophyllite, sillimanite, grog, bauxite and diaspore as raw materials – manufacturing processes – micro structure and properties

UNIT II

BASIC PROPERTIES

Magnesite, forsterite, dolomite and chrome based refractories – raw materials and composition – manufacturing processes – micro structure and properties.

SPECIAL REFRACTORIES

Oxide based, carbide based and nitride based refractories – cordierite – zirconia – carbon – fusion cast refractories, slide gate, purging refractories, and continuous casting refractories – ceramic fibres.

REFRACTORIES FOR IRON AND STEEL INDUSTRY

Coke oven, blast furnace, twin hearth, LD converter – continuous casting – electric arc furnace, induction furnaces – reheating furnaces – slide plate system – nozzle, shroud/ SDN – ladle and tundish lining practices – monolithic - gunning techniques – refractor, slag and metal interactions.

UNIT III

REFRACTORIES FOR CEMENT AND NON FERROUS INDUSTRY

Wet/ dry process for cement making – preheater and pre calcinatory and zone lining – alkali and wear resistance – refractory requirement and use in copper, aluminum and hydro carbon industry – use of monolithic.

REFRACTORIES FOR GLASS INDUSTRY

Design of glass tank for container, sheet, lamp, float glasses, refractory practices in side wall, throat, forehearth, and roof of glass tanks – regenerator systems – alumina and AZS fused cast refractories – glass corrosion resistance, oxidation, seed potential tests – glass defects and analysis – feeder expendables

UNIT IV REFRACTORIES FOR CERAMIC INDUSTRY

Kiln furniture – types – properties of requirement - silicon carbide, mullite, corderite, alumina, zirconia – mullite, zirconia types – kiln design – LTM concept – fast firing technology

UNIT V REFRACTORIES FOR ENERGY CONSERVATION

Insulation refractories – types- ceramic fiber product – design and installation – ceramic coatings – case studies in ceramic fiber usage.

Textbook:

1. B. M. Coop and E. M Piekson, Raw Materials for the refractory industries and industry materials and consumer survey, 1981.

References

1. J. H. Eheslers Refracrtories: production and Properties. Iron and Steel Institute, London, 1972.
2. Akira Nistrikawa, Technology of monolithic refractories, Plibrico japan co. Tokyo 1984
3. D.N. Nandi, Hand Book Refractory's, Tata Mc Graw hill publishing Co. New Delhi 1991

4. K.Shaw, Refractories and thick uses ADP sciences publisher U K 1972
5. Keishi GOTON, Powder Technology Hand Book, Marcel Dekker Inc. 1997
6.Chester J.H., Steel Plant Refractories, 2nd Edition, 1973, United Steel Companies Limited, Sheffield UK8.Advances in Refractory Technology, Ed. Robert E Fisher, Ceramic Transaction Vol 4., American Ceramic society, 1990, Westerville, Ohio, USA.

CHE413: Chemical Reaction Engineering:

(Common with chemical Engg.)

Batch reactors introduction and overview of the subject, kinetics of homogenous relations, non elementary reactions, collision theory and transition state theory, Arrhenius relation, and various methods of analysis of batch reactor data (including variable volume and variable pressure data) isothermal batch reactor design.
Homogeneous flow reactors: design equations for plug flow reactor (PFR) and CSTR, data analysis in flow reactor, design of PFR, CSTR, cascade of CSTR'S and combination of PFR and CSTR.
Multiple reactions: design for multiple reactions, parallel reactions, series reactions (omit reversible and series – parallel reactions)
Non-isothermal design: energy balance equations for Batch, PFR and CSTR under non-isothermal conditions, equilibrium conversions under adiabatic conditions, design of the homogeneous reactors under adiabatic conditions.
Non- ideal flow: residence time distribution curves E,F,and C, interpretation of the response data for the "dispersion" and "tanks in series" models(omit multiparameter models)
Heterogeneous catalysis: catalyst properties, physical adsorption and chemisorptions, adsorption isotherm. Derivation of rate equations for a various mechanisms (Adsorption, surface reactions and desorption controlling etc.) Data analysis for heterogeneous laboratory catalytic reactors, isothermals packed bed (PFR) reactor design, effectiveness factor and internal pore diffusion, criterion for internal pore diffusion limitation.

Text book:

1. chemical reaction engineering , levenspiel, octave 3rd edition John Wiley, 1999

Reference ;

1. **"Elements of chemical reaction engineering" Fogler H S 3rd edition printice hall india, 2000.
2. chemical engineering kinetics smith J M 3rd edition Mc graw Hill ,1981

CHU 414 – Industrial engineering and management

(Common with chemical Engg.)

Management – elements of management, planning, coordinating, motivating, controlling, management needs-role of manager-skills of manager, pioneer in managements – scientific management –Taylor's Gilberts-Blackett's and george Dantzing's contribution to the management development.
Production systems- operations manager's activities –types of operations- classifications of production systems-manufacturing and service units- mass, jobbing and batch type production systems. Ownership – form of ownership- proprietorship – partnership business owned by the company cooperation and government owned enterprises. Internal organization –organization chart- types of formal organization – line Taylor's functional and line and staff type organization – principles of organization.
Process planning – process charts- group technology. Product development- product life cycle concept, perato analysis standardization.
Work study – method study and work measurement , plant layout-objectives – planning problems-layout problems-types of layout production planning and control – forecasting- controlling and intermediate production system- function under PPC.

Textbook:

1. Industrial Engineering and Management bt O.P.Khanna , Dhanpat raj and sons.

Reference books:

1. works organization and management , basu K.C.Sahu, N.K.Dutta ,oxford publications.
2.modern production management, buffa wiley eastern edition
Essential of managements, Koontz and O'Donnels, McGraw Hill.

CHE 415- Process dynamics and control

(Common with chemical Engg.)

Linear open loop systems : response of 1st order systems, physical examples of 1st systems, response of 1st systems in series. 2nd order systems, transportation lag.
Linear closed loop systems : the control system , controllers and final control elements , block diagrams of a chemical reactor control systems , closed – loop transfer functions, transient response of simple control systems, stability root locus
Frequency response: introduction to frequency response , control systems design by frequency.
Process Applications: cascade control , feed forward control, ratio control dead time compensation, internal model control, controller tuning and process identification, control valves, theoretical analysis of complex process like, steam –jacketed kettle and heat exchanger

Textbook

Process systems analysis and control 2nd edition Donlad Coughnowr McGraw hill 1991

Reference:

1. Chemical process control: an introduction to theory & practice, george Stephanopoulos, prentice –hall of India private limited, new Delhi 1993

BTCT 416
General Chemical Technology

Sulphur and Sulphuric acid: sources of sulphur- sulphuric acid – different processes of manufacturing – contact process DCDA process for sulphuric acid manufacture.

Nitrogen Industries: manufacture of ammonia, nitric acid, Urea, Ammonium Nitrate.

Phosphorous and phosphoric acid Industries: methods for production of phosphorous and phosphoric acid, - manufacture of super phosphate and triple super phosphate

Chloro- Alkali industries: manufacture of soda ash, caustic soda and chlorine

Coal and coal chemicals – types of coal – different uses – distillation of coal – treatment of products – low and high temperature carbonization of coal , coal tar distillation.

Petroleum – origin- classification – composition of crude oil – production of crude oil – distillation of crude petroleum – refining- methods- uses of products .

Extraction of vegetable oils – purification – acid value- hydrogenation of oils – Iodine value – manufacture of fatty acids and soaps – saponification value – detergents – classification and manufacture.

Manufacture of pulp – Kraft process and sulphite process – production of paper.

Polymerization – methods – manufacture of polyethylene, phenol formaldehyde, SBR, Synthetic fibers, - rayon, 6- nylon, 6, 6-nylon, polyesters

Textbooks:
1. "Dryden's Outlines of chemical technology", Gopala Rao, M&Marshall Sitting {eds.} affiliated east west press Pvt. Ltd.
2. "Shreve's chemical process industries", Austin, G.T, mc GRaw hill Book.

References
1. "Encyclopedia of chemical technology" Kirk R.E. & other, D.F {eds} inter science

BTCT-417 REFRACTORIES LAB

1. Preparation of clay based refractories
2. Preparation of sillimanite based refractories.
3. Preparation of high alumina refractories.
4. Preparation of fused mullite refractories.
5. Preparation of sintered mullite refractories.
6. Preparation of insulation refractory's.
7. Preparation of temporary binders.
8. Determination of porosity.
9. Determination of water absorption.
10. Determination of cold crushing strength.

CHE418- PDC LAB *(Common with chemical Engg.)*

List of experiments

1. response of resistance thermometer
2. Response of thermometer with and without thermal wall.
3. response of manometer
4. response of single-tank liquid level system
5. response of two-tank liquid level system
6. Calibration of thermocouples.
7. Response of mixing process.
8. Calibration of mixing process.
9. Study of ON –OFF control.

CE419 INDUSTRIAL TRAINING

The students are supposed to submit a detailed report covering the following aspects related to civil engineering projects that are relevant to the industry in which they received training:

4/4 B.Tech 2nd semester

CHE 421 Chemical Process Equipment Design

(Common with chemical Engg.)

Introduction to plant design and costs.

Process design and development: design project procedure, design information from the literature and other sources of information, flow diagrams, preliminary design, and comparison of different processes, firm process design, equipment design and specialization, and scale up in design, safety factors specifications, and materials of construction.

General design considerations: health and safety hazards, fire and explosion hazards, personnel safety, loss prevention, thermal pollution control, noise pollution and control, plant location, plant layout, plant operation and control, utilities, structural design, storage, materials handling, materials and fabrication selection , optimum design and design strategy.

Material transfer, handling and treatment equipment-design and costs:

Incompressible fluid flow systems design, flow through parallel, series and piping, network systems, compressible fluid flow systems design, design and cost estimation of fibers.

Mechanical design of process equipment: design and selection of storage vessels and low pressure vessels, design of roofs, bottom plates, formed heads, flat plate and conical closures. Tall vertical columns. Supports to process vessels, distillation columns, heat exchangers, evaporations.

Heat transfer equipment design and costs;

Heat exchangers for sensible heat exchange-double pipe, shell and tube, plate heat exchangers, heat exchangers with extended surface, optimum heat exchangers design, heat exchangers with phase change-single effect evaporators, multiple effect evaporators , vapor recompression evaporators, condensers- condensation of single vapors, condensation with boiling range, reboilers.

Mass transfer equipment design:

Continuous distillation, design methods for binary systems and pseudo binary systems for multi component distillation. Plate efficiencies, entrainment, approximate column sizing, selection of plate type, plate construction, plate hydraulic design, plate design procedure, plate area, diameters, liquid flow arrangements, entrainment, weep point, weir dimensions, perforated area, hole size, hole pitch, hydraulic gradient, liquid throw, plate pressure drop, down comer design. Packed columns, choice of plate or packing, types of packing, packed bed height, prediction of height of transfer of unit (HTU) liquid distribution, stimulation of pressure drop in packed towers, allowable velocities. Column diameter, column internals. Wetting rates. Reactor design, equations for reactor design application, batch reactor, tubular flow reactor, back mix reactors, expression for reaction rates, mechanical features of reactor design.

Text books

1. Peters M.S and Timmerhaus K.D – Plant design and economics for chemical engineers 4th edition, McGraw Hill Book Co.

Reference books:

1. Backhurst J.R and Harker,J.H – process plant design, Heinemann educational books , London(1973)
2. coulson J.M and Richardson J.F chemical Engineering Vol. VI (an introduction to chemical engineering design) Pergamon press 1993

BTCT-422

FURNACE TECHNOLOGY

UNIT I COMBUSTION PROCESS

Combustion, reaction of combustion process – mechanism of combustion – combustion energy calculations of solid, liquid and gaseous fuels.

UNIT II KILN ACCESSORIES

Equipment for solid fuel combustion – types and classification of burners used for liquid and gaseous fuels – nature of flames – laminar, turbulent, premixed and diffusion flames, burning velocity.

UNIT III FURNACE DESIGN

Factors for consideration – draught establishment – natural/induced draught – measurement of draught – chimney calculation – heat transfer in kilns – safety aspects – types of refractories and insulating material used in furnaces.

UNIT IV KILNS AND FURNACES

Classification of kilns: open top kiln, updraught kilns, down draught kilns, bottle kilns, muffle kilns, chamber kilns, Hoffman's kiln, tunnel kilns, rotary kilns, glass tank furnace, blast furnace, open hearth furnaces.

UNIT – V: TEMPERATURE MEASUREMENTS

Segar cones, Hold Crofts bars, Bullers ring, electrical resistance pyrometer, thermocouple pyrometer, radiation pyrometer, temperature recorders.

Textbook:

1. Shaha. A.K., Combustion Engineering and Fuel Technology., Oxford& IBH Publishing Company, New Delhi 1974

References:

1. Robert D. Reed, Furnace Operations, Gulf Publishing Company, Paris, 1991.
2. Harrold, E .Soisson, Instrumentation in industry, Jhon Weily and Sons, NY 1995.
3. Daneil Rhodes, Kilns Design and Construction and Operation, Chilton Book Company Pennsylvania, 1974
4. Paschiks, V., & Jhon Persson, Industrial Electric Furnaces and Applications, Interscience Publishers, NY 1960

CHE 423- Process Engineering Economics
(Common with chemical Engg.)

Value of money Equivalence: value of money, equations for economic studies, equivalence, types of interest, discrete, continuous, Annuities: Relation between ordinary annuity and the periodic payments. Continuous cash flow and interest compounding, present worth of an annuity, perpetuities and capitalized costs. Bonds and debentures: value of a bond and yields rate.

Depreciation: Types and various methods of calculating depreciations depreciation accounting.

Cost accounting: basic relationship in accounting, ***balance sheet*** and income statement. Various ratios to study the balance sheet and income statements

Cost estimation; cash flow for industrial operations, factors affecting investments and production costs-estimation of capital investment, cost indices, cost factors in capital investment, methods of estimating capital investment. Estimation of total product cost: manufacturing costs and general expenses.

Profitability, alternate investments and replacements. Mathematical methods for profitability evaluation.

Economic production charts for plants operating below 100%, above 100% and under dumping conditions.

General procedure for determining optimum conditions. Break even chart for production schedule and its significance for optimum analysis.

Economic balance in fluid flow, heat transfer and mass transfer operations: optimum economic pipe diameter in fluid dynamics , optimum flow rate of cooling water in condenser in heat transfer and optimum reflux ration in distillation operation.

Economic balance in cyclic operations and semi continuous cyclic operations. Economic balance in yields and recovery, economic balance in chemical reactors, batch and flow reactors .

Textbooks:

1. 1. Peters M.S and Timmerhaus K.D – Plant design and economics for chemical engineers 4th edition, McGraw Hill Book Co.
2. Process Engineering Economics by Herbest E schweyer Mc Graw Hill Book Company.

CHE 425 – CPED Lab *(Common with chemical Engg.)*

1. Sensible heat exchangers (1-2 or 2-4)
2. Condenser and reboiler.
3. Multiple effect evaporator
4. Fractionating column – plate and packed columns
5. Packed bed absorber
6. Continuous tubular reactor (homogeneous and heterogeneous)

BTCT 425- Project work.

Each student is required to submit a report on the project assigned to him by the department. The report should be based on the information in the literature or data obtained in the laboratory/industry.

Report to be in the form of following chapters:-

1. Introduction. **2**. Physical & chemical properties **3**.Literature survey for different processes **4**. Selection of the process **5**.Material and energy balance. **6**. Specific equipment design (process as well as mechanical design with drawing).**7**.general equipment specifications **8**.plant location and layout. **9.** Material of construction. **10**. Health and safety factors **11**.preliminary cost estimation **12**.Bibliography.

Electives for future

Elective -I

CERAMIC RAW MATERIALS

GENERAL GEOLOGY AND MINEROLOGY

Formation of rocks, their characteristics and classification into igneous, sedimentary and metamorphic group – formation of mineral deposits – physical and mineral characteristics of minerals – composition, color, streak, luster, fracture, cleavage, hardness, density and tenacity – elements of optical mineralogy

CLAYS

Clay minerals – clay structure – kaolinite and montmorillonite groups – geology of clay deposits, their classification, china clay, ball clay, fire clay, building clay etc., - beneficiation of clays – mica chlorite, illite group – talc – pyrophyllite, wollastonite group – chemical properties – physical properties.

: FLUXES

Soda and potash feldspar – other feldspars – nephline syenite – geology of formation – physical and chemical properties – beneficiation.

: SILICA AND SILICATE MATERIALS

Silica – polymorphic modification – silica structure – physical and chemical properties of silica – silicate chemistry – minerals –sillimanite, kyanite, andalusite – availability in India and their uses in ceramic industry.

OTHER RAW MATERIALS

Geology of bauxite, magnesite, dolomite, chrome, limestone, rutile, zircon, beryllia minerals, alumina, carbides, nitrides – properties and uses

Textbooks &References:

1. Norton F.H., fine ceramics technology and applications McGraw Hill co;NY,1978.
2. Worrall W.E ceramic raw materials pergamon press, NY 1992.
3. Deer W.A Howie R.A. & J.Rock forming minerals Longman London 1967.
4. Ryan W. properties of ceramic raw materials pergamon press 2nd Edn, 1978.
5. Wilson M.J., clay minerology Chapman & Hall 1955

Elective -II

WHITEWARE AND HEAVY CLAYWARE

CLAASSIFICATION OF WHITEWARE PRODUCTS

Body formulation and properties – tableware, earthenware talc bodies, vitreous bodies, high alumina bodies, porcelain, bone china, sanitary ware, stoneware, majolica, terracotta, artware – physical properties of mixtures – role of water.

WHITEWARE

Classification, body composition, white wares at home, construction, electrical appliances, industrial uses – manufacturing and properties.

HEAVY CLAYWARE

Raw materials – methods of winning and handling –classification of building materials – manufacture of building bricks, hollow bricks and other bricks – roof tiles, paving tiles – sewer pipes.

FINE CERAMICS

Packing of two component system – porosity – effect of grain size, unfired porosity – experimental verifications – wet to dry contraction – unfired strength – permeability and casting rate – dry to fired contraction.

TESTS AND QUALITY CONTROL

IS inspection – LOI, plasticity, strength, MOR, thermal shock resistance, abrasion resistance, porosity, acid and alkali resistance – chipping resistance – chemical analysis – electrical and thermal conductivity?

Text books& References :

6. Allen Dinsdale, Pottery Science: Materials, Processes and Products, Ellis Horwood Ltd., NY, 1986.
7. Sudhir Sen, Ceramic White Ware, Oxford & IBH Publishing Co., New Delhi, 1992.
8. F. Singer and S. Singer, Industrial Ceramics, Oxford & IBH Publishing Co.,. 1991.
9. Ryan, W and Radford, C. Whitewares: Production, Testing and Qualist Control, Pergamon Press., NY, 1987.
10. Richard Zakin, Ceramic, A & C Black, 1990.

Terpstra, Ceramic Processing, Chapman and Hall, 1995

Elective -III

FUELS, REFRACTORIES & FURNACE

Part A

Wood, charcoal and coal characteristics – formation of coal, grading of coal – handling of storage of coal – coal washing – hardness and grindability of coal – calorific value – manufacture of coal –coal analysis.

Origin and composition of natural oil – refining process of liquid petroleum products - synthetic liquid products – calorific values – storage and handling liquid fuels. Natural gas – composition and calorific values – liquefied petroleum gas – oil gas – coal gas

Air requirement – combustion process of solid, liquid and gaseous fuels – control of combustion process – testing of fuels.

Part B

SILICA REFRACTORIES

Raw materials and composition – manufacturing process steps – quality of raw materials and process parameter on quartz inversion – glassy phase and other micro structural features – porosity, strength, RUL dependence on micro structure – specifications of silica refractories.

ALUMINA – SILICA REFRACTORIES

Al_2O_3 – SiO_2 phase diagram – clay, pyrophyllite, sillimanite, grog, bauxite and diaspore as raw materials – manufacturing processes – micro structure and properties

BASIC REFRACTORIES

Magnesite, forsterite, dolomite and chrome based refractories – raw materials and composition – manufacturing processes – micro structure and properties.

SPECIAL REFRACTORIES

Oxide based, carbide based and nitride based refractories – cordierite – zirconia – carbon – fusion cast refractories, slide gate, purging refractories, and continuous casting refractories – ceramic fibres.

Part C

KILN ACCESSORIES

Equipment for solid fuel combustion – types and classification of burners used for liquid and gaseous fuels – nature of flames – laminar, turbulent, premixed and diffusion flames, burning velocity.

FURNACE DESIGN

Factors for consideration – draught establishment – natural/induced draught – measurement of draught – chimney calculation – heat transfer in kilns – safety aspects – types of refractories and insulating material used in furnaces.

KILNS AND FURNACES

Classification of kilns: open top kiln, updraught kilns, down draught kilns, bottle kilns, muffle kilns, chamber kilns, Hoffman's kiln, tunnel kilns, rotary kilns, glass tank furnace, blast furnace, open hearth furnaces.

Textbook:

1. A. K. Shaha., Combustion Enineeringg & Fuel Technology, Oxford & IBH Publishing Company, New Delhi, 1974.
2. M. Coop and E. M Piekson, Raw Materials for the refractory industries and industry materials and consumer survey, 1981.
3. Shaha. A.K., Combustion Engineering and Fuel Technology., Oxford& IBH Publishing Company, New Delhi 1974

References:

1. Wilfrid Francis & Matin C. Peter, Fuels & Fuel technology., Pergamon Press 1980.
2. Samir Sarkar, Fuels & Combustion, 2nd edn. Orient Longman, Bombay 1990.
3. J.D. Gillchrist , Fuels, Furnaces & Refractories,Pergamon Press, NY, 1977.
4. Om Prakash Guptha, Elements of fuels, furnaces & Refractories, Khanna Publishers 1995.
5. J.P Holman, Heat transfer, Mc Graw Hill 1997.
6. J. H. Eheslers Refracrtories: production and Properties. Iron and Steel Institute, London, 1972.
7. Akira Nistrikawa, Technology of monolithic refractories, Plibrico japan co. Tokyo 1984
8. D.N. Nandi, Hand Book Refractory's, Tata Mc Graw hill publishing Co. New Delhi 1991
9. K.Shaw, Refractories and thick uses ADP sciences publisher U K 1972
10. Keishi GOTON, Powder Technology Hand Book, Marcel Dekker Inc. 1997
11. Chester J.H., Steel Plant Refractories, 2nd Edition, 1973, United Steel Companies Limited, Sheffield UK8.Advances in Refractory Technology, Ed. Robert E Fisher, Ceramic Transaction Vol 4., American Ceramic society, 1990, Westerville, Ohio, USA.
12. Robert D. Reed, Furnace Operations, Gulf Publishing Company, Paris, 1991.
13. Harrold, E .Soisson, Instrumentation in industry, Jhon Weily and Sons, NY 1995.
14. Daneil Rhodes, Kilns Design and Construction and Operation, Chilton Book Company Pennsylvania, 1974
15. Paschiks, V., & Jhon Persson, Industrial Electric Furnaces and Applications, Interscience Publishers, NY 1960

(Elective Lab)
WHITEWARE AND HEAVYCLAY WARE LAB

11. Preparation of ceramic slip in a pot mill
12. Determination of slip specific gravity.
13. Determination of slip viscosity.
14. Effect of water on viscosity of slip.
15. Effect of deflocculant on viscosity of slip.
16. Determination of residue in a slip.
17. Plaster mould making.
18. Making of solid slip cast article.
19. Making of drain slip cast article.
20. Biscuit firing.