

**Faculty of Engineering & Technology**

**Department of Cement Technology**

**B.Tech. (Cement Tech.)**

**Semester- III**

**TEACHING & EXAMINATION SCHEME**

<b>Code No.</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total Credit</b>
04MS301	Engineering Mathematics III	3	1		4
04CT302	Process Calculation	3	1		4
04ME303	Fundamental & Advance Thermodynamics	3	1		4
04ME304	Strength of Material	3	1		4
04GE307	Geology and Mining of Limestone Deposit	3	1		4
04ME351	Strength of Material Lab			2	1
04ME352	Fundamental & Advance Thermodynamics Lab			2	1
04CT353	Testing of Cement Raw Materials Lab			2	1
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**Semester- IV**

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<b>Code No.</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
04ME401	Heat & Mass Transfer	3	1		4
04CT406	<b>Elective</b>	3	1		4
04CT403	Size Reduction & Pre Homogenization	4	1		5
04ME404	Fluid & Fluid Particle Mechanics	4	1		5
04EE405	Electrical Engineering in Cement Industry	4	1		5
04ME451	Fluid & Fluid Particle Mechanics Lab			2	1
04CT452	Size Reduction & Pre Homogenization Lab			2	1
04EE453	Electrical Engineering in Cement Industry Lab			2	1
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**Elective- (Choose any one of these)**

04CT406-A                      Raw Mix Design & Chemistry of Cement

04CT406-B                      Use of Low Grade Limestone in Cement Manufacture

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**Semester- V**

**TEACHING & EXAMINATION SCHEME**

<b>Code No</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total Credit</b>
04CT501	Refractory Engineering	3	1		4
04CT502	Pyro processing & Clinker manufacture	3	1		4
<b>04CT503</b>	<b>Elective</b>	3	1		4
04CT504	Fuels & Firing system	3	1		4
04EV505	Environmental Engineering	4	1		5
<b>Elective Lab</b>					
04CT554-A	Energy Management Lab			2	1
04CT552	Environmental Engineering Lab			2	1
04CT553	Fuels & Firing System Lab			2	1
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**Elective**

**04CT503-A      Energy Management**

**04CT503-B      Industrial Economics**

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**Semester- VI**

**TEACHING & EXAMINATION SCHEME**

<b>Code No</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total Credit</b>
04CT601	Instrumentation & process control	3	1		4
04CT602	Maintenance Practices in Cement Plant	4	1		5
04CT606	Alternate Fuel & Raw Materials for Cement Production	3	1		4
04CT604	Total Quality Management	3	1		4
04CT607	<b>Elective</b>	3	1		4
04CT651	Testing of Concrete Lab			2	1
04CT652	Testing of Cement by BIS Method Lab			2	1
04CT653	Instrumentation Lab			2	1
					<b>24</b>

**Elective- (Choose any one of these)**

04CT607-A            Special Cements & Performance of Cement

04CT607-B            Concrete Technology

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Semester- VII

#### TEACHING & EXAMINATION SCHEME

Code No	Subject	L	T	P	Total Credit
04MT701	Project & Plant Management	3	1		4
04CT702	Designing of Cement Plant	3	1		4
04CT703	Material Handling System & Safety in Cement Plant	4	1		5
04CT704	Optimization Technique	3	1		4
	<b>Elective</b>	3	1		4
04MM706	Marketing of Cement	3	1		4
04CT751	Application of Cement Lab			2	1
04CT752	Application Software Lab			2	1
04CT753	Advance Method of Cement & Clinker Testing Lab			2	1
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### Electives

Student will select one out of the below three subjects as elective

1. **04CT705-A** EIA and EMP of cement plant
2. **04CT705-B** Energy Audit in Cement Plant

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**Semester- VIII**

**TEACHING & EXAMINATION SCHEME**

<b>Code No</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total Credit</b>
<b>Choose any one of these</b>					16
04CT851-A	Project work- seminar and viva				
04CT851-B	20 Weeks Sandwich Training in Plant- seminar and viva				
					16

## B.Tech. (Cement Tech.)

### Semester- III

#### Process Calculation

**Objective:** This course is designed such that a student can understand the problem of Process Calculations in cement manufacture

**Course Content:**

Unit-I:	Basic and derived units, use of model units in calculations, Methods of expression, compositions of mixture and solutions, Ideal and real gas laws - Gas constant - calculations of pressure, volume and temperature using ideal gas law, Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.
Unit-II	Stoichiometric principles, application of material balance to unit operations like distillation, evaporation, crystallization, drying etc., Material balance with chemical reaction, Limiting and excess reactants, recycle, bypass and purging.
Unit-III	Unsteady state material balances, calculation of absolute humidity, molal humidity, relative humidity and percentage humidity, use of humidity in condensation and drying, Humidity chart, dew point.
Unit-IV	. Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels, calculation of excess air from orsat technique and problems, heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy.
Unit-V	Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction, effect of pressure and temperature on heat of reaction, Energy balance for systems with and without chemical reaction, unsteady state energy balances. Introduction to Computer aided calculations-steady state material and energy balances

**Text Books:**

1. Bhatt, B.L., VORA, S.M., "Stoichiometry ", Tata McGraw-Hill, 1976.
2. Hougen, O.A., Watson, K.M and Ragatz, R.A., " Chemical Process Principles Part-I ",John Wiley and Asia Publishing, 1970.
3. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering ",Fourth Edition, Prentice Hall Inc., 1982.

**Reference Books:**

1. Whitwell, J.C., Tone, R.K. "Conservation of Mass and Energy ", McGraw-Hill, 1973.
2. Process Calculation for Chemical Engineering, Second Revised Edition, Chemical Engineering Education Development Centre, I.I.T., Madras, 1981

## B.Tech. (Cement Tech.)

### Semester- III

#### Fundamental and Advance Thermodynamics

**Objective:** This course is designed such that a student can understand the Fundamental and Advance Thermodynamics for clinker manufacture

**Course Content:**

Unit -I	Fundamental concepts in thermodynamics: heat and work, the first law of thermodynamics, joule's experiment, Internal energy, state functions, enthalpy, steady-state steady-flow processes, equilibrium and the phase rule, reversible processes, processes at constant volume and constant pressure, heat capacities, thermodynamics analysis of control volume, unsteady flow processes, charging and discharging of vessel.
Unit -II	Volumetric properties of pure fluids, P-V-T diagrams, Ideal gas, virial equation and its applications, cubic equations of state, generalized correlations for gases and liquids.  THERMAL EFFECTS: Sensible heat and latent heat. Standard heat of formation, heat of reaction and heat of combustion, effect of the temperature on the heat of reaction, the second law of thermodynamics, statement of the second law, heat engines, carnot cycle, thermodynamic scale of temperatures, entropy, the third law of thermodynamics.
Unit -III	Thermodynamic properties of pure fluids, maxwell's equations, helmholtz and gibbs functions. residual properties. two-phase systems, tables and diagrams of thermodynamic properties of gases and liquids. Cycles for conversion of heat into power, refrigeration and liquefaction, thermodynamic analysis of processes.
Unit -IV	An Introduction to vapour-Liquid Equilibria, qualitative behaviour of the vapour-liquid equilibria (VLE), Simple models for vapour liquid, equilibria: Raoult's and henry's laws, dewpoint and bubble point calculations, VLE by modified raoult's law and K-value correlations. Flash calculations.
Unit -V	Solution Thermodynamics, Applications Liquid phase properties from VLE data. Fugacity. Activity coefficient. Excess Gibbs energy. Data reduction. Thermodynamic consistency. Models for the excess Gibbs energy. Local composition models. Property changes of mixing. Heat effects of mixing processes.

**Text Book :**

1. Thermodynamics an engineering approach- 5<sup>th</sup> edition, Yunus A Cengel
2. Introduction to Chemical Engineering Thermodynamics, 7/e, J.M Smith , H.c Van ness

**Reference Book:**

1. Chemical Engineering Thermodynamics-I; K A Gavhane: Nirali Prakashan

## **Thermodynamics Lab.**

### **List of Experiments :**

1. Experimental Measurement of P-V-T data Experiment
2. 2: Measurement of activity coefficient at infinite dilution by using gas chromatograph
3. Measurement of Vapor-Liquid Equilibrium Data
4. Refrigeration cycle experiment
5. Determination of partial molar enthalpies by adiabatic calorimetric
6. Ebulliometric determination of vapour pressure
7. Ebulliometric determination of infinite dilution activity coefficient
8. Verification of Debye Huckel Theory
9. To prove the Boyle Marriott law
10. To determine joule Thomson coefficient of Argon

## B.Tech. (Cement Tech.)

### Semester- III

#### Strength of Materials

**Objective:** This course is designed such that a student can understand strength of the materials

**Course Content:**

Unit –I:	<p><b>Simple Stress and Strains:</b> Introduction types of loads and deformation, types of stresses and strain. Hooke's law, stress strain diagram for ferrous and non ferrous materials modulus of elasticity. Rigidity and bulk modulus of materials Stress in bars of varying cross sections, composite sections and compound sections Thermal stresses and strains ,thermal stresses in composite section. Poisson's ratio, volumetric strain, relation between different modulus, strain energy, resilience, proofresilience, modulus of resilience suddenly applied loads and impact loads..</p>
Unit-II	<p><b>S.F. and B.M. Diagrams:</b> Definition, types of loading types of beams, shear force and bending moment sign conventions S.F. and B.M. diagrams for cantilever simply supported and overhanging beams with point or concentrated loads uniformly distributed loads and combination of point and U.D.L. Point of contra flexure, numerical problems.</p> <p><b>Principal Planes and Principal Stresses:</b> Stresses on inclined plane subjected to direct shear or combination of stresses in two mutually perpendicular planes. Principal planes and principal stresses, analytical and graphical methods.</p>
Unit-III	<p><b>Bending Stresses in Beams:</b> Theory of simple bending as assumptions made in simple bending theory position of neutral axis, surface moment or resistance. Modulus of section of symmetrical sections such as rectangular, circular and I sections, bending stresses in symmetrical sections. Simple problems. Reinforced concrete beams, beam of uniform strength.</p> <p><b>Shear Stresses in Beams.:</b> Introduction shear stress equation, assumptions made, distribution of shear stresses over various sections, such as rectangular, circular and I,L &amp; T sections, Simple numerical problems.</p> <p><b>Deflection of Beams:</b> Introduction Strength and stiffness of beam curvature of bent beam, Derivation of equation for slope and deflection of beam in case of cantilever and simply supported beam loaded with point loads U.D.L. and combination. Simple numerical problems. Importance of deflection and practical applications.</p>
Unit-IV	<p><b>Torsion of Shaft:</b> Definition of torsion relation between stress, strain and angle of twist assumptions made strength of solid and hollow circular shaft, polar moment of inertia. Calculation of shaft diameter on the basis of strength and stiffness for the given horse power transmitted torsional rigidity. Maximum torque comparison of solid and hollow shaft size of shaft for a given torque.</p>
Unit-V	<p><b>Spring:</b> Definition types and use of springs, leaf spring, helical and spiral springs, Stiffness of a spring and maximum shear stress, deflection of spring. Spring Classification based on size shape and load.</p> <p><b>Columns and struts:</b> Definitions crippling load different end conditions, slenderness ratio, equivalent length, Euler's theory Rankine's formulae, radius of gyration, Rankine constant for different materials Limitations of Rankine formula simple problem B.I.S. code for columns.</p> <p><b>Stresses in Frames:</b> Definition of frame, perfect ,deficient and redundant frame.</p>

**Text Books:**

1. Strength of Materials : R.S. Khurmi
2. Strength of Materials: K.D. Sexena
3. Laboratory Experiments In Strength of Materials : B.D. Sharma
4. Strength of Materials :Ryder.

**Reference Books:**

5. Strength of Materials. B.C. Punmia.
6. Strength of Materials: Sadhu Singh.
7. Strength of Materials: S. Ramamuruthan.

**Strength of Materials Practical****List of Experiment:**

1. Study and demonstration of Universal Testing Machine &its attachments
2. Tension Test on mild steel, Aluminium & compression test on Bricks and Concrete block on Universal Testing Machine.
3. Direct Shear Test of mild steel on Universal Testing Machine.
4. Brinell Hardness Test on Mild Steel.
5. Rockwell hardness Test on Hardened Steel.
6. Izod & Charpy- Impact tests of a standard specimen
7. Torsion Test on Mild steel bar.

## B.Tech. (Cement Tech.)

### Semester- III

#### Introduction to Cement and Cement Raw Materials

**Objective:** History of Cement and Binding Materials, chemical and Physical characteristic of Cement Raw materials.

**Course Content:**

Unit –I:	<b>Introduction to Cement and Binding materials :</b> History of binding materials and Cement, Classification of Cement Binders, Lime as Binder, cement and its importance in construction, Cement and its Raw Mill Composition, History of Cement manufacturing process, material composition of cement, various unit operation of cement manufacture, the present status and future of cement industry in India.
Unit-II	<b>Types of Cement-I:</b> Description and use of various type of Cement such as, Ordinary Port Land Cement ( OPC -33 grade , 43 grade and 53 Grade ) , Portland Pozzolana Cement ( PPC), Portland Slag Cement ( PSC),
Unit-III	<b>Type of Cement-II:</b> Ordinary & Rapid Hardening Portland cement, Extra Rapid Hardening Portland cement, Sulphate Resisting Portland cement, Low – Heat Portland cement, Oil well cement, White Portland cement, Coloured Portland cement, Water Repellent and Hydrophobic Portland cement , Masonry cement, Expansive cement, K – type Expansive , M – type Expansive , S – type Expansive, Portland Pozzolanic cement, Super Sulphate cements, High Early Strength cement, Alinite cement, Belite cement, Early strength cement,
Unit-IV	<b>Calcareous Raw Materials:</b> Source of Lime, Limestone, Chalk, Marl, Industrial wastes as cement Raw materials
Unit-V	<b>Argillaceous Raw Materials:</b> Source of Silica, Alumina, Iron Oxide, Shale and effect of coal ash and additives use as corrective materials, Fly ash , Slag, sludge as cement raw materials.  <b>Additives and Gypsum :</b> Origin and occurrences, distribution/ availability in India, Physical and Chemical Characteristics of various additive in India such as Bauxite, Iron Ore , Laterite, and gypsum

**Text Books:**

1. Chemistry of Cement and Concrete: F M Lea, Arnold, London
2. Cement Data Book: W. H Duda , Verlag G m Bh,Berlin.

**Reference Books:**

1. Norms for limestone exploration for cement manufacture : NCCBM
2. Text Book of Geology : P K Mukherjee
3. Geology of India and Burma : MS Krishnan, CBS Publisher and Distributer, Delhi

## Testing Cement Raw Materials

### List of Experiment

1. Chemical analysis
  - a. Determination of Total Carbonate ,  $\text{CaCO}_3$  and  $\text{MgCO}_3$  of limestone
  - b. Chemical analysis for Major Constituents ( LOI, CaO,  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{Fe}_2\text{O}_3$ , MgO)
  - c. Chemical analysis for minor constituents (  $\text{TiO}_2$ ,  $\text{P}_2\text{O}_5$ ,  $\text{Mn}_2\text{O}_3$ , Chloride )
2. Physico Mechanical Analysis of limestone
  - a. Colour and Texture
  - b. Bulk Density Porosity
  - c. Moisture Content
  - d. Hardness
  - e. Compressive Strength
3. Gypsum: Determination of  $\text{SO}_3$  & Moisture

## B.Tech. (Cement Tech.)

### Semester- III

#### Geology and Mining of Limestone

**Objective:** The Course has been design to give the knowledge about the geological origin, distribution in India, chemical and physical characteristic of cement grade limestone and the mining practices to supply homogeneous material from the limestone quarry/mines.

#### Course Content:

Unit –I:	<b>Introduction to Stratigraphy &amp; Geology of Limestone</b> :Introduction to Indian stratigraphy and distribution of limestone, origin & formation of calcareous rocks, Brief idea about Structural Geology: fold, fault, joint, unconformities:, Igneous , Sedimentary and Metamorphic rocks.
Unit-II	<b>Distribution and characteristic of Cement Grade Limestone</b> :Physical and Chemical characteristic of limestone, Classification cement grade limestone deposits. Distribution of cement grade limestone deposits in India and its physical and chemical characteristics, Petrographic study of Limestone
Unit-III	<b>Limestone Requirement for Cement Plant</b> :National Inventory of Cement grade limestone deposits of India, Requirement of limestone for various capacity of Cement plant and its physical and chemical requirements, UNFC Classification of Limestone Deposits.
Unit-IV	<b>Exploration and Deposit Evaluation</b> :Phases of Geological Exploration with reference to limestone deposits , Brief idea about Geological Mapping, Surveying , Sampling practices, Recoding of Exploration Data, Preparation of Geological Maps and section, Methods of Reserve estimation, Statistical and Geo Statistical evaluation of Bore Hole data , Computer Aided Deposit evaluation and Development of 3-D Deposit Model,
Unit-V	<b>Mining of Limestone:</b> Introduction to surface mining, method of mining of limestone deposits, estimation of block size and bench height, estimation of block wise bench wise grade and tonnage, selection of mining equipment ( Excavator, Dozer, Dumper etc.) , Blasting techniques, type of explosive use, Mine production scheduling and planning , Advance method of limestone mining, Pit Head Quality Control practices. Brief idea about PL and ML application, EIA and EMP of Limestone Mines

#### Text Books:

1. Text Book of Geology : P K Mukherjee
2. A Hand book on Surface Mining Technology : Samir Kumar Dash, Sagar prakashan, Khargpur
3. Cement & Concrete Science & Technology , Vol-I , Part- II : S N Ghosh
4. Norms for limestone exploration for cement manufacture : NCCBM
5. National Inventory of cement grade limestone deposits in India : NCCBM
6. SME, Mining Engineering Hand Book; Arthur B. Cummins, Ivan A. Given: Society of Mining Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers, Inc, New York.

## B.Tech. (Cement Tech.)

### Semester- IV

#### HEAT AND MASS TRANSFER

**OBJECTIVE:** To impart knowledge on aspects of heat and mass transfer operations in cement clinker manufacturing process.

#### Course Content:

Unit –I:	Introduction to heat transfer and general concepts of heat transfer by conduction, convection and radiation, Conduction: Basic concepts of conduction in solids, liquids, gases, steady state temperature fields and one dimensional conduction without heat generation e.g. through plain walls, cylindrical and spherical surfaces, composite layers, etc. Insulation materials, critical and optimum insulation thickness. Extended surfaces, fins and their applications. Introduction to unsteady state heat transfer.
Unit-II	Convection: Fundamentals of convection, Basic concepts and definitions, natural and forced convection, hydrodynamic and thermal boundary layers, laminar and turbulent heat transfer inside and outside tubes. Dimensional analysis, determination of individual and overall heat transfer coefficients, heat transfer in molten metals.  Radiation: Basic laws of heat transfer by radiation, black body and gray body concepts, view factors, Kirchhoff's law, solar radiations, combined heat transfer coefficients by convection and radiation.
Unit-III	Heat Exchange Equipment: shell and tube heat exchangers, double pipe heat exchangers, NTU, HTU
Unit-IV	Definition, Ficks Law, Flux equation, Molecular diffusion in gases, Steady state diffusion of A through non diffusing B, Steady state equimolar counter diffusion. Problems. Analogy between mass transfer and heat transfer, film theory, surface renewal theory, penetration theory, equilibrium.
Unit-V	Concepts & general principles, equilibrium Rate of drying curve, time of drying, Problems based on above topic. Drying equipments- Tray drier, Rotary drier, Drum drier, fluidized bed drier, Pneumatic drier, applications Important mass transfer operations: absorption , adsorption, humidification

#### TEXT BOOKS / REFERENCE BOOKS

1. Unit Operations of Chemical Engineering, Tata McGraw Hill, New Delhi. McCabe, W. L., Smith, J. C. and Harriot, P
2. Unit Operations, CBS Publishers, New Delhi. Brown, G. G
3. Process Heat Transfer, McGraw Hill, New Delhi, Kern, D. Q
4. Mass Transfer Operations, McGraw Hill, New Delhi Treybol, R. E

**B.Tech. (Cement Tech.)**

**Semester- IV**

**RAW MIX DESIGN & CEMENT CHEMISTRY**

**Objective:** The objective of the course to understand chemical aspect of cement, its composition, manufacture process and its influence on performance of cement & concrete

**Course Content:**

Unit -I:	Sampling and pre blending of cement raw materials, estimation of Silica Modulus, Alumina Modulus, Hydraulic Modulus, Lime Saturation Factor, Liquid Content, method proportioning, 2,3 and 4 component mixes, impact of moduli values on cement manufacturing process and quality of clinker, calculation of lime consumption factor
Unit-II	Cement manufacturing process, chemical composition of various types cement, Introduction to phase rule, phase diagram: Alite , Belite, aluminat and Ferrite phase, cement component and their phase relation, Binary and ternary compounds of cement and formation of eutectic,
Unit-III	Bauge's calculation, clinker minerals , absorption of constituents in clinker phases, chemical reaction during clinkerisation, Role of minor constituents in clinkerization , Thermo chemistry of clinker formation
Unit-IV	Mineralizer, Role of additive in clinker formation, various mineralizer and fluxes, their role in manufacture of clinker,
Unit -V	Hydration of calcium silicate phases, role of gypsum in cement hydration process, hydration of Portland cement, hydration of Portland cement at increased temperature

**Text Books / Reference Books :**

1. Chemistry of Cement and Concrete, Arnold, London.: F. M. Lea,
2. Cement Data Book: W. H Duda , Verlag G m Bh,Berlin
3. Chemistry of Portland Cement, Reinhold, New York :R. H. Bouge

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### Semester- IV

#### SIZE REDUCTION AND PREHOMOGENISATION

**Objective:** The purpose of this course is to familiarize with unit operations and practices related to size reduction, homogenization, blending and controls in a cement plant.

**Course Content:**

Unit –I:	<b>Particle Size Analysis:</b> Sieve analysis, cumulative and fractional plot, size distribution, size averaging and equivalence, size estimation in sub-micron range. Optimum sizes at various stages from extraction from mines. Influence of size fraction on reactivity of lime stone. Screening equipments such as grizzlies, stationary, vibrating, curved and DSM screens & screen capacity.
Unit-II	<b>Size Reduction:</b> Laws of size reduction (Bond's, Rittinger's & Kick's); energy requirement in size reduction; work index. Theory of crushing & grinding; crushing efficiency; size reduction machinery crushers such as Jaw crusher, gyratory crushers, impact crushers, roll crushers and cone crushers; Grinders such as hammer mills, roller mills and ball mills & tube mills.. <b>Grinding System:</b> Tube mill system, Roller Press, Hybrid/ Pregrinding system, Vertical Roller Mill(without separator), Finish Grinding system
Unit-III	<b>Material Handling:</b> Various systems of material handling; haulage and transportation from mines, trucks, dumpers etc. <b>Conveying of Solids:</b> Conveyor selection, classification of conveyors, conveyors such as belt, screw, chain, vibratory, apron. Pneumatic and hydraulic transportation of solids; pneumatic conveying systems.
Unit-IV	<b>Storage of Solids:</b> Bins, silos, hoppers & feeders; storage of raw materials in piles <b>Size Classification and Air Separators:</b> Methods of size classification, principles of air separators, and different types of air separators used in cement manufacturing. Wet classification; hydro-cyclones; cyclone material balances in open circuit and closed circuit operations & separating efficiency.
Unit-V	<b>Blending &amp; Prehomogenization:</b> Preparation of cement raw meal as per raw mix design, combined & segregated pre-homogenization, Methods of prehomogenisation, Types of homogenisation silos: discontinuous batch homogenisation silos , continuous overflow homogenizing silos , continuous homogenizing silos stacking of blending beds , Chevron method , Windraw method , Areal stock piling , Axial stock piling, continuous stock piling ,Alterative stock piling Equipments used for reclaiming material from stockpiles such as scraper, bucket wheel, bucket wheel with slewing boom and drum re-claimers. Blending bed theory; batch & continuous homogenization; Fuller's one-eight blending method. Stacking of blending beds namely in longitudinal & circular stockpiles system & their comparison.

**Text Books / Reference Books :**

1. Cement Data Book: W. H Duda , Verlag G m Bh,Berlin
2. Cement Engineers Hand Book: Labhaanand Kolhaans
3. Operational Norms for cement plant: NCCBM publication

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**Semester- IV**

**FLUID & FLUID PARTICLE MECHANICS**

**Objective:** This course is designed such that a student can understand the problem of fluid flow, size reduction and related areas

**Course Content:**

Unit –I:	<b>Properties of fluids:</b> viscosity , thermodynamic properties ,compressibility and bulk modulus , surface tension and capillarity ,vapour pressure and cavitation, fluid statics, Forces on fluids, pressure depth relationship for compressible and incompressible fluids, Forces on submerged bodies: buoyancy and floatation, Rigid body motion, pressure measurements: simple manometers ,differential manometers
Unit-II	<b>Kinematics of flow:</b> Description of velocity field and acceleration, velocity potential and Stream functions, Fluids in circulation, Irrotational flow, types of motion, vortex flow, continuity equation, Dimensional analysis, Buckingham Pi Theorem, Rayleigh Method, Dimensionless numbers and their physical significance
Unit-III	<b>Dynamics of Fluid flow:</b> Laminar and turbulent flows, Pressure drop in pipes, pipe fittings and pipe network, friction factor, Conservation of mass, momentum and energy, Mechanical engineering Bernoulli's equation, Euler's equation of motion, Bernoulli's equation from Euler's equation
Unit-IV	<b>Flow measuring devices for chemical plants:</b> venturimeter, orifice meter, nozzle, Rotameter, pitot's tube and notches and weirs. Turbulent Flow: Reynold's experiment, friction loss in pipe flow ,shear stress in turbulent flow Boundary layer flow, separation of boundary layer, Drag and lift, Flow in open channels
Unit-V	Pumping and compressing of chemicals and gases, reciprocating pumps, slip of reciprocating pumps , rotary pumps, centrifugal pumps and blowers, priming of centrifugal pumps , cavitation, suction lift , NPSH and calibrations, mixing and agitation, types of mixers and their selection, power requirement, compressible fluid flow

**Text Books / Reference Books :**

1. Fluid Mechanics and its application: Guta ,V and Gupta, S.K.
2. Element of Fluid Mechanics: Seshdri, E .V and Patankar, S . V.
3. Unit Operation Of Chemical Engineering: McCabe, W. L., Smith, J. C and Harriot, P: Tata Mcgraw Hill, New Delhi
4. Unit Operations : CBS Publisher , New Delhi :Brow, G. G. :
5. Fluid Mechanics and its Applications, Gupta, V. and Gupta, S. K.,
6. Elements of Fluid Mechanics, Prentice Hall of India, : Seshadri, E. V. and Patankar, S. V

**B.Tech. (Cement Tech.)**

**Semester- IV**

**ELECTRICAL ENGINEERING IN CEMENT INDUSTRY**

**Objective:** This course is designed such that a student can understand the basic concept of electrical engineering especially used in cement plant.

**Course Content:**

Unit-I:	<b>Generation of Electrical Energy.</b> Specific and annual KWH-consumption, Types of generating stations, Own power plant or public utility supply, Supply from public utility, Maximum demand, Investment cost of electrical equipment.
Unit-II	<b>Switchgears in Electrical system.</b> Main Switchgear, Secondary medium tension switchgear, Low tension switchgear, Safety Regulation. <b>Underground Cables:</b> - Medium tension cables, Cable dimensions, Laying of Cables, Low tension cables.
Unit-III	<b>Protection devices in electrical system.</b> Protection devices, protection and monitoring devices for large motors, protection and monitoring device for large motors, Electric protection, Under voltage protection, Over current & short circuit protection, Differential protection, Thermal protection, Motor starter with overload protection, Ground protection, Lightning protection, starter ground fault.
Unit-IV	<b>Distribution System.</b> Power Distribution, Criteria for various distribution concepts, Limits between high, Medium and low voltage, Example of distribution concepts, Quarry power distribution, Medium voltage power distribution (6 KV, 4, 160 V), Low Voltage power distribution (600 V or less), Emergency Power supply.
Unit-V	<b>Electrical Machines.</b> Transformers, motors variable speed motors, Motor Starters, Motors for special purpose. <b>Electrical Devices:-</b> Motor control center, MCC-survey, constant speed motors, Power factor correction, Dual starter adjustable torque drive motor, Sector motor, Drive motors for roller mills

**Text Books:**

1. Engg. Circuit Analysis , Mc Graw Hill: W.H.Hayt & J.E. Kemmerly
2. Principles of Electrical Engg. – PHI: Del Toro
3. Cement Data Book: W. H Duda , Verlag G m Bh,Berlin

## **ELECTRICAL ENGINEERING LAB**

### **List of Experiment**

1. To draw open circuit characteristics (E to  $I_f$ ) and load characteristics for a self excited DC generator
2. To draw open circuit characteristics (E to  $I_f$ ) and load characteristics for a separately excited DC generator
3. To find the self and mutual inductance of a transformer
4. To perform short circuit and open circuit test for a single phase transformer and hence find the core losses and copper losses and other transformer parameters associated with it.
5. To study and plot V-I characteristic of thyristor
6. To find maximum  $dv/dt$  and  $di/dt$  limit of thyristor
7. To study the forced commutation circuit of thyristor and to find out its commutation period
8. To study different chopper circuit using thyristor.
9. Verification of thevenin theorem
10. Verification of maximum power transfer theorem

## **FLUID MECHANICS LAB**

### **List of Experiment :**

1. Determination of discharge through a given venturimeter and Orifice meter
2. Determination of discharge through Pitot Tube.
3. Determination of  $C_c$ ,  $C_v$ , and  $C_d$  for different type of orifices and mouth pieces
4. Determination of loss of head due to sudden enlargement & friction in pipe
5. Determination of Discharge through different type of notches
6. Study of reciprocating pump

## **SIZE REDUCTION LAB**

### **List of experiments**

1. To study the performance of Ball Mill and find out its crushing efficiency.
2. To study the performance of Jaw Crusher and find out its crushing efficiency.
3. To study the performance of Crushing Rolls and find out its crushing efficiency.
4. To study the settling characteristics.(Free & Hindered settling) of a given suspension of particles.
5. To study the filtration characteristics of rotary vacuum filter.
6. To carry out differential and cumulative screen analysis of given sample of solid particles.

**B.Tech. (Cement Tech.)**

**Semester- V**

**REFRACTORY ENGINEERING**

**Objective:** This course is designed such that a student can understand the refractories and its use in cement Plant

**Course Content:**

Unit-I	Fundamentals of refractory, their classification, importance of refractories for cement production, types of refractories, its application, factors effecting wear of refractories in cement industry. Castables, its types and composition, mortars
Unit II	Drying and firing phase diagram, manufacture and properties of silica, alumina silicate refractories, periclase, magnesite, magnesite- chrome, dolomite, high and low temperature insulating refractories, acid proof bricks and carbon based refractories,
Unit III	Properties and measurement of porosity, bulk density, fusion point, permeability, cold crushing strength, refractoriness under load, hot modulus of rapture , creep behaviour, abrasive resistance, thermal conductivity , thermal expansion& spelling, reaction of refractories, Slag, glasses, Carbon monoxide, acids, alkalise, flue gases, corrosion of regenerated refractories by flue gases
Unit IV	Subdivision of burning process & selection of refractory in kiln drying zone, preheating zone, calcining zone, transition zone, sintering zone, cooling zone, lining of preheater, kiln hood, coolers, features of refractory installation (brick joints, lining methods, rotating methods, screw jack method etc)
Unit- V	Selection of refractories and castables for different location of Cement plant, Procedure for laying start up and stoppage of kiln for cement plant, measures to improve refractory life in rotary kiln in cement plant, cost effectiveness, case studies for payback calculation

**Test Books:**

7. Refractory Engineering and Kiln Maintenance in Cement Plant: J P Saxena, CRC Press, Technology & Engineering
8. Refractory Lining of Cement Kiln System : Process Technology: Cement Seminar, Holderbank

**Reference Books:**

9. Hand Book of Industrial Refractories Technology: Stephen C, Carniglia Godon L Barma, Noyes Publication
10. Refractory Linings: Thermo mechanical Design and Applications: Charles Schacht, CRC Press, Technology & Engineering

## B.Tech. (Cement Tech.)

### Semester- V

#### PYROPROCESSING AND CEMENT MANUFACTURE

**Objective:** This course is designed such that a student can understand the Pyroprocessing of Rotary Kiln and manufacturing of Clinker .

#### Course Content:

Unit –I:	Types of kiln, Rotary Kiln, different type of clinkerisation process, , Advantages and Disadvantages of each process; <b>Dry process, Semidry process; LEPO kiln , Wet Process;</b> Long wet process Kiln, Introduction to preheater and precalcinator modern rotary kiln, Thermal heat calculation, sizing of kiln, Heat balance of kiln, air balance of kilns, inlet seal ,methods used to feed raw meal in the kilns,
Unit-II	Types of <b>preheaters</b> , comparison , selection of different stages(4/5/6) preheaters, <b>Precalciners</b> : Theoretical aspect of Precalciners, Basic arrangement, Features of precalciners , Present status of precalciner development, advantages and disadvantages of different type of precalciners , primary air, secondary air, tertiary air, Optimization of kiln output, factors affecting the kiln output, determination, parameters of kiln evaluation ; thermal loading, volumetric loading, % filling etc, norms for pyro processing, kiln operation, kiln bypass system
Unit-III	Process fans, purpose of fan, types of fans, their application, concept of pressure, velocity pressure, total pressure in an air stream, characteristic curves of fans, fan laws, comparison and selection of principal type of fans
Unit-IV	<b>Cooling of Clinker</b> : purpose of clinker cooling, types of coolers <b>Grate Cooler</b> Reciprocating grate cooler, History, Design features of modern coolers, Cooler control, Cooler de dusting, Non-ventilating cooler, Travelling grate cooler. <b>Rotary Cooler:</b> General, Design, Cooling performance, Advantages / Disadvantages <b>Planetary Cooler</b> : General, Design features, Internal heat transfer equipment, Heat transfer and efficiency, Enhanced. cooling, Advantages / Disadvantages <b>Other Systems</b> : g-cooler, Shaft cooler <b>Comparison of Coolers</b> : Range of application, Operating data and heat balance, Capital and operating costs
Unit-V	Method of clinker storage, Silos and Gantry, Gypsum and other additives, grinding aids, types of cement grinding system and their comparison, Cement conveying to storage, single and multi component silos, cement packing & Transportation, Bulk Loading.

#### Test Books:

1. Cement Data Book: W. H Duda , Verlag G m Bh,Berlin.
2. Kiln System : Process Technology: Cement Seminar, Holderbank

#### Reference Books:

1. Precalcining System : Process Technology: Cement Seminar, Holderbank
2. Clinker Cooler : Process Technology: Cement Seminar, Holderbank

## B.Tech. (Cement Tech.)

### Semester- V

## ENERGY MANAGEMENT

**Objective:** This course is designed such that a student can understand the Energy Management in Cement Plant

### Course Content:

Unit –I:	<b>Energy management:</b> Introduction, definition, Need for Energy management, general principles of Energy management, planning for energy management, Energy Basics for Energy manager, starting of Energy management program, world Energy Utilisation.
Unit -II	<b>Energy Audit:</b> Introduction, Energy Audit basics, preparing for an energy Audit, Tools for Energy Audit, Phase-II The facility inspection, preliminary Identification, Energy Management opportunities, EA report, energy action plan, Implementation of recommendations, Energy Bills Electrical rate structures. Energy Conservation acts,
Unit-III	<b>Lighting:</b> Introduction, Components of Lighting system, Lamp types, Ballasts, determine lighting needs, maintenance of lighting system, Survey, identifying potential Energy management opportunities <b>HVAC:</b> Introduction, Working of HVAC system, Heating cooling ventilation loads.
Unit-IV	<b>Economic Analysis:</b> Introduction, costs, cash flow diagrams, simple payback period, Time value of money, energy discounted cash flows, single sum analysis, cost analysis methodology, cost effectiveness, taxes and depreciation, inflation
Unit-V	<b>Energy utilisation in cement manufacturing process:</b> Energy consumption scenario in crusher, raw material grinding, pyro processing, cement grinding, coal grinding, packing. Energy conservation opportunities in cement industry, Perform Achieve and trade (PAT) Energy Conservation Acts. Energy Audit Case Studies.

### Text Books:

1. Energy management principle- Applications, benefits, savings by craig B.Smith Pergamon press.
2. Guide to energy management, Barney.L capehart, Wayne C Tarner, William J Kennedy

### Reference Books:

1. Energy Efficiency in Electrical Utilities : Guide Book National Certification Examination for Energy Manager and Energy Auditors , Bureau of Energy Efficiency, New Delhi
2. Plant Engineers and managers by Albert Thuman 2<sup>nd</sup> edition.
3. Handbook of energy audits by Albert Thuman.

### Energy Management Practical

### List of Experiment

1. Energy conservation in rotating systems (photogate systems, pendulums).
2. Efficiency of electrical motors
3. Energy-efficient lighting: comparing incandescent bulb and compact fluorescent bulb.
4. Comparison of any two size reduction equipment
5. Studies on boilers
6. Studies on centrifugal pumps, blowers and compressors
7. Losses in pipe flow
8. Critical radius of insulation.
9. Comparison of heat losses in double pipe exchanges of two different diameters
10. Determination of calorific value of fuels (solid/liquid/gaseous fuels)

## B.Tech. (Cement Tech.)

### Semester- V

#### FUELS AND FIRING SYSTEM

**Objective:** This course is designed such that a student can understand the fuel requirement and firing systems in manufacturing of clinker

#### Course Content:

Unit –I:	<b>Introduction:</b> Type of fuels, Coal, Lignite, Oil and Natural Gas, Geological Origin and distribution of coal Lignite and Oil and Natural gas. Distribution of coal and lignite deposits in India. Introduction to alternative fuels for cement manufacture.
Unit-II	<b>Characteristics of Fuel:</b> Physical and Chemical characteristics of different types of fuel, Ultimate and Proximate analysis of coal, calculation of theoretical air requirement, Characteristics of coal& lignite and their influence in burning of clinker, preparation and handling of fuel, safety hazards
Unit-III	<b>Firing System-I:</b> Introduction to various types of firing system in cement plant, their advantages and disadvantages.  <b>Coal Firing System:</b> introduction to coal firing system, classification of firing system, selection criteria for coal firing, Pulverised coal ash flame, Pulverised coal ash burner.
Unit-IV	<b>Firing System-II</b>  <b>Oil Firing System:</b> Introduction to Fuel oil, Fuel Oil transport and storage, Fuel oil Automization, Fuel oil Burners, Control loops in fuel oil plant  <b>Gas firing System:</b> Natural gas, Natural gas preparation, Natural gas burners, Flame adjustment, safety precautions.
Unit-V	<b>Flame &amp; Burners:</b> Introduction, types of flame, flame characteristics, flame adjustment, flame momentum, Secondary firing and pre-calculator, Combustion Indications. Burners, types of burners , application

#### Test Books :

1. Fuels and combustion : Samir Sarkar, New Delhi

#### Reference Books:

1. Firing System: Process Technology: Cement Seminar, Holderbank
2. Flame & Burners : Process Technology: Cement Seminar, Holderbank

## **Fuels and Firing System Practical**

### **List of Experiment:**

#### **1. Analysis of Coal , Lignite and Pet Coke**

##### **a. Proximate analysis**

- i. Moisture content
- ii. Volatile Matter
- iii. Fixed Carbon
- iv. Ash Content

##### **b. Ultimate Analysis**

- i. Wt % of Carbon
- ii. Hydrogen
- iii. Oxygen
- iv. Sulphur
- v. Nitrogen

##### **c. Determination of Gross Calorific value**

## B.Tech. (Cement Tech.)

### Semester- V

#### ENVIRONMENTAL ENGINEERING

**Objective: To get a broad perspective on environment issues related with cement industry**

**Course Content:**

Unit-I:	<b>Introduction :</b> The Environment, Interaction of Humans and Environment, Role of an engineer in Environmental improvement, Types of pollution, Air Quality-sources and classification of pollutants, Influence of meteorological phenomena on air quality, plume behaviour, Water Quality - physical, chemical & biological parameters, Noise and ground vibration, Standards & limits for air, water, waste water, noise, solid and hazardous waste
Unit-II	<b>Sources of Pollution in Cement Industry :</b> <b>Air</b> - Ambient Air Quality, Fugitive dust, Point Source – Green House Gas, particulate matter (PM), SO <sub>2</sub> , NO <sub>x</sub> , CO, HCl, HF, Heavy Metals, Dioxins & Furans, TOC, TVOC etc. <b>Water</b> – Consumption, sources of water, waste water generation, storm water <b>Noise</b> – Sources, <b>Solid and Hazardous Waste</b> – utilization
Unit-III	<b>Control of Pollution-I: Air</b> - Control measures for improving ambient air quality (AAQ) and fugitive dust, AAQ – Monitoring methods, Air Pollution Control Equipments for controlling Point Source Emissions – Bag Filter / Bag House, ESP, Hybrid Filter, Multi Cyclones, Wet Scrubber, Gravity Setting chamber, Control of gaseous emissions by primary and secondary (SCR/ SNCR) techniques. Stack monitoring for particulate matter and gases. GHG control – Blended cement, use of alternate fuels, carbon sequestration.
Unit-IV	<b>Control of Pollution-II</b> <b>Noise</b> - abatement techniques, <b>Waste water</b> – treatment methods and reuse. . <b>Solid and Hazardous Waste</b> – Management, Measures for pollution control in Mines
Unit-V	<b>Environment Management :</b> Introduction to various Environmental Act & Regulations, Environment Protection Act 1986, Water (Prevention and Control of Pollution) act, Water (Prevention and Control of Pollution) Cess act, Air (Prevention and Control of Pollution) act, Forest (Conservation) Act, Hazardous Waste (Management, Handling and trans boundary movement) Rules, Solid Waste Management Rules, Mines Act, Factory Act, Corporate Responsibility for ENV Protection (CREP).  Environment Management Tools i. EMS – ISO 14001 ii. Environmental Audit / Statement iii. Environment Impact Assessment (EIA) / EMP iv. Life Cycle Assessment (LCA) ISO 14040 / 44 v. Clean Development Mechanism (CDM)

Text Books: 1. Environmental Pollution Control Engineering : C S Rao  
2. Air Pollution : M N Rao, H.V.N. Rao  
3. Environmental Engineering : Peavy and Rowe

Reference Books:

4. Air Pollution Control by S P Mahajan, T.V. Ramachandra
5. Pollution Control in Process Industries : S P Mahajan

## **BCT-515P: Environmental Engineering Practical**

### List of Experiment

#### **I. Air**

##### A. Ambient Air Quality Monitoring

- i. Sampling and collection Methodology
- ii. Monitoring of Ambient Air pollutants
  1. Particulate Matter
    - Fugitive Dust using High Volume Sampler (HVS) / Respirable dust sampler (RDS)
    - PM<sub>10</sub> using Respirable dust sampler
    - PM<sub>2.5</sub> using Fine Particulate Sampler
    - Dust fall
  2. Gaseous Pollutants
    - SO<sub>2</sub>
    - NO<sub>2</sub>
    - CO

#### **II. Water**

##### A. Physical and chemical tests of water

pH, Colour, Turbidity, Electrical Conductivity, Suspended /Dissolved /Total Solids, Coagulation and Flocculation, Hardness, Acidity, Alkalinity, Salinity, Chloride, Fluoride, Residual Chlorine

##### B. Test to determine the quality/strength of Waste water

BOD, COD, SVI, Sulphates, Chlorides, Nitrates

#### **III. Noise and Ground Vibration**

##### A. Noise Monitoring (Leq, Ld, Ln, Ldn)

##### B. Ground Vibration Monitoring using Blast Mate

## B.Tech. (Cement Tech.)

### Semester- VI

#### INSTRUMENTATION AND PROCESS CONTROL

**Objective:** To get a broad perspective of Instrumentation and process control in cement plant

**Course Content:**

Unit –I:	<b>General Principles</b> Introduction to Process control systems, Regulator & Servo control, Feed Forward & Feed backward control, Negative & Positive Feed back Control, variables & Physical Elements of a Control system, Physical, Block & Signal Flow Diagram. Use of Laplace & Inverse Laplace Transformation in study of Process Dynamics.
Unit-II	Dynamic Modeling of a Process, Dynamic behavior of First order systems and First order systems in series. Dynamic behavior of second & higher order system for various kind of inputs, Transportation & Transfer Lag, stability
Unit-III	Modes of control action, Controllers & Final control Elements, Reduction of Block & Signal Flow Diagrams, Closed loop transfer function and response of closed loop control system for various type of control actions. On Off controllers , P controllers, PI controllers , PID controllers, material level control in silos and bins, level indicators with rotating paddles, continuous level indicators, turning fork level indicators
Unit-IV	Measurement of Temperature: temperature of secondary air, measuring in grate and satellite coolers, temperature of burning zone, measuring with thermocouples, pyrometers, optical pyrometers , radiation pyrometers, shell temperature of rotary kiln Measurement of Pressure & Vacuum, weighing installations, solids flow meter, solids flow feeder,
Unit-V	The process control computer: history of computer control in cement industry Control panels: development of control panels , control panels and control rooms, decentralised control panels, Measuring instruments in cement plant, Use of expert system Fuzzy logic rotary kiln control, Foxboro control system, control technique of hierarchical structure and distributed intelligence Process control advances for cement industry (DDC/DCS/PLC/SCADA) Automation, X Ray fluorescence analysis

**Text Books/Reference books :**

1. Chemical Process control : Stephanopolous, G. PHI 1990
2. Process system analysis and control : Coughanower, McGraw Hill 1991
3. Principles of measurement systems: Bently JP Longmans.
4. Principles of Industrial Instrumentation: Patranabis, D, TM

#### INSTRUMENTATION LAB

**List of Experiments:**

1. To study the response, time constant of thermocouple/ Bimetallic thermometer.
2. To study the characteristics of an on-off controller.
3. To study the characteristics of a PI/PID pneumatic / electronic controller.
4. Calibration of temperature and pressure measuring instruments
5. Analysis of solution by UV/VIS spectrophotometer

## B.Tech. (Cement Tech.)

### Semester- VI

#### MAINTENANCE PRACTICES IN CEMENT PLANT

**Objective:** The course is designed to familiarize with cement plant utilities , maintenance and operational problem

**Course Content:**

Unit-I	Basic Concepts of Reliability: Probability distributions used in maintenance engineering- Binomial, Poisson, Exponential, Normal, Log-normal, Gamma and Weibull distribution; failure rate, hazard rate, failure modes, MTTR, MTBF, MTTF
Unit-II	System Reliability Models: System reliability-n-component series systems, m-component parallel systems and combined system; standby systems; K-out-of-m systems; redundancy techniques in system design; event space, decomposition (Key Stone), cut and tie sets, Markov analysis, reliability and quality, unreliability, maintainability, availability
Unit-III	Maintenance Concepts and Strategies: Introduction, maintenance functions and objectives, maintenance planning and scheduling, maintenance organization.  General Introduction to Maintenance Types: Breakdown, emergency, corrective, predictive, and preventive; maintenance prevention; design-out maintenance, productive maintenance, shutdown maintenance and scheduled maintenance.
Unit-IV	Condition Based Maintenance: Principles of CBM, pillars of condition monitoring, CBM implementation and benefits; condition monitoring techniques- visual monitoring, vibration monitoring, wear debris monitoring, corrosion monitoring, performance monitoring
Unit- V	Reliability Centered Maintenance (RCM):- Concept, methodology, benefits; Total Productive Maintenance: Evolution of TPM, TPM objectives, concept, pillars of TPM. Failure Modes and Effects Analysis (FMEA)/ Failure Modes, Effects and Criticality Analysis (FMECA): Overview, elements of FMECA, applications and benefits, risk evaluation, risk priority numbers, criticality analysis, process FMEA, qualitative and quantitative approach to FMECA; design FMEA and steps for carrying out design FMEA

**Text Books :**

1. An Introduction To Reliability & Maintainability Engg; TMH: Ebeling CE
2. Reliability Engineering; East West Press.: Srinath L.S
3. Reliability engg and life testing; PHI :Naikan
4. Comprehensive Maintenance Management; PHI: Telang AD and Telang A
5. Reliability and Maintenance Engineering; New age International publisher.Balaguruswamy; Reliability Engg; TMH: Mishra R.C
6. Engg Maitainability- How to design for Reliability and easy maintenance; PHI: Dhillon

## B.Tech. (Cement Tech.)

### Semester- VI

#### ALTERNATE FUEL & RAWMATERIAL FOR CEMENT PRODUCTION

**Objective:** To get a broad perspective about the waste utilization and effluent in cement industry

**Course Content:**

Unit –I:	What are the industrial waste, types of industrial waste use as alternative raw materials for cement manufacture: fly ash, blast furnace slag, LD slag, red mud, lime sludge, phospho-gypsum, jerosite, lead and zinc slag, kimberlight rejects, marble slurry, mines rejects, cement kiln dust, What are hazardous and non hazardous waste, method of disposal of solid waste, physio-chemical and mineralogical properties of industrial waste to use as cement raw materials. Broad out line on the various dry beneficiation technique to use the limestone mines rejects as cement raw materials.
Unit-II	Types of alternative fuels for cement kiln : Refused Derived Fuel from MSW, used tyres, Biomass, industrial plastics, waste oils and solvents, domestic waste, ETP sludge, saw dust, rice husk, spent wash, pharmaceutic waste, characteristics of alternate fuels, various handling & pre processing equipment of alternate fuels, Advantages and disadvantages of alternate fuels, environmental consideration in use of alternate fuels in cement kiln.
Unit-III	Introduction to generation and availability of coal ash, types of coal ash and its usages, characteristics and classification of fly ash, chemical and physical properties of fly ash, phase composition of fly ash, use of fly ash in manufacturing of PPC ( Fly ash based) , hydration of fly ash, factors affecting the rheological properties of cement pastes containing fly ash, advantages of use of fly ash in cement and concrete.Mechanical and chemical activation of fly ash. What are the Blast furnace slag, processing of blast furnace slag, composition, physical and chemical properties of blast furnace slag, constituents of glassy slag, Lime -slag cement, slag as raw materials for clinker manufacture, manufacturing of Portland Slag Cement( PSC), Estimation of slag in cement hydration of PSC and advantages of Slag use in cement manufacture. LD Slag chemical and physical properties and its use in cement manufacture
Unit-IV	What are the hazardous waste rules under the environmental protection act, Guide line for collection, storage and transportation of hazardous waste, pre processing to prepare homogeneous waste mixes suitable for co-processing, Emission standards for co-processing of alternate fuel and raw materials and hazardous waste in cement plant, methods of emission monitoring.
Unit-V	Recovery of energy from in cement industry-Possible Heat Sources such as Kiln Shell,clinker cooler,kiln system exit gas. waste heat recovery/thermal energy storage applications :Sensible Heat Storage.

**Text Books/ Reference books :**

1. “Urban Environment Management” Local Govt and community action,Concept publishing company, New Delhi, 2003. Archana Ghose
2. Cement Data Book: W. H Duda , Verlag G m Bh,Berlin.
3. Assessment of utilization of Industrial solid Wastes in cement manufacturing ,CPCB
4. Chemistry of Cement and Concrete: F M Lea, Arnold, London
- 5 Guidelines on Co-processing in Cement /Power/Steel industry , Central Pollution Control Board, February 2010

## B.Tech. (Cement Tech.)

### Semester- VI TOTAL QUALITY MANAGEMENT

**Objective:** To get a detailed review of quality policies and quality objective in cement plant

**Course Content:**

Unit -I	<b>Introduction:</b> Definition and Need of quality, Aspects of quality, Quality characteristic, Quality specification, Quality function, Economics of quality. Inspection, Its objectives and types, Inspection versus Quality Control, Statistical Quality Control, its Tools, Advantages, limitations and Applications. <b>Probability &amp; Statistics:</b> Definition, Measures of Central tendency & Dispersion, Concept of Variation, Variable and attribute data, Frequency distribution, correlation & regression analysis, test of hypothesis: F test, t test and $X^2$ test.
Unit -II	<b>Control Charts:</b> Concept of variability, Assignable & chance causes, Concept of specifications and tolerances, Definition and objectives of control charts, Control charts for variables and attributes & related problems, Variable charts vs attribute charts, Patterns on control charts, Type-I & Type-II Errors, Process capability and its methods of determination.
Unit -III	<b>Acceptance Sampling:</b> Definition, Advantages over 100% inspection, Methods of taking samples, Operating characteristics curve & its characteristics. Single, Double and Multiple, Sequential Sampling Plan & Related problems.
Unit -IV	<b>Quality Assurance:</b> Need, Principles, Essentials and Advantages of Quality Assurance System, Quality Manual, Field complaints, Quality Audit & its types, Quality Assurance Methods, Quality Control vs Quality Assurance.
Unit-V	<b>Quality systems:</b> Brief on, ISO:9001–2000, ISO:14040 Quality management systems. Description of TQM Concept of quality circles, Practices of quality Control system in a cement plant. Life cycle assessment, Application of six sigma in quality control

**Text Book/ Reference Books:**

1. "Statistical Quality Control", McGraw Hill & Co. :EL Grant & RS Leavenworth,
2. "Statistical Quality Control", Dhanpat Rai & Co.: M. Mahajan,
- 3 "Statistical Quality Control", Dhanpat Rai & Co.: O.P. Khanna
4. "Statistical Quality Control", Khanna Pulishers: R.C. Gupta,
5. Guide Norms for cement plant operations, NCB Publication.
6. "Fundamentals of Quality Control", Pearson Education :Amitav Mitra,
7. "Total Quality Control", McGraw Hill & Co. :Feigenbaum,
8. "Quality Control systems", McGraw Hill Int. Education: Taylor J.R.,

## TESTING OF CEMENT BY BIS METHOD LAB

### Practical:

1. Chemical testing of cement.
  - Determination of loss on ignition
  - Determination of  $\text{SiO}_2$
  - Determination of  $\text{Al}_2\text{O}_3$
  - Determination of  $\text{Fe}_2\text{O}_3$
  - Determination of  $\text{CaO}$
  - Determination of  $\text{MgO}$
  - Determination of  $\text{SO}_3$
  - Determination of insoluble residue
2. Mechanical testing of cement
  - Determination of density
  - Determination of specific surface
  - Determination of normal consistency
  - Determination of setting time
  - Determination of soundness test by
    - Le Chatelier
    - Autoclave
  - Determination of compressive strength
  - Determination of drying shrinkage

## B.Tech. (Cement Tech.)

### Semester- VI

#### SPECIAL CEMENTS & PERFORMANCE OF CEMENT

**Objective:** . To study Special Cements & their Performance

**Course Content:**

Unit –I:	Characteristic of fly ash, Granulated blast furnace slag, other Pozzolanic materials for cement production Introduction to Geopolymeric cement, alternate Cementitious Materials other than OPC.
Unit-II	Special Cement: Chemical, Mineralogical and physical Characteristic of some of special cement such as Portland Pozzolana Cement ( PPC) Portland Slag Cement ( PSC)           Decorative Portland cement Supersulphate Cement                Chemical Cement Oil Well Cement                         Calcium Aluminate Cement Low energy Cement
Unit-III	Application of Cement and Performance Requirement: Concrete and mortars, introduction to various infrastructure and use of cement,. Requirement of setting, strength and durability of different concrete constructions, effect of chemical composition and physical characteristic of cement on performance, fineness and particle size distribution , tailoring performance of cements.
Unit-IV	Concrete Chemistry : Cement paste in concrete, Durability consideration of concrete, Carbonation, Chloride penetration and corrosion of reinforcement, Alkali silica reaction, sulphate attacks, attack by acid and other aggressive agencies. Performance of Blended Cement, advantages of Portland Pozzolana Cements( PPC) and Portland Slag Cement ( PSC)
Unit-V	Admixture and Special use of cement : Chemical Admixtures and mineral additives : Function of admixtures, Classification of admixtures, physical requirement of admixtures, organic retarders and accelerator, Air entraining agents and grinding aids, water reducers and superplasticizer, inorganic accelerators and retarders, effect of high low temperature pressure on concrete, very high strength cement based materials

**Text Books/.Reference Books:**

1. Chemistry of Cement and Concrete: F M Lea, Arnold, London
2. Properties of Concrete : Neville, A.M. Longmans.
3. Cement Industry Data Book, CAM , New Delhi
4. World Cement Directory: CEMBUREAU

## **TESTING OF CONCRETE**

### **List of Experiment**

- 1) Soundness test
- 2) Setting time test
- 3) Standard consistency
- 4) Heat of hydration
- 5) Compressive strength
- 6) Aggregate impact value
- 7) Slump test

### **Text book/Reference book:**

- 1) Concrete technology : MS Shetty

**B.Tech. (Cement Tech.)**

**Semester- VII**

**PROJECT & PLANT MANAGEMENT**

**Objective: To handle green field and brown field cement projects**

**Course Content:**

Unit –I:	Role of project engineering in project organisation ;Plant location and plant layout; Startup and shut downs of project; Preliminary data for construction projects; Process engineering; Flow diagram, Plot plans, Scheduling the project; Engineering design and drafting.
Unit-II	Business and legal procedures <b>Procurement operations:</b> Organisation and operation of a procurement department, Contract versus Commodity buying; Procurement requiring engineering participation, Procurement of off-the-shelf materials, Expediting and inspection, Procurement procedure, Project engineering and procurement. Office procedure: Conferences, Technical writing, Filing systems, Contracts and contractors: Engineering and constructors firms, Selecting the contractor, The basis of contract
Unit-III	.Details of engineering design and equipment selection, Process instruments, Plant utilities, Foundations, Structures and buildings, Safety and plant design
Unit-IV	. Construction planning: Construction personnel: Jurisdictional disputes and labour relations, Construction labours distribution, Labour rates. Construction operations: Site preparation, Driving of pile, Temporary buildings, Temporary water supply, Roadways and rail road , Excavation operation, Installation of underground facilities, Electrical conduit, Foundation construction, Erection of guyed derrick, Erection of elevated reinforced concrete structures and structural steel, Erection of major equipment, Installation of piping.
Unit-V	Critical path method (cpm): Events and activities; Network diagramming; Earliest start time and earliest finish time ;latest start time and latest finish time; Float, Advantage of CPM ;Cost to finish he projects earlier than normal cost; Precedence diagramming. Programme evaluation and review technique. Single versus multiple time estimates; Frequency distribution

**Text Books/ Reference Books:**

1. Plant design and economics for chemical engineers. .Peter S. Max & Timmerhaus, Mc Graw Hill (2002).
2. “PERT AND CPM.” , Srinath L. S., Affiliated east press pvt. Ltd., new york (1973)
- 3.,”Chemical engineering handbook” Perry J. H. 7<sup>th</sup> ed. Mc Graw Hill ( 1997).
4. “Cost and optimization in engineering”. JELLEN F. C., Mc Graw Hill

## B.Tech. (Cement Tech.)

### Semester- VII

## DESIGNING OF CEMENT PLANT

**Objective: To have an knowledge of design of a cement plant**

**Course Content:**

Unit –I:	<b>Process Development</b> Taking up the design of cement plant ,process flowchart, design margins to arrive at capacities , running hours in various sections , sectional and individual capacities , machinery schedules. <b>Machineries used in making cement :</b> Quarrying operations , crushers , stacker reclaimer system , grinding mills , screens , separators and classifiers , blending system , metering system , preheaters, calciners , kilns , clinker coolers , material handling system compressors, fan, blowers, motors , gear boxes
Unit-II	<b>Technoeconomic feasibility studies:</b> Investment decision , demand forecast and market limestone deposits , infrastructural facilities , manpower requirement , implementation schedule , commissioning , capital cost of the project , cost of production , profitability and investment analysis , factors governing the size of cement plant <b>Civil design and construction :</b> non factory buildings , colony guest houses ,storage silos , bins , hoppers , water supply
Unit-III	<b>Electricals &amp; Instrumentation</b> Power distribution & cables, power consumption and calculation, instrumentation & process control , lighting , communication. <b>Layouts of various section of cement plants:</b> Departmental layouts , layouts of crushing plants , storage of limestone , stacker reclaimer system , raw mills & separators , layouts of coal mills ,conveying of raw meals/ pulverized coal / cement , batch blending and continuous blending systems , kiln feed system , pyroprocessing system
Unit-IV	<b>Detailed Engineering :</b> ,Rotary Kiln, Teritary Air Duct, ,Coal and Oil Firing and Metering Systems , Clinker Cooler - Collecting Spillage and Product , Cooling Air Fans , Cooler Vent and Dust Collectors ,Clinker Conveying and Storage ,Handling Coal and Gypsum ,Handling Slag, Handling Fly Ash , Cement Mills , Packing , Layout of Packing Plant.
Unit-V	Selecting and ordering machinery : ordering machinery , formulating enquiries ENQS, technical data sheets TDS 1-8, evaluation , critical operational and design parameters, time factor

**Text Books/Reference Books:**

- 1 Peters M., Timmerhaus K. & Ronald W., Plant Design & Economics for Chemical Engineers, McGraw Hill
- 2 S.P Deolkar ., Handbook for designing Cement Plants

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**Semester- VII**

**MATERIAL HANDLING SYSTEM & SAFETY IN CEMENT PLANT**

**Objective: To have knowledge on material handling systems of cement plant and various safety measures required in cement plant operations**

**Course Content:**

Unit –I:	Introduction to Material Handling :Objective and Benefit of better handling, limitation and negative aspects, Importance, Objective plant layout and material handling. The material flow cycle, material handling equation. Principle of material handling: Systems, Material Flow, Simplification, Gravity, Space Utilization, safety and mechanisation Equipment Selection, Flexibility, Dead Weight, Motion, Idle time, Maintenance, Control capacity and performance.
Unit-II	Basic Handling Equipment types & systems, Equipment classifications. The Unit load Concept: Types of Unit load, advantages and disadvantages, Planning the Unit load systems, Unit load Efficiency. Selected Material Handling Equipment: Conveyors, Cranes, Elevators, Hoists, Monorail, Industrial Vehicles Container and supports, Auxiliary Equipment.
Unit-III	Basic Analytical Techniques of Material Handling problems. Quantitative technique for material handling analysis: Linear programming, Transportation programming, Transshipment Programming, Dynamic Programming, Queuing Theory, Conveyor analysis.
Unit-IV	Material Handling at Work place. Equipment Cost Determination: Evaluation of Direct and Indirect cost Evaluation of intermediate Cost factor, Evaluation of intangible factors, Evaluation of investment alternatives, Determination of Total Handling cost of material handling.
Unit-V	Occupational Health and Safety :Importance of Safety Performance & its monitoring, Classification of Industrial Accidents Plant Safety Inspection / Procedures , Accident Investigation System, Concept of root cause analysis , Method for computation of Frequency and Severity rates for Industrial injuries / accidents as per IS 3786 : 1983

**Text Books/Reference Books:**

1. Material Handling System Design: James M Apple, Gerogia Institute of Technology, The Ronald press company, New York.

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**Semester- VII  
OPTIMIZATION TECHNIQUE**

**Objective: Application of operation research techniques to optimise various cement plant process parameters**

**Course Content:**

Unit-I:	Introduction to process optimization; formulation of various process optimization problems and their classification. Basic concepts of optimization-convex and concave functions, necessary and sufficient conditions for stationary points, graphical method.
Unit-II	Optimization of one dimensional functions, unconstrained multivariable optimization-direct search method, Region elimination methods, Fibonacci search method, Golden section search method. Point-Estimation method: Successive quadratic estimation method. Indirect first order and second order method. Gradient-based methods: Newton-Raphson method, Bisection method, Secant method, Cubic search method. Root-finding using optimization techniques
Unit-III	Multivariable Optimization Algorithms: Optimality criteria, Unidirectional search, direct search methods: Evolutionary optimization method, simplex search method, Powell's conjugate direction method. Gradient-based methods: Cauchy's (steepest descent) method, Newton's method
Unit-IV	Constrained Optimization Algorithms: Kuhn-Tucker conditions, Transformation methods: Penalty function method, method of multipliers, Sensitivity analysis, Direct search for constraint minimization: Variable elimination method, complex search method
Unit-V	Successive linear and quadratic programming, optimization of staged and discrete processes. Specialized & Non-traditional Algorithms: Integer Programming: Penalty function method, Non traditional Optimization Algorithms, Duality

**Text Books/ Reference Books:**

1. T.F. Edgar and D.M. Himmelblau Optimization of Chemical Processes – McGraw Hill (1989)
2. K. Urbanier and C. McDermott - Optimal Design of Process Equipment – John Wiley (1986)  
Kalyanmoy Deb ,Optimization for engineering design, , Prentice Hall of India
- 3.G.S. Beveridge and R.S. Schechter, Optimization theory and practice, Mc Graw Hill, Newyork, 1970.
- 4.Reklitis, G.V., Ravindran, A., and Ragdell, K.M., Engineering Optimization- Methods and Applications, John Wiley, New York, 1983.
5. SS Rao, Optimization Theory and Applications

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### Semester- VII

### Elective

## ENERGY AUDIT IN CEMENT PLANT

**Objective:** This Course structure is design to give basic knowledge on Energy Audit in Cement Plant

### Course Content:

Unit –I:	<b>Energy management &amp; Audit :</b> Definition & Objectives of Energy Management ,Energy Audit: Types and Methodology, Energy Audit Reporting Format ,Understanding Energy Costs and Energy Performance , Matching Energy Usage to Requirement ,Maximising System Efficiency , Energy Audit Instruments
Unit-II	<b>Material and energy balance:</b> Basic Principles ,The Sankey Diagram and its Use, Material Balances ,Energy Balances, Method for Preparing Process. <b>Energy action planning</b> Introduction , Energy Management System, <b>Financial management</b> Introduction, Investment Need, Appraisal and Criteria , Financial Analysis, Financial Analysis Techniques , Sensitivity and Risk Analysis , Financing Options, <b>Project management</b> Introduction , Steps in Project Management <b>Energy monitoring:</b> Definition , Elements of Monitoring & Targeting System , A Rationale for Monitoring, Targeting and Reporting , Data and Information Analysis ,
Unit-III	<b>Fuels and combustion:</b> Introduction to Fuels, Properties of Liquid Fuels , Properties of Coal , Properties of Gaseous Fuels , Combustion of Oil , Combustion of Coal , Combustion of Gas , Draft System , Combustion Controls. <b>Boilers :</b> Introduction, Boiler Types and Classifications, Performance Evaluation of Boilers ,Energy Conservation Opportunities <b>Furnaces:</b> Types and Classification of Different Furnaces, Performance Evaluation of a Typical Furnace, General Fuel Economy Measures in Furnaces. <b>Insulation and refractory:</b> Purpose of Insulation, Types and Application, Calculation of Insulation Thickness , Simplified Formula for Heat Loss Calculation.
Unit-IV	<b>Electrical system :</b> Electricity Billing, Electrical Load Management and Maximum Demand Control, Power Factor Improvement and Benefits ,Transformers, System Distribution Losses. <b>Electric motors :</b> Motor Efficiency, Motor Selection, Energy Efficient Motor, Factors Affecting Energy Efficiency and Minimising Motor, Motor Load Survey: Methodology <b>Energy efficiency in electrical utilities:</b> Efficient Operation of Compressed Air Systems Compressor Capacity Assessment, Checklist for Energy Efficiency in Compressed Air System <b>Fans and blowers :</b> Fan Performance Evaluation and Efficient System Operation, Fan Performance Assessment , <b>Energy efficient technologies in electrical systems:</b> Maximum Demand Controllers , Automatic Power Factor Controllers,, Energy Efficient Transformers, Electronic Ballasts ,Energy Efficient Lighting Controls
Unit-V	<b>Cogeneration:</b> Need for Cogeneration, Principle & Technical Options for Cogeneration , Classification of Cogeneration Systems , Factors Influencing Cogeneration Choice , Typical Cogeneration Performance Parameters, <b>Waste heat recovery :</b> Classification and Application , Benefits of Waste Heat Recovery ,Development of a Waste Heat Recovery System ,Commercial Waste Heat Recovery Devices. Waste minimisation and resource conservation , Waste Minimisation Methodology. <b>Energy Performance Assessment for Equipment and Utilities Systems :</b> Cogeneration , Turbines, Heat Exchangers, Electric Motors and Variable Speed Drives, Fans and Blowers, Water Pumps, Compressors, light systems.

### Text Books/ Reference Books:

1. Energy Management and Energy Audit : Bureau of Energy Efficiency, New Delhi, Govt of India Publication.
2. Energy Efficiency in Cement Industry : J Sirchis , Elsevier Applied Science.

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**Semester- VII**

**Elective**

**EIA & EMP OF CEMENT PLANT**

**Objective: The course is structure to give an idea about EIA & EMP for a cement plant.**

**Course Content:**

Unit –I:	<b>Introduction :</b> The Environment, Interaction of Humans and Environment, Role of an engineer in Environmental improvement. <b>Present Environmental Scenario:</b> socio economic studies , buffer zone , demographic profile , environmental quality , air environment , micro-meteorology, dust environment , water quality , noise level
Unit-II	<b>Sources of Pollution in Cement Industry :</b> Air Water ,Noise –Solid and Hazardous Waste :Control measures for improving ambient air quality (AAQ) Pollution Control Equipments for controlling Point Source Emissions – Bag Filter / Bag House, ESP, Hybrid Filter, Multi Cyclones, Wet Scrubber, Gravity Setting chamber, primary and (SCR/ SNCR) techniques. Stack monitoring ,carbon sequestration
Unit-III	<b>Environmental Impact Assessment :</b> Impact on socio economic factors , Impact due to land degradation , impact on topography and drainage , impact due to solid waste , impact due to coal stocks , impact on flora and fauna , impact on safety , impact on environmental quality , ambient air quality , impact on water quality , impact on noise levels , mathematical modelling for dispersion of air pollutants,Battelle Environmental Evaluation System.
Unit-IV	<b>Environment Management ACT:</b> Introduction to various Environmental Act & Regulations, Environment Protection Act 1986, Water (Prevention and Control of Pollution) act, Water (Prevention and Control of Pollution) Cess act, Air (Prevention and Control of Pollution) act, Forest (Conservation) Act, Hazardous Waste (Management, Handling and trans boundary movement) Rules, Solid Waste Management Rules, Corporate Responsibility for ENV Protection (CREP). <b>Environment Management Tools :</b> EMS – ISO 14001, Environmental Audit / Statement, Clean Development Mechanism (CDM)
Unit-V	<b>Environmental management plan :</b> socio economic factors, rehabilitation , compensatory afforestation , welfare measures , environmental quality , ambient air quality , green belt development , water quality , noise levels control measures , occupational health , disaster and hazard management. <b>Post Project environmental monitoring programme :</b> organisational structure , monitoring scheme, equipments required for monitoring , budgetary provision for EMP

**Text Books:**

1. Environmental Pollution Control Engineering : C S Rao
2. Air Pollution : M N Rao, H.V.N. Rao
3. Environmental Engineering : Peavy and Rowe
4. Air Pollution Control by S P Mahajan, T.V. Ramachandra
5. Pollution Control in Process Industries : S P Mahajan

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**Semester- VII**  
**Elective**  
**INDUSTRIAL ECONOMICS**

**Objective:** To provide the board concept on the economic aspect of the industry and profitability analysis

Unit-I	<p><b>Scope of industrial economics and its history ,Industrial Efficiency: concepts and measurement</b> Meaning of the concept of industrial efficiency ,the determinants of economic efficiency, measurement of efficiency level, efficiency condition in the theory of production, efficiency and decision making process</p> <p><b>Organizational form and alternative motives of the firm</b> :types of organizational form, choice of the organizational form, business motives</p> <p><b>Elements of market structure , market conduct and conceptual framework for the study of industrial economics</b> : standard forms of market structure , concept of workable competition ,conceptual framework of the study of industrial economics</p>
Unit II	<p><b>Demand Analysis:</b> theory of demand , elasticity concept , demand for the products of individual firms in an industry , demand forecasting.</p> <p><b>Cost theory and optimum size of the firm</b> : theory of cost and production , efficiency and size of the firm , empirical estimation , effect of firm size on other performance indicators and conduct</p>
Unit III	<p><b>Diversification , vertical Integration and merger</b> : Motives for Diversification , vertical Integration and merger, measurement approaches ,empirical evidences ,implication for public policies</p> <p><b>Industrial Finance and accounting</b> :The need for finance , types of finance , sources of finance , contribution of various sources of finance in Indian Situation , choice of funding: internal vs External sources , accounting</p>
Unit IV	<p><b>Determinants of profitability</b> :theory of profitability, empirical studies on profitability analysis</p> <p><b>Ananalysis of financial ratios and and relationships</b> : classification and description of ratios ,standards for comparison of ratios , limitations of ratio analysis, inter relatedness of financial ratios , <b>Breakeven analysis</b> , application of breakeven analysis in financial management</p> <p><b>Investment decisions</b> : nature and types of investment decisions , preparation of time profile of a project, methods of project evaluation , ranking of projects NPP vs IRR, Risks and Uncertainties in project appraisal, appraisal of public projects : Social Cost benefit analysis , replacement decision , Inventory Investment, market investment</p>
Unit- V	<p><b>Advertising strategy : role of advertising models of advertising behaviour empirical tests on effects of advertising</b></p> <p><b>Pricing Decisions:</b> general situation for pricing decision ,pricing procedures , pricing in public enterprises , empirical evidence on pricing , growth of the firm , Industrial Location analysis</p> <p><b>Government regulation of Industry</b> : Legal framework of industrial regulation in India ,<b>Labour Productivity</b> : The determinants and empirical analysis of labour productivity</p>

**Test Books:**

1. Industrial Economics :An Introductory Text book : R.R Barthwal
2. Chemical Engineering and Plant Economics: Peter & Timmerhaus

## **Application of Cement Lab**

1. Preparation of laboratory scale ordinary Portland clinker
2. Preparation of OPC 33, 43 and 53 grade cement
3. Preparation of PPC flyash based in the laboratory
4. Preparation of PSC in the laboratory
5. Performance study of PPC and PSC prepared in the lab

## **Application Software Lab**

1. Auto Cad Practices
2. 3- dimensional limestone deposit modelling
3. Matlab

## **Advance Method of Cement & Clinker Testing Lab**

1. XRD method for analysis of cement raw materials and clinker, limestone and clinker phases
2. XRF for analysis of cement raw materials and Cement clinker , Limestone ,clay , iron ore ,bauxite
3. Petrographic Analysis of limestone, Cement Clinker minerals and Concrete

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### Semester- VIII

## MARKETING MANAGEMENT

**Objective:** : To provide the concept of marketing management to the student especially for cement marketing

### Course Content:

Unit-I	<p><b>Introduction to marketing</b> : market, marketing-definition and characteristics, marketing concepts ,marketing mix, core concepts of marketing , marketing organisation, marketing management model</p> <p><b>Emerging issues in marketing:</b> consumer orientation, integrated marketing , business ethics in marketing , direct and online marketing(cyber marketing),green marketing, quantitative techniques for marketing decisions , consumerism, consumer relation building</p> <p><b>Marketing environment and demand forecasting</b> : marketing environment: definitions , nature , market demand , demand forecasting: meaning and definition</p>
Unit II	<p><b>Consumer behaviour and market segmentation:</b> consumer behaviour , market segmentation, market targeting, product positioning</p> <p><b>Product decisions:</b> Product, product mix, product line and product items, new product , product life cycle, consumer adoption</p> <p><b>Product related strategies:</b> branding , packaging, labelling, after sales services</p> <p><b>Pricing decisions</b> : pricing objectives, factors affecting pricing decision, pricing methods</p>
Unit III	<p><b>Market promotion mix:</b> meaning and definition, objectives of market promotion</p> <p><b>Advertising:</b> advertising media, advertising budget, advertising agency, advertising message, advertising copy writing, evaluation of advertising effectiveness.<b>Personal Selling and sales force management:</b> personal selling, sales force management, sales force objectives, sales force size, sales forces remuneration, recruitment, selection of sales force , sales force training, sales force control.<b>Sales promotion:</b> definition , characteristics , importance , merits , benefits</p>
Unit IV	<p><b>Publicity and public relation:</b> publicity-meaning, definition, objective, importance , difference between publicity and advertising</p> <p><b>Physical distribution and channel of distribution:</b> physical distribution –introduction , concept and nature , objective, order p[rocessing, warehousing, inventory control, transportation , organisational responsibility, market logistics, channel of distribution</p>
Unit- V	<p><b>Rural Marketing:</b> introduction, characteristics, importance , rural marketing mix problems and challenges.Marketing of services, elements of retailing, International marketing, international marketing environment, Marketing control: types of marketing control, annual plan control, profitability control, efficiency control, strategic control</p> <p><b>Analysing Competition:</b> marketing strategies for competitors :market leaders, market challengers , market followers market niches.</p> <p><b>Case Study:</b> cases studies and analysis in cement marketing</p>

### Test Books:

- 1.Principles of marketing management : Philip Kotler
2. Marketing Management : A strategic and decision Making Approach : John .W Mullins
3. Marketing Management: V.S.Ramaswamy and S.Namakumari
- 4 Marketing Management, MGH, New Delhi.: Byod Walker et..al

## **B.Tech. (Cement Tech.)**

### **Semester- VIII**

BCBT-812: Project Work / 20 weeks Sandwich in plant training , Seminar and Viva

Objective : Under this activity the student will learn to carry out the independent work

1. The student may opt the project work or 20 weeks in plant training under the sandwich Apprenticeship training approved by Board of Apprenticeship Training , Western , Mumbai  
On successful completion of the training the student will submit a comprehensive report on the training carried out.
2. The student opt for the project will carry out independent project work under a project guide of the department and submit a report of the project findings .
3. Based on the report submitted Training/Project the student will give a seminar and will be evaluated by the internal examiners.
4. There will be a viva on the training/project carried out by the internal and an external examiner preferably from cement industry approved by the vice chancellor.