

Faculty of Engineering & Technology

Department of Cement Technology

Diploma (Cement Tech.)

Semester- III

TEACHING & EXAMINATION SCHEME

Subject code	Subject title	L	T	P	Credit
09CT301	Introduction Cement, Cement Raw Materials, Geology & Mining of Limestone	4	1		5
09CT302	Raw Mix Design and Chemistry of Cement	3	1		4
09CT303	Material and Energy Balance	3	1		4
09ME304	Fluid Mechanics	3	1		4
09EE305	Electrical Engineering and Electronics	4			4
09CT351	Testing of Cement Raw Materials Lab			2	1
09ME352	Fluid Mechanics Lab			2	1
09EE353	Electrical Engineering and Electronics Lab			2	1
	Total Credit				24

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Semester- IV

TEACHING & EXAMINATION SCHEME

Code No.	Subject	L	T	P	Credit
09ME401	Heat and Mass Transfer	3	1		4
09ME402	Fundamentals of Thermodynamics	3	1		4
09CT403	Size Reduction and Homogenisation	4	1		5
09CT404	Pyroprocessing and Clinker Formation	3	1		4
09CT405	Quality Control in Cement Manufacture	3	1		4
09CT451	Size Reduction and Homogenisation lab			2	1
09ME452	Fundamentals of Thermodynamics Lab			2	1
09CT453	Physical & Chemical Testing of cement Lab			2	1
					24

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Semester- V

TEACHING & EXAMINATION SCHEME

Subject code	Subject title	L	T	P	Credit
09CT501	Instrumentation and Process Control	3	1		4
09CT502	Energy Management	3	1		4
09CT503	Safety, Health and Environment	4			4
09CT504	Special Cements and Application	4			4
09CT505	Utility and Maintenance in Cement Plant	4	1		5
09CT551	Energy Management Lab			2	1
09CT552	Safety, Health and Environment Lab			2	1
09CT553	Advance Testing Method of Clinker and Cement Lab			2	1
	Total Credit				24

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Semester- VI

TEACHING & EXAMINATION SCHEME

Code No	Subject	L	T	P	Total Credit
09CT601	Marketing Strategy of Cement	3	1		4
09MT602	Project & Plant Management	3	1		4
09CT603	Performance of Cement & Concrete	3	1		4
09CT652	Project Work, Seminar and Comprehensive Viva				12
	Total Credit				24

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Semester- III

Introduction to Cement, Cement Raw Materials, Geology and Mining of Limestone

Objective: The course is design to know the history of cement, chemical and Physical characteristic of Cement Raw materials, Distribution of limestone deposits in India, Assessment of limestone deposit for cement manufacture and preliminary idea about mine planning and production scheduling of Limestone.

Course Content:

Unit –I:	Introduction to Cement and cement manufacturing process: What is cement and its importance in construction, History of cement and 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	Types of Cement : Description and use of various type of Cement such as, Ordinary Portland Cement, Portland Pozzalana Cement, Portland Slag Cement, Sulphate Resistant Cement, White Portland Cement, and Low heat Cement, Masonry Cement, Oil Well Cement.
Unit-III	Calcareous Raw Materials: Source of Lime, Limestone, Chalk, Marl, Industrial waste, geological distribution of limestone deposits in India, Assessment of limestone deposits for Cement manufacture. Argillaceous Raw Materials: Source of Silica, Alumina, Iron Oxide, Shale and effect of coal ash and additives use as corrective materials, Fly ash , Slag, lime sludge as cement raw materials.
Unit- IV	Deposit Evaluation : Prospecting and Exploration of limestone deposit, Classification of limestone deposit, Reserve Estimation, Statistical and Geostatistical evaluation, Computer Aided Deposit Evaluation.
Unit-V	Mine Planning: 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, Advance method of limestone mining, equipment safety in mining operation, pit head quality control.

Text Books / Reference Books :

1. Chemistry of Cement and Concrete: F M Lea, Arnold, London
2. Cement Data Book: W. H Duda , Verlag G m Bh, Berlin
3. Norms for limestone exploration for cement manufacture : NCCBM
4. National Inventory of cement grade limestone deposits in India : NCCBM
5. Text Book of Geology : P K Mukherjee
6. Surface Mining Technology:

BCT-311P: Testing of Cement Raw Materials Practical

List of Experiment :

1. Physical Identification of Limestone
2. Physical Analysis of Limestone
 - a. Determination of Specific Gravity
 - b. Hardness
 - c. Compressive Strength
3. Determination of Total Carbonate and Magnesium Carbonate of Limestone
 - a. Chemical analysis and determination of LOI, CaO, SiO₂, Al₂O₃, Fe₂O₃, MgO, Na₂O, K₂O, Cl of Limestone

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Semester- III

Raw Mix Design and Chemistry of Cement

Objective: The objective of the course to understand chemical aspect of cement, its composition, cess manufacture and its influence on performance.

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.
Unit-II	Cement manufacturing process, chemical composition of various types cement, 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, phase diagram, chemical reaction during clinkerisation, Role of miner 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 clinker minerals, role of gypsum in cement hydration process, hydration of Portland cement and strength of Portland cement

Text Books / Reference Books :

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

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Semester- III

Material and Energy Balances

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	Basics of material Balance, equation, with or with out chemical reactions , recycle, bypass, purge calculations, Numerical on material Balances
Unit-II	Heat Capacity, Calculation of entropy changes, energy balance with chemical reactions, Heat of vaporization, heat of formation, laws of thermochemistry, heat of combustion, Heat of reaction.
Unit-III	Units and Dimensions, conversion of units, Dimensional Group and constants, Rayleigh method, Buckingham theorem, limitations, dimensionless numbers and their significances
Unit-IV	Behaviour of Ideal gas, gaseous mixture, Vapour pressure, Clausius Cylaperon equation, Ideal Gas Balance, Cox Chart, Duhring's plot, Raut's law, Humidity and saturation, Relative Humidity, Humid heat, Humid volume, Dew point.
Unit-V	Preparation of heat balance for pyro processing systems in cement plant,

Text Books / Reference Books :

1. Chemical Process Principles, Vol. I and II: Hougen, O. A., Watson, K. M. and Ragatz, Wiley/CBS, New Delhi.
2. Calculations for Chemical Engineers: Rao, Ch. Durga Prasad and Murthy, D. B. S., Process MacMillan India, New Delhi.
3. Basic principle and Calculation in Chemical Engineering: D M Himmelblau, Prentice Hall
4. Chemical Calculation :D P Tiwari, Vindra Publication.
5. Stoichiometry: Bhatt, B I and Vora S M , Tata McGraw Hill
6. Solved Example of Chemical Engineering: G K Roy: Khana Publisher

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Semester- III

Fluid 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:	Dimensional Analysis, Rayleigh’s method, Buckingham’s theorem, Limitation, Dimensionless number and their significance
Unit-II	Fluid, Nature and properties of fluids, newtonian non-newtonian fluids, flow types laminar and turbulent flow, hydrostatic equilibrium, manometers laminar flow, viscosity, Reynolds number
Unit-III	Equation of continuity, equation of motion, Bernoulli equation and flow measuring devices- venturimeter, orifice meter pitot tube , Hagen-poiseuille equation,
Unit-IV	flow in pipes, friction factor, smooth and rough boundaries, flow through non circular cross section ,Motion of particles through fluid, packed and fluidised bed.
Unit-V	Fluid- solid separation, particle size analysis, screening equipment, terminal setting velocities , setting tank, hydro cyclones, principle of separation, introduction to separation equipment.

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 : Brow, G. G. : CBS Publisher , New Delhi
5. Fluid Mechanics and its Applications, Gupta, V. and Gupta, S. K.,
6. Elements of Fluid Mechanics, Seshadri, E. V. and Patankar, S. V., Prentice Hall of India,

DCT-314P: Fluid Mechanics Practical

List of Experiment :

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

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Semester- III

Electrical Engineering and Electronics

Objective: This course has been designed to know the student the basic concept of electrical engineering and about various electrical equipment used in cement plant

Course Content:

Unit –I:	Basic Electrical Circuit analysis KVL, KCL, nodal voltage analysis, mesh current analysis, thevinin theorem, Norton theorem, Maximum power transfer theorem, Diode and their application, diode rectifier circuit, BJT, BJT Operating region and characteristics, BJT as amplifier circuit, binary number system, hexagonal number system, octal number system, binary coded decimal, logic gates, De Morgan Theorem.
Unit-II	Magnetism and electromagnetism, flux, mmf, flux density, reluctance, magnetic field intensity, permeability, 3 phase circuit, star and delta connections , 3 phase power circulation, principle of transformer operation, losses, efficiency and phasor diagram
Unit-III	D. C. Motor and Genitor, construction, and principle of operation, type of D C Machine, dynamic braking of D C Motor, losses and efficiency
Unit-IV	AC machines, synchronous generators, synchronous motor construction, types and principle of operation, 3- phase induction motor, flux and mmf phasor in induction motor, rotor frequency, emf current, power loss efficiency, reluctance motor, universal motor.
Unit-V	Power Electronics and Devices Terminal characteristics of thyristor, SCR turn on method, switching characteristics, phase control rectifier, principle of operation of chopper and inverter, electric devices, Concept of electric drive , D C Drive and A C Drive

Text Books / Reference Books :

1. Fundamental of Electrical Engineering and Technology: William, D Stanley, John R. Hackworth, Richard L Jones.
2. Power Electronics: Dr P S Sharma

DCT-315P: Electrical Engineering Practical

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

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Semester- IV

HEAT AND MASS TRANSFER

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

Course Content:

Unit-I:	Introduction to heat transfer , general concept of heat transfer by conduction , convection and radiation, introduction to unsteady state heat transfer. Heat Transfer By Conduction Basic concept and definition, Basic laws, steady state conduction, concept of resistance, insulation and critical radius, one dimensional conduction without heat generation through plain walls, cylindrical, spherical surface & composite walls.
Unit-II	Heat Transfer By Convection Natural and forced convection, mean temperature difference, individual film and overall heat transfer coefficient, fins
Unit-III	Radiant Heat Transfer Basic Laws of radiation, Black body and grey body concept, Kirchoff's law radiation between surfaces, view factors,
Unit-IV	HEAT EXCHANE EQUIPMENT Shell and tube heat exchanger, solid – gas heat exchange, gas – gas heat exchange, HTU,NTU DIFFUSION AND MASS TRANSFER BETWEEN PHASES Molecular and turbulent diffusion, diffusion coefficient, Fick's Law, Diffusivity, ,Analogy between heat and mass transfer, diffusion in solids: molecular and knudsan diffusion, mass transfer coefficient
Unit-V	Equipment For Gas - Liquid Operations Bubble columns, agitated contactors, tray towers, packed towers, Important Mass Transfer Operations Absorption and adsorption operation, humidification and drying

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

Diploma (Cement Tech.)

Semester- IV

FUNDAMENTALS OF THERMODYNAMICS

Objective: The course is design to give broad perspective of basic thermodynamic principals and its laws.

Course Content:

Unit –I:	Introduction: The scope of thermodynamics, temperature, defined quantities; volume, pressure, work, energy, heat, Joules Experiments. The first law and other basic concepts: The first law of thermodynamics, thermodynamic state and state functions, enthalpy, the steady-state steady-flow process, equilibrium, the phase rule, the reversible process, constant-V and constant- P processes, heat capacity.
Unit-II	Volumetric properties of pure fluids: The PVT behavior of pure substances, virial equations, the ideal gas, the applications of the virial equations, second virial coefficients from potential functions. Cubic equations of state, generalized correlations for gases, generalized correlations for liquids, molecular theory of fluids, Zeroth Law of Thermodynamics
Unit-III	Thermodynamics of flow processes : principles of conservation of mass and energy for flow systems, analysis of expansion processes ; turbines, throttling ; compression processes –compressors and pumps ; calculation of ideal work and lost work.
Unit-IV	The second law of thermodynamics: Statements of the second law, heat engines, thermodynamic temperatures scales, thermodynamic temperature and the ideal gas scale, Entropy, Entropy changes of an ideal gas, mathematical statement of the second law, the third law of thermodynamics, entropy from the microscopic view point, combined first and second law of thermodynamics , Third law of thermodynamics
Unit-V	Refrigeration and liquefaction: The Carnot refrigerator, the vapor compression cycle, the comparison of refrigeration cycles, the choice of refrigerant, absorption refrigeration, the heat pump, liquefaction processes Thermodynamic properties of fluids: Property relations for homogeneous phases, residual properties, two phase systems, thermodynamic diagrams, tables of thermodynamic properties, generalized property correlation for gases

Text Books / Reference Books :

1. Thermodynamics & An Intro. To Thermostatistics :Herbert B Callen
2. Thermodynamics Engineering :D.K.Chavan & G.K. Pathak
3. Thermodynamics (U.P. Technical University, Lucknow): R. K. Rajput

THERMODYNAMICS

List of Experiment

1. Thermal conductivity of materials
2. Measurement of Vapour liquid equilibrium data
3. Experimental measurement of PVT data
4. Refrigeration cycle experiment
5. Tray drier

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Semester- IV

PYROPROCESSING AND CLINKER FORMATION

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OBJECTIVE: The emphasis of the course will be on description of operations in a cement kiln and manufacture of cement. completion of this course, a student will be familiar with the operation in a cement kiln and controls.

Course Content:

Unit –I:	The Cement Kiln Operation Types of kilns, different types of clinkerization process, wet process, semi-wet process, dry process, advantages- disadvantages of each process, chain type system in wet process, Lepol grate kiln, heat requirement in each process, L/D ratio. Thermal calculations, sizing of kiln. Heat balance of kiln, air balance of kiln, inlet seal, methods used to feed raw meal to kiln, different types of preheaters, types of precalcinators their advantages and disadvantages, selection of preheaters, affect of leakages on kiln operation, optimization of kiln output, factors affecting kiln output .
Unit-II	Coal Grinding Plant Preparation of fuel burning, sampling of coal, proximate and ultimate analyses of coal, calorific value of coal and its determination, crushing and grinding of coal, residue and moisture determination and their control, removal of fine coal from dust-laden gases, different equipments used, cyclones, bag filters and ESPs.
Unit-III	Firing system-different types of firing systems, their advantages and disadvantages, conveying of pulverized coal to kiln, calcinations and its control, process parameters like velocity, temperature and draught at various stages, burners, development in burner system
Unit-IV	Cooling Of Clinker Different types of coolers used, their operation and control, planetary coolers; grate coolers, cooling efficiency, air requirement for cooling operation, different methods of clinker cooling and their advantages, methods of clinker storage-silo and gantry.
Unit-V	Refractories Temperature profile inside kilns, functions of refractories, different types of refractories, ceramic phase diagrams

Text Books / Reference Books :

1. The Rotary Cement Kiln, Edward Arnold. K. E. Perey,
2. Chemistry of Cement and Concrete, Arnold, London. F. M. Lea
3. Cement Chemistry, Academic Press, London:. H. F. W. Taylor
4. Innovations in Portland Cement Manufacturing: Bhattay

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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:	Particle Size Analysis: 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	Size Reduction: 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..
Unit-III	Material Handling: Various systems of material handling; haulage and transportation from mines, trucks, dumpers etc. Conveying of Solids: Conveyor selection, classification of conveyors, conveyors such as belt, screw, chain, vibratory, apron. Pneumatic and hydraulic transportation of solids; pneumatic conveying systems.
Unit-IV	Storage of Solids: Bins, silos, hoppers & feeders; storage of raw materials in piles Size Classification and Air Separators: 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	Blending & Prehomogenization: Preparation of cement raw meal as per raw mix design, combined & segregated pre-homogenization, Methods of prehomogenisation, stacking of blending beds , Chevron method , Windraw method , Areal stock piling , Axial stock piling, continuous 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

SIZE REDUCTION LAB**LIST OF EXPERIMENTS**

1. Tests on crushing strength of limestone,
2. Estimation of Bond's work index,
3. Study of different grinding system in cement plant (field visit),
 - a. vertical roller mill,
 - b. Different types of crusher
 - c. Ball mill

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Semester- IV

DCT415: QUALITY CONTROL IN CEMENT MANUFACTURE

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

Course Content:

Unit -I	Statistical concepts: Treatment of variability , histograms , means, standard deviation ,variance, co-efficient of variation , estimation of standard error of means , control charts ,Theoretical distribution: Normal and log Normal distribution Statistical Quality Control: control charts , advantages of quality control, acceptance & sampling
Unit -II	Input control: control of input at various stages of production , control of raw materials, raw meal and kiln feed, chemical composition and physical characteristics , norms of control
Unit -III	Specifications : Quality and specification requirements, minimum value specified , average values expected in production , acceptance criteria NATIONAL & INTERNATIONAL SPECIFICATIONS differences in test methods , comparison of requirements SCHEME OF TESTING AND INSPECTION Detailed requirements of STI issued by Bureau of Indian Standards
Unit -IV	Quality Assurance: Need, Principles, Essentials and Advantages of Quality Assurance System, Quality Manual, Field complaints, Quality Audit & its types, Quality Assurance Methods
Unit-V	Quality systems: Brief on, ISO:9001–2000 Quality management systems. Description of TQM Concept of quality circles, Practices of quality Control system in a cement plant.

Text Book: :

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.

Reference Book: 1.

1. “Fundamentals of Quality Control”, Pearson Education: Amitav Mitra
2. “Total Quality Control”, McGraw Hill & Co: Feigenbaum.
3. “Quality Control systems”, McGraw Hill Int. Education: Taylor J.R.

PHYSICAL & CHEMICAL TESTING OF CEMENT

LIST OF EXPERIMENT :

4. Physical and chemical testing of limestone, coal & cement
5. Physical Analysis of Limestone and cement
 - a. Determination of Specific Gravity
 - b. Hardness of limestone
6. Determination of CC and MC of Limestone and cement
 - a. Chemical analysis and determination of LOI, CaO, SiO₂, Al₂O₃, Fe₂O₃, MgO of Limestone and cement
7. Proximate and ultimate analysis of coal.
8. Determination of Liter Weight of Clinker

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Semester- V

Instrumentation and Process Control

Objective: This course is design to give the idea about the instrumentation and various process control systems in cement plant.

Course Content:

Unit –I:	General Principles : Introduction to process control, Principle of feedback and feedforward control, introduction to dynamics of first and higher order system
Unit-II	Mode of feed back Control: On-Off, Proportional, integral, derivative control and their combination control
Unit-III	Instrumentation: General performance and characteristics of instruments, instrumentation error, calibration, concept of stability and optimum control, Different types of sensors, transducers and measuring instruments required for process variables like temperature, pressure and flow, type of valves, role of electronic devices computer control.
Unit-IV	Measuring instruments in cement plant, Use of expert system, Fuzzy logic control, CCR operation.
Unit-V	Process control advances for cement industry (DDC/DCS/PLC/ SCADA)

Text Books / Reference Books :

7. Cement Data Book: W. H Duda , Verlag G m Bh,Berlin
8. Chemical process control: Stephnopolous, G . PHI 1990
9. Process System analysis and Control: Coughnower, McGraw Hill, 1991
10. Principle of measurement systems: Bently J P, Longmans.
11. Principle of Industrial Instrumentation: Patranabis, D, TMH

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Semester- V

DCT 512: Energy Management

Objective: The course is design to take various steps to conserve energy in cement manufacture .

Course Content:

Unit –I:	Energy Requirement Introduction various types of energy, requirement of thermal and electrical energy in cement manufacture, global and Indian trend of energy.
Unit-II	Energy Audit: Energy Monitoring and metering, target setting, the global trend, benchmarking, energy efficiency, plant capacity utilization, energy audit technique and advantages.
Unit-III	Thermal Energy: Heat Balance, Kiln refractory interface, lowering the losses, concept of preheating and precalcining, role of blended cements Electrical Energy: Different electrical motors in cement plant, crushers, mills, kiln, fans, motors and drives
Unit-IV	Energy Conservation act 2001 & 2010, Identification of Waste heat recovery
Unit-IV	Case Studies: Selected 4 case studies of energy audit and energy conservation measurements in Indian Cement Plants

Text Books / Reference Books :

1. Cement Data Book: W. H Duda , Verlag G m Bh,Berlin
2. The Rotary Cement Kiln: Perey, K. E., Edward Arnold
3. Energy Management Principle- Applications, benefits, savings craigB.SmithPergamon press.
4. Guide to energy management, Barney.Lcapehart, Wayne C Turner, William J Kennedy

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)

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Semester- V

Safety, Health and Environment

Objective: The course content is designed to familiar the student with Safety and Environment of cement plant operation.

Course Content:

Unit –I:	<p>Safety:</p> <p>Introduction to process of safety, Importance of safety, type of accident & causes, direct and indirect effect of accident, accident and loss statistics, safety consideration and design of cement plant, protective and safety devices for personal and general hygienic management in and around premises, respirators and ventilation system- local and dilution. Measure of risk , laws, rules and regulation conserving safety in cement plant for prevention of accident, managerial aspect of safety.</p>
Unit-II	<p>Dust Generation and Control:</p> <p>Both fugitive and point source of dust emissions in cement plant, classification of particle size distribution of dust, cement kiln dust characteristics, dust emission standards, health effects on workers exposure to dust, method of adoption to control of dust at the source, dust control equipment, such as gravity setting chamber, cyclones, ESP, Bag house filters and ESP with GCT efficiency of collection.</p>
Unit-III	<p>Air pollution Control:</p> <p>Emission source of CO, CO₂, NO_x and Sox, concerns about green house gas emissions and climate change, health concern, source model- release and flow of toxic gases and particulates from the stack factors affecting their dispersion and modelling. Measuring equipment of exit gases ,SO_x, NO_x and CO. Regulatory requirements, equipment required to control gaseous pollutants, recent development.</p>
Unit-IV	<p>Noise Abatement:</p> <p>Noise of running machinery and mills, method of noise suppression, balancing of equipment, noise barriers, effect of plantation, effect on human health, regulatory requirement.</p>
Unit-V	<p>Environment around Mines: Use of explosives, Blasting and resultant vibration, controlled and sequential blasting ,</p> <p>Ecological and environmental conditions around limestone mines, plantation, roads, water bodies, social forestry and safety measure</p> <p>Management Techniques: Concept of clean development mechanism, Environmental Impact Analysis (EIA) and Environmental Management Plan (EMP)</p>

Text Books/ Reference Books :

1. Chemical Process Safety: Roy E. Sanders, Butter Worth Heinemann, New Delhi
2. Safety related acts and regulations
3. Environmental Pollution Control Engineering : C S Rao
4. Environmental Engineering : Peavy and Rowe

Safety, Health and Environment Practical**Name of Experiment**

1. Determination of Biological oxygen demand (BOD)
2. Determination of Chemical oxygen demand (COD)
3. Measurement of Dissolved Oxygen (DO)
4. Water quality assessment.
5. Orsat analysis
6. High volume sampler
7. Spectrophotometer (Colored material concentration)
8. Study of Fire Extinguishers
9. Study of safety valves, pressure relief valves etc.
10. Determination of sound intensity (decibel meters)

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Semester- V

Special Cement and performance of Cement

Objective: The course is design to familiarize the students with some special cement and application of cement .

Course Content:

Unit –I:	Introduction to Geopolymeric cement, characteristic of fly ash, Granulated blast furnace slag, other pozzolanic materials for cement production
Unit-II	Special Cement: Chemical, Mineralogical and physical Characteristic of some of special cement such as -Portland Pozzolana Cement (PPC) -Portland Slag Cement (PSC) - Supersulphate Cement - Oil Well Cement - Low heat Cement - White Cement - Low Carbon Cement
Unit-III	Performance Requirement of cement 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	Durability consideration of concrete, sulphate attacks, corrosion of reinforcing steel in concrete, attack by acid and other aggressive agencies.
Unit-V	Performance of Blended Cement, advantages of Portland Pozzolana Cements(PPC) and Portland Slag Cement (PSC)

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

Advance Testing Method of Clinker and Cement Practical

List of Experiment :

1. Test of compressive strength of cement with standard mortar cubes.
2. X-Ray analyses of raw meal / kiln feed, Clinker
3. Mineralogical and Petrographic Analysis of
 - a. Limestone,
 - b. Clinker
 - c. Concrete

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Semester- V

Utility and Maintenance in Cement Plant

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

Course Content:

Unit –I:	Operational Problem: Cause and measure to solve them, coating, ball formation, cyclone jamming, other emerging conditions, wear in cement plant- abrasion, erosion, corrosion, causes and control measures.
Unit-II	Packing and Despatch: Finish grinding of clinker with gypsum and other additives, combined grinding and separate grinding packing machines, use of grinding aids, type of packing medium, tolerances, bag and bulk supply, dispatch of cement.
Unit-III	Maintenance: Maintenance strategies, preventive maintenance, condition monitoring for predictive Maintenance, check for kiln alignment and shell ovality, annual maintenance, shutdown Maintenance, economic life of refractories , and machineries, check lists, shutdowns, upset kiln conditions- causes and controls.
Unit-IV	Typical lay out in a cement plant related to material handling, Material Handling lay out for water ,: Water supply in cement plant, requirement in plant and colonies, water for cooling and quenching, water for fire fighting, water treatment.
Unit-V	Material Handling lay out for air ,: Air supply to kiln system, compressed air, blowers and compressors, exhaust, pumps, Movement of materials , conveyors, F K pumps, Dense phase transport,

Text Books / Reference Books :

1. Cement Data Book: W. H Duda , Verlag G m Bh,Berlin
2. Handbook of Material Handling
3. Maintenance Engineers Hand book,
4. Cement Engineers Hand Book: Labhaanand Kolhaans
5. Operational Norms for cement plant: NCCBM publication

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Semester- VI

MARKETING STRATEGY OF CEMENT

Objective: To have an idea of professional marketing strategy and consumer protection in cement utilisation

Course Content:

Unit –I:	. Marketing :Definition Importance Scope Marketing Management :Tasks and Trends, Company orientations towards marketplace : Production Concept, Product Concept, Selling Concept, Marketing Concept, Building customer value, satisfaction and loyalty, Customer Relationship Management(CRM), Analyzing marketing environment
Unit-II	Market Segmentation, Targeting and Positioning strategies; Marketing Mix; The product; Product Life Cycle and strategies;; Product Mix decisions; Branding; Packaging and Labeling
Unit-III	Pricing Decisions; Factors influencing Price five “C”s; Pricing Strategies; New product pricing; Price adjustment strategies
Unit-IV	Distribution Decisions; Channel alternatives; Choice of Channel; Channel Management, Channel Dynamics, Managing promotion Mix; Advertising, Personal selling, Sales Promotion and publicity, Integrated Marketing Communication., Market survey of cement, Quality control of cement , Statistical analysis of quality of cement based on the data of field data.
Unit-V	Marketing Control techniques; Marketing Audit; Social Marketing; Green Marketing; Web Marketing;

Text Books:

Reference Books

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

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Semester- VI

PROJECT & PLANT MANAGEMENT

Objective: To have an idea of project and plant management in cement plant

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, Scheduling the project; Engineering design and drafting.
Unit-II	Business and legal procedures Procurement operations: Organisation and operation of a procurement department, Contract versus Commodity buying; Expediting and inspection, Procurement procedure, Project engineering and procurement. Office procedure: Conferences, Technical writing, Filing systems, Contracts and contractors: Engineering and constructors firms, The basis of contract, Ethics and the 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, Temporary buildings, Temporary water supply, Roadways and rail road spurs, Erection of elevated reinforced concrete structures , Erection of major equipment, final stage of construction.
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 :

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

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Semester- VI

PERFORMANCE OF CEMENT & CONCRETE

Objective: To get a broad perspective of cement and concrete performance

Course Content:

Unit –I:	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-II	Classification of aggregate, source Physical, Chemical and Thermal properties of aggregate, Grading of aggregate, Quality of water used for construction, use of sea water for mixing of concrete.
Unit-III	Introduction to admixture, construction chemicals, plastisizers, use of admixture in concrete , factors affecting the workability of concrete, effect of superplasticizer on the properties of hardened concrete, retarder, accelerator, pozzolanic or mineral admixture, construction chemicals for water proofing.
Unit-IV	Properties of fresh and hardened concrete: workability and its measurement, factors affecting workability, requirements of workability, Estimation of errors, Strength of concrete , stress and strain characteristics of concrete, Dimensional stability- shrinkage and creep, creep of concrete , permeability of concrete, durability of concrete, concrete in marine environment, acid attack, Efflorescence , fire resistance, Thermal properties of concrete
Unit-V	Concept of concrete mix design, various method of mix design, Indian method of concrete mix design, sampling and acceptance criteria in mix design, Inspection and testing of structures : core test, Load test, nondestructive test, Special concrete and concreting methods, Light weight concrete, Light weight aggregate concrete, High density concrete, Fibre reinforced concrete.

Text Books:

1. Chemistry of Cement and Concrete: F M Lea, Arnold, London
2. Properties of Concrete : Neville, A.M. Longmans.
3. Concrete Technology : M L Gambhir
4. Concrete Technology : Theory & practices :M S Shetty.

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Semester- VI
PROJECT WORK, SEMINAR AND
COMPREHENSIVE VIVA

Student will opt one of the subject as the project work. During the semester the student will visit the cement plant to study (if required) on the project and carry out the experiments , prepare a report on the project work carried out. The student will present the project work before the internal examiner and will be evaluated by the examiners. There will be a viva on the project work and will be evaluated by the external examiner preferably form the cement plant approved by the Controller of Examination.

List of Project Topic

1. Quality Control & Quality Assurance in Cement Manufacture
2. Pyroprocessing & Clinker Manufacture
- 3 .Manufacturing of Portland Pozzolana Cement
- 4 Manufacturing of Portland Slag Cement
- 5 Manufacturing of Ordinary Portland Cement.
6. Energy Management in Cement Plant
- 7 EIA & EMP of Cement Plant.
