ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

Programme: B.Sc. Honours in Cement Science (Major)

w.e.f. AY 2023-24

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Essentials and Applications of Mathematical, Physical and Chemical Sciences	3+2	4
		2	Advances in Mathematical, Physical and Chemical Sciences	3+2	4
	II	3	Geology and Mining of Limestone	3	3
			Geology and Mining of Limestone Practical Course	2	1
		4	Cement and Cement Raw Materials	3	3
			Cement and Cement Raw Materials Practical Course	2	1
II	III	5	Size Reduction and Pre-homogenisation	3	3
			Size Reduction and Pre-homogenisation Practical Course	2	1
		6	Material Handling systems in Cement Industry	3	3
			Material Handling systems in Cement Industry Practical Course	2	1
		7	Raw Mix Design and Clinker Manufacturing	3	3
			Raw Mix Design and Clinker Manufacturing Practical Course	2	1
		8	Safety, Health and Environment Science	3	3
			Safety, Health and Environment Science Practical Course	2	1
	IV	9	Fuels and Firing Systems	3	3
			Fuels and Firing Systems Practical Course	2	1
		10	EIA and EMP of cement plant	3	3
			EIA and EMP of cement plant Practical Course	2	1
		11	Refractory Engineering	3	3
			Refractory Engineering Practical	2	1

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
			Course		
III	V	12	Pyro process in Cement Industry	3	3
			Pyro process in Cement Industry Practical Course	2	1
		13	Special Cements and Performance of Cement	3	3
			Special Cements and Performance of Cement Practical Course	2	1
		14	Cement Grinding, Packing and Loading for Dispatch	3	3
			Cement Grinding, Packing and Loading for Dispatch Practical Course	2	1
		15	Alternative Fuels and Raw materials for Cement Production	3	3
			Alternative Fuels and Raw materials for Cement Production Practical Course	2	1
	VI	Semester Internship/Apprenticeship with 12 Credits			
IV	VII	16	Kiln Systems and Theory	3	3
			Kiln Systems and Theory Practical Course	2	1
		17	Admixtures, Composed Cement and its uses	3	3
			Admixtures, Composed Cement and its uses Practical Course	2	1
		18	Cement Industry Best Abatement Techniques (BAT)	3	3
			Cement Industry Best Abatement Techniques (BAT) Practical Course	2	1
	VIII	19	Rotary Kiln Operating Procedures	3	3
			Rotary Kiln Operating Procedures Practical Course	2	1
		20	Energy efficiency techno1ogles in cement industry	3	3
			Energy efficiency techno1ogles in cement industry Practical Course	2	1
		21	Combustion Technology	3	3
			Combustion Technology Practical Course	2	1

SEMESTER-I

COURSE 1: ESSENTIALS AND APPLICATIONS OF MATHEMATICAL, PHYSICAL ANDCHEMICAL SCIENCES

Theory Credits: 4 5 hrs/week

Course Objective:

The objective of this course is to provide students with a comprehensive understanding of the essential concepts and applications of mathematical, physical, and chemical sciences. The course aims to develop students' critical thinking, problem-solving, and analytical skills in these areas, enabling them to apply scientific principles to real-world situations.

Learning outcomes:

1. Apply critical thinking skills to solve complex problems involving complex numbers, trigonometric ratios, vectors, and statistical measures.

2. To Explain the basic principles and concepts underlying a broad range of fundamentalareas of physics and to Connect their knowledge of physics to everyday situations

3. To Explain the basic principles and concepts underlying a broad range of fundamentalareas of chemistry and to Connect their knowledge of chemistry to daily life.

4. Understand the interplay and connections between mathematics, physics, and chemistry in various applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts.

5 To explore the history and evolution of the Internet and to gain an understanding of network security concepts, including threats, vulnerabilities, and countermeasures.

UNIT I: ESSENTIALS OF MATHEMATICS:

Complex Numbers: Introduction of the new symbol i – General form of a complex number – Modulus-Amplitude form and conversions

Trigonometric Ratios: Trigonometric Ratios and their relations – Problems on calculation of angles**Vectors:** Definition of vector addition – Cartesian form – Scalar and vector product and problems **Statistical Measures**: Mean, Median, Mode of a data and problems

UNIT II: ESSENTIALS OF PHYSICS:

Definition and Scope of Physics- Measurements and Units - Motion of objects: Newtonian Mechanics and relativistic mechanics perspective - Laws of Thermodynamics and Significance- Acoustic waves and electromagnetic waves- Electric and Magnetic fields and their interactions- Behaviour of atomic and nuclear particles- Wave-particle duality, the uncertainty principle- Theories and understanding of universe

UNIT III: ESSENTIALS OF CHEMISTRY: :

Definition and Scope of Chemistry- Importance of Chemistry in daily life -Branches of chemistry and significance- Periodic Table- Electronic Configuration, chemical changes, classification of matter, Biomolecules- carbohydrates, proteins, fats and vitamins.

UNIT IV: APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY:

Applications of Mathematics in Physics & Chemistry: Calculus , Differential Equations & Complex Analysis

Application of Physics in Industry and Technology: Electronics and Semiconductor Industry, Robotics and Automation, Automotive and Aerospace Industries, Quality Control and Instrumentation, Environmental Monitoring and Sustainable Technologies.

Application of Chemistry in Industry and Technology: Chemical Manufacturing, Pharmaceuticals and Drug Discovery, Materials Science, Food and Beverage Industry.

UNIT V: ESSENTIALS OF COMPUTER SCIENCE:

Milestones of computer evolution - Internet, history, Internet Service Providers, Types of Networks, IP, Domain Name Services, applications.
Ethical and social implications: Network and security concepts- Information Assurance Fundamentals, Cryptography-Symmetric and Asymmetric, Malware, Firewalls, Fraud Techniques- Privacy and Data Protection

Recommended books:

1. Functions of one complex variable by John.B.Conway, Springer- Verlag.
2. Elementary Trigonometry by H.S.Hall and S.R.Knight
3. Vector Algebra by A.R.Vasishtha, Krishna Prakashan Media(P)Ltd.4.Basic Statistics by

B.L.Agarwal, New age international Publishers

5. University Physics with Modern Physics by Hugh D. Young and Roger A. Freedman
6. Fundamentals of Physics by David Halliday, Robert Resnick, and Jearl Walker
7. Physics for Scientists and Engineers with Modern Physics" by Raymond A. Serway andJohn W. Jewett Jr.
8. Physics for Technology and Engineering" by John Bird
9. Chemistry in daily life by Kirpal Singh
10. Chemistry of bio molecules by S. P. Bhutan
11. Fundamentals of Computers by V. Raja Raman
12. Cyber Security Essentials by James Graham, Richard Howard, Ryan Olson

STUDENT ACTIVITIES

UNIT I: ESSENTIALS OF MATHEMATICS:

1: Complex Number Exploration

Provide students with a set of complex numbers in both rectangular and polar forms.

They will plot the complex numbers on the complex plane and identify their properties2:

Trigonometric Ratios Problem Solving

Give students a set of problems that require the calculation of trigonometric ratios and their relations.

Students will solve the problems using the appropriate trigonometric functions (sine, cosine, tangent, etc.) and trigonometric identities.

3: Vector Operations and Applications

Provide students with a set of vectors in Cartesian form.

Students will perform vector addition and subtraction operations to find the resultant vectors.

They will also calculate the scalar and vector products of given vectors.

4: Statistical Measures and Data Analysis

Give students a dataset containing numerical values.

Students will calculate the mean, median, and mode of the data, as well as other statistical measures if appropriate (e.g., range, standard deviation).
They will interpret the results and analyze the central tendencies and distribution of the data.

UNIT II: ESSENTIALS OF PHYSICS:

1. Concept Mapping

Divide students into groups and assign each group one of the topics.

Students will create a concept map illustrating the key concepts, relationships, andapplications related to their assigned topic.

Encourage students to use visual elements, arrows, and labels to represent connections and interdependencies between concepts.

2. Laboratory Experiment

Select a laboratory experiment related to one of the topics, such as motion of objects orelectric and magnetic fields.
Provide the necessary materials, instructions, and safety guidelines for conducting the experiment.
Students will work in small groups to carry out the experiment, collect data, and analyze the results.

After the experiment, students will write a lab report summarizing their findings,observations, and conclusions.

UNIT III: ESSENTIALS OF CHEMISTRY

1: Chemistry in Daily Life Presentation

Divide students into groups and assign each group a specific aspect of daily life where chemistry plays a significant role, such as food and nutrition, household products, medicine,or environmental issues.
Students will research and create a presentation (e.g., PowerPoint, poster, or video) that showcases the importance of chemistry in their assigned aspect.
2: Periodic Table Exploration

Provide students with a copy of the periodic table.

Students will explore the periodic table and its significance in organizing elements based ontheir properties.
They will identify and analyze trends in atomic structure, such as electronic configuration, atomic size, and ionization energy.

3: Chemical Changes and Classification of Matter

Provide students with various substances and chemical reactions, such as mixing acids andbases or observing a combustion reaction.
Students will observe and describe the chemical changes that occur, including changes incolor, temperature, or the formation of new substances.
4: Biomolecules Investigation

Assign each student or group a specific biomolecule category, such as carbohydrates,proteins, fats, or vitamins.
Students will research and gather information about their assigned biomolecule category, including its structure, functions, sources, and importance in the human body.

They can create informative posters or presentations to present their findings to the class.

UNIT IV: APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY

1: Interdisciplinary Case Studies

Divide students into small groups and provide them with interdisciplinary case studies that involve the interdisciplinary application of mathematics, physics, and chemistry.

Each case study should present a real-world problem or scenario that requires the integrationof concepts from all three disciplines.

2: Design and Innovation Project

Challenge students to design and develop a practical solution or innovation that integrates mathematics, physics, and chemistry principles.

Students can choose a specific problem or area of interest, such as renewable energy, environmental conservation, or materials science.
3: Laboratory Experiments

Assign students laboratory experiments that demonstrate the practical applications of mathematics, physics, and chemistry.

Examples include investigating the relationship between concentration and reaction rate, analyzing the behavior of electrical circuits, or measuring the properties of materials.

.4: Mathematical Modeling

Present students with real-world problems that require mathematical modeling and analysis.

UNIT V: ESSENTIALS OF COMPUTER SCIENCE:

1. Identifying the attributes of network (Topology, service provider, IP address and bandwidth of
2. your college network) and prepare a report covering network architecture.
3. Identify the types of malwares and required firewalls to provide security.
4. Latest Fraud techniques used by hackers**.**

SEMESTER-I

COURSE 2: ADVANCES IN MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES

Theory Credits: 4 5 hrs/week

Course Objective:

The objective of this course is to provide students with an in-depth understanding of the recent advances and cutting-edge research in mathematical, physical, and chemical sciences. The course aims to broaden students' knowledge beyond the foundational concepts and expose themto the latest developments in these disciplines, fostering critical thinking, research skills, and the ability to contribute to scientific advancements.

Learning outcomes:

1. Explore the applications of mathematics in various fields of physics and chemistry, to understand how mathematical concepts are used to model and solve real-world problems.

2. To Explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physics to everyday situations.

3. Understand the different sources of renewable energy and their generation processes and advances in nanomaterials and their properties, with a focus on quantum dots. To study the emerging field of quantum communication and its potential applications. To gain an understanding of the principles of biophysics in studying biological systems. Explore the properties and applications of shape memory materials.

3. Understand the principles and techniques used in computer-aided drug design and drug delivery systems, to understand the fabrication techniques and working principles of nanosensors. Explore the effects of chemical pollutants on ecosystems and human health.

4. Understand the interplay and connections between mathematics, physics, and chemistry in various advanced applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts.

5 Understand and convert between different number systems, such as binary, octal, decimal, and hexadecimal. Differentiate between analog and digital signals and understand their characteristics.Gain knowledge of different types of transmission media, such as wired (e.g., copper cables, fiber optics) and wireless (e.g., radio waves, microwave, satellite)..

UNIT I: ADVANCES IN BASICS MATHEMATICS

Straight Lines: Different forms – Reduction of general equation into various forms –Point of intersection of two straight lines

Limits and Differentiation: Standard limits – Derivative of a function –Problems on product ruleand quotient rule

Integration: Integration as a reverse process of differentiation – Basic methods of integration

Matrices: Types of matrices – Scalar multiple of a matrix – Multiplication of matrices – Transpose ofa matrix and determinants

UNIT II: ADVANCES IN PHYSICS:

Renewable energy: Generation, energy storage, and energy-efficient materials and devices. **Recent advances in the field of nanotechnology**: Quantum dots, Quantum Communication- recent advances in biophysics- recent advances in medical physics- Shape Memory Materials.

UNIT III: ADVANCES IN CHEMISTRY:

Computer aided drug design and delivery, nano sensors, Chemical Biology, impact of chemical pollutants on ecosystems and human health, Dye removal - Catalysis method

UNIT IV: ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS &CHEMISTRY

Mathematical Modelling applications in physics and chemistry Application of Renewable energy: Grid Integration and Smart Grids,**Application of nanotechnology**: Nanomedicine,

Application of biophysics: Biophysical Imaging, Biomechanics, Neurophysics,

Application of medical physics: Radiation Therapy, Nuclear medicine

Solid waste management, Environmental remediation- Green Technology, Water treatment.

UNIT V: Advanced Applications of computer Science

Number System-Binary, Octal, decimal, and Hexadecimal, Signals-Analog, Digital, Modem, Codec, Multiplexing, Transmission media, error detection and correction- Parity check and CRC, Networking devices- Repeater, hub, bridge, switch, router, gateway.

Recommended books:

1. Coordinate Geometry by S.L.Lony, Arihant Publications
2. Calculus by Thomas and Finny, Pearson Publications
3. Matrices by A.R.Vasishtha and A.K.Vasishtha, Krishna Prakashan Media(P)Ltd.
4. "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle
5. "Energy Storage: A Nontechnical Guide" by Richard Baxter
6. "Nanotechnology: Principles and Applications" by Sulabha K. Kulkarni and Raghvendra A. Bohara
7. "Biophysics: An Introduction" by Rodney Cotterill
8. "Medical Physics: Imaging" by James G. Webster
9. "Shape Memory Alloys: Properties and Applications" by Dimitris C. Lagoudas
10. Nano materials and applications by M.N.Borah

11. Environmental Chemistry by Anil.K.D.E.

12. Digital Logic Design by Morris Mano

13. Data Communication & Networking by Bahrouz Forouzan.

STUDENT ACTIVITIES

UNIT I: ADVANCES IN BASIC MATHEMATICS

1: Straight Lines Exploration

Provide students with a set of equations representing straight lines in different forms, suchas slope-intercept form, point-slope form, or general form.

Students will explore the properties and characteristics of straight lines, including theirslopes, intercepts, and point of intersection.

2: Limits and Differentiation Problem Solving

Students will apply the concept of limits to solve various problems using standard limits.

Encourage students to interpret the results and make connections to real-world applications,such as analyzing rates of change or optimizing functions.

3: Integration Exploration

Students will explore the concept of integration as a reverse process of differentiation andapply basic methods of integration, such as the product rule, substitution method, or integration by parts.

Students can discuss the significance of integration in various fields, such as physics andchemistry

4: Matrices Manipulation

Students will perform operations on matrices, including scalar multiplication, matrixmultiplication, and matrix transpose.

Students can apply their knowledge of matrices to real-world applications, such as solvingsystems of equations or representing transformations in geometry.

UNIT II: ADVANCES IN PHYSICS:

1: Case Studies

Provide students with real-world case studies related to renewable energy, nanotechnology,biophysics, medical physics, or shape memory materials.

Students will analyze the case studies, identify the challenges or problems presented, andpropose innovative solutions based on the recent advances in the respective field.

They will consider factors such as energy generation, energy storage, efficiency, sustainability, materials design, biomedical applications, or technological advancements.

2: Experimental Design

Assign students to design and conduct experiments related to one of the topics: renewableenergy, nanotechnology, biophysics, medical physics, or shape memory materials.

They will identify a specific research question or problem to investigate and design anexperiment accordingly.

Students will collect and analyze data, interpret the results, and draw conclusions based ontheir findings.

They will discuss the implications of their experimental results in the context of recentadvances in the field.

3: Group Discussion and Debate

Organize a group discussion or debate session where students will discuss the ethical, social, and environmental implications of the recent advances in renewable energy, nanotechnology, biophysics, medical physics, and shape memory materials.

Assign students specific roles, such as proponent, opponent, or moderator, and provide them with key points and arguments to support their positions.

UNIT III: ADVANCES IN CHEMISTRY:

1. Experimental Design and Simulation

In small groups, students will design experiments or simulations related to the assigned topic.

For example, in the context of computer-aided drug design, students could design a virtualscreening experiment to identify potential drug candidates for a specific disease target.

For nano sensors, students could design an experiment to demonstrate the sensitivity andselectivity of nano sensors in detecting specific analytes.
Chemical biology-related activities could involve designing experiments to study enzyme-substrate interactions or molecular interactions in biological systems.
Students will perform their experiments or simulations, collect data, analyze the results, and draw conclusions based on their findings.

2. Case Studies and Discussion

Provide students with real-world case studies related to the impact of chemical pollutants on ecosystems and human health.
Students will analyze the case studies, identify the sources and effects of chemical pollutants,and propose mitigation strategies to minimize their impact.

Encourage discussions on the ethical and environmental considerations when dealing withchemical pollutants.
For the dye removal using the catalysis method, students can explore case studies wherecatalytic processes are used to degrade or remove dyes from wastewater.

Students will discuss the principles of catalysis, the advantages and limitations of thecatalysis method, and its applications in environmental remediation.
3: Group Project

Assign students to work in groups to develop a project related to one of the topics.

The project could involve designing a computer-aided drug delivery system, developing anano sensor for a specific application, or proposing strategies to mitigate the impact of chemical pollutants on ecosystems.
Students will develop a detailed project plan, conduct experiments or simulations, analyzedata, and present their findings and recommendations.
Encourage creativity, critical thinking, and collaboration throughout the project.

UNIT IV: ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS &CHEMISTRY

1: Mathematical Modelling Experiment

Provide students with a mathematical modelling experiment related to one of the topics. Forexample, in the context of renewable energy, students can develop a mathematical model to optimize the placement and configuration of solar panels in a solar farm.
Students will work in teams to design and conduct the experiment, collect data, and analyze the results using mathematical models and statistical techniques.
They will discuss the accuracy and limitations of their model, propose improvements, and interpret the implications of their findings in the context of renewable energy or the specific application

area.
2: Case Studies and Group Discussions

Assign students to analyze case studies related to the applications of mathematical modellingin nanotechnology, biophysics, medical physics, solid waste management, environmental remediation, or water treatment.
Students will discuss the mathematical models and computational methods used in the case studies, analyze the outcomes, and evaluate the effectiveness of the modelling approach.
Encourage group discussions on the challenges, ethical considerations, and potentialadvancements in the field.

Students will present their findings and engage in critical discussions on the advantages andlimitations of mathematical modelling in solving complex problems in these areas.

3. Group Project

Assign students to work in groups to develop a group project that integrates mathematical modelling with one of the application areas: renewable energy, nanotechnology, biophysics,medical physics, solid waste management, environmental remediation, or water treatment.

The project could involve developing a mathematical model to optimize the delivery of radiation therapy in medical physics or designing a mathematical model to optimize wastemanagement practices.
Students will plan and execute their project, apply mathematical modelling techniques,analyze the results, and present their findings and recommendations.
Encourage creativity, critical thinking, and collaboration throughout the project.

UNIT V: Advanced Applications of computer Science
Students must be able to convert numbers from other number system to binary numbersystems

1. Identify the networking media used for your college network

Identify all the networking devices used in your college premises.

SEMESTER-II

COURSE 3: GEOLOGY AND MINING OF LIMESTONE

Theory Credits: 3 3 hrs/week

Learning Objectives:

1. To impart and inculcate the basic geological knowledge to students
2. Create awareness in students about the Earth's environment, critical issues and need for sustainable development.
3. The course will help the students to exhibit an improved understanding of fundamental petrologic processes and common rock types and their occurrences.

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Classify geological limestone origin in India.
2. Analyse cement grade limestone properties.
3. Describe geological exploration process.
4. Explain 3 mining equipment.

5. Apply environmental protection plans.

III Syllabus:

Unit I Stratigraphy & Geology of Limestone

1. Indian stratigraphy. Types of rocks: Igneous, sedimentary and metamorphic rocks.
2. Structural geology - Fold, Fault, Joint, Unconformities
3. Origin & formation of calcareous rocks

Unit II Distribution and Characteristic of Cement Grade Limestone

1. Physical and chemical characteristics of Limestone. Petrographic study of limestone.
2. Classification of cement grade limestone deposits.
3. UNFC classification of limestone deposits.

Unit – III Exploration and Deposit Evaluation

1. Phases of Geological Exploration with reference to limestone deposits.
2. Geological Mapping, Preparation of Geological Maps and section, Surveying, Sampling practices.
3. Recoding of Exploration Data, Methods of Reserve estimation.

Unit- IV Mining of Limestone

1. Surface mining, method of mining of limestone deposits.
2. Estimation of block size and bench height, estimation of block wise bench wise grade and tonnage, Selection of mining equipment (Excavator, Dozer, Dumper etc.)
3. Blasting techniques, types of explosives used, Uses of explosives, Mine production scheduling and planning. Advance methods of limestone mining,

Unit V Environment around Mines

1. Blasting and resultant vibration, controlled and sequential blasting.
2. Ecological and environmental conditions around limestone mines, plantation, roads, water bodies, social forestry and safety measure Management Techniques.
3. Concept of clean development mechanism, Environmental Impact Analysis (EIA) and Environmental Management Plan (EMP). Brief idea about PL and ML application.

SEMESTER-II

COURSE 3: GEOLOGY AND MINING OF LIMESTONE

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Handle the Muffle Furnace
2. Acquire skill on reverse titration methods
3. Develop filtration techniques.
4. Perform volumetric analysis
5. List 3 oxides in limestone

V. Practical Syllabus:

1. Determination of Loss on ignition
2. Estimation of Carbonates of Limestone
3. Determination of Insoluble matter in Limestone
4. Determination Calcium oxides in Limestone by volumetric method
5. Determination total oxides in Limestone (Al2O3, Fe2O3, MgO)

VI. References:

1. Text Book of Geology : P K Mukherjee
2. Chemistry of Cement and Concrete: F M Lea, Arnold, London
3. A Hand book on Surface Mining Technology : Samir Kumar Dash, Sagar prakashan, Khargpur
4. Cement Data Book: W. H Duda , Verlag G m Bh, Berlin.
5. Norms for limestone exploration for cement manufacture : NCCBM

VII. Co-curricular Activities:

1. Field work
2. Mines visit
3. Assignments on aspects of syllabus
4. Individual student seminars
5. Preparing Charts

SEMESTER-II

COURSE 4: CEMENT AND CEMENT RAW MATERIALS

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. To know the History of Cement, chemical and Physical characteristic of Cement Raw materials.
2. Focus on the assessment of the Cement raw materials.
3. To know the use of Alternative Raw Materials in the clinker

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Explain history of development of binders.
2. Analyse basic concepts of cement manufacturing process.
3. Emphasise types of cement.
4. Examine cement raw materials.
5. Identify available alternate raw materials.

III Syllabus:

Unit I Introduction to Binding Materials

1. Introduction, History of binding materials. Properties and Applications of Binders
2. Plaster Binders, Magnesium Binders, Cement Binders.
3. Calcium Binders – Classification and production of Lime, Lime properties and Lime stacking.

Unit II Introduction to Cement

1. History of Cement manufacturing process, Cement and its Raw Mill Composition, Material composition of cement.
2. Description and use of various type of Cements: Ordinary Port Land Cement (OPC -33 grade , 43 grade and 53 Grade)
3. Portland Pozzolana Cement, Portland Slag Cement

Unit – III Type of Cements

1. Rapid Hardening Portland cement, Extra Rapid Hardening Portland cement, Sulphate Resisting Portland cement.
2. Low – Heat Portland cement, Oil well cement, White Portland cement, Coloured Portland cement, Water Repellent and Hydrophobic Portland cement , Masonry cement.
3. Expansive cement, Super Sulphate Resistant cement, High Early Strength cement, Alinite cement, Belite cement.

Unit IV Cement Raw Materials

1. Calcareous Materials: Limestone, Chalk, Marl.
2. Source, Properties and applications of Calcareous Materials.
3. Argillaceous raw materials: Source, Properties and applications of Silica, Alumina, Iron Oxide, Shale.

Unit V Additives and Alternate Raw Materials

1. Gypsum: Origin, Properties, classification and applications. Role of Gypsum in Cement.
2. Additives - Physical and Chemical Characteristics of various additives such as Bauxite, Iron Ore, Laterite.

3. Industrial waste, types of industrial waste 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.

SEMESTER-II

COURSE 4: CEMENT AND CEMENT RAW MATERIALS

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Understand impact of Specific surface on Strength
2. Fix Cement – Water Ratio
3. Handle Vicat apparatus
4. Measure soundness of cement
5. Operate the compressive strength machine

V. Practical Syllabus:

1. Determination of specific surface
2. Determination of normal consistency
3. Determination of setting time
4. Determination of soundness test by Le Chatelier Autoclave
5. Determination of compressive strength

VI. References:

1. Chemistry of Cement and Concrete, Arnold, London.: F. M.Lea,
2. Cement Data Book: W. H Duda , VerlagG mBh,Berlin
3. Chemistry of Portland Cement, Reinhold, New York :R. H.Bouge.
4. Norms for limestone exploration for cement manufacture : NCCBM
5. Geology of India and Burma : MS Krishnan, CBS Publisher and Distributer, Delhi

VII. Co-curricular Activities:

1. Seminars
2. Assignments
3. Quiz
4. Group Discussions
5. Industry Yard Visit

SEMESTER-III

COURSE 5: SIZE REDUCTION AND PRE-HOMOGENIZATION

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. Understand the principles, Laws and methods of size reduction
2. Describe various size reduction equipment's and their efficiencies
3. Focus on the importance of the Blending and Homogenizing process.

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Describe 5 different screening equipment
2. Calculate size reduction energy requirements
3. Determine 4 crushers
4. Execute Air separators operational procedures
5. Interpret 4 clinker stacking methods

III Syllabus:

Unit I Particle Size Analysis

1. Sieve analysis, Cumulative and fractional plot, size distribution, size averaging and equivalence, size estimation in sub-micron range
2. Optimum sizes at various stages from extraction from mines. Influence of size fraction on reactivity of limestone
3. Screening equipments such as grizzlies, stationary, vibrating, curved and DSM screens & screen capacity

Unit II Size Reduction

1. Laws of size reduction -Bond's law, Rittinger's law & Kick's law, Working Index. Crushing efficiency
2. Size reduction machinery crushers by application of compression such as Jaw crusher, gyratory crushers, roll crushers, cone crushers
3. Size reduction machinery crushers by impact such as Impact crushers and Hammer mills

Unit – III Size Classification and Separators

1. Storage of Solids: Bins, silos, hoppers & feeders; storage of raw materials in piles
2. Size Classification and Air Separators: Methods of size classification, principles of air separators and different types of air separators used in cement manufacturing
3. Wet classification: hydro-cyclones, cyclone material balances in open circuit and closed circuit operations & separating efficiency.

Unit- IV Blending & Pre-homogenization

1. Preparation of cement raw meal as per raw mix design, combined & segregated pre-homogenization, Methods of pre-homogenisation.
2. Types of homogenisation silos: discontinuous batch homogenisation silos, continuous overflow homogenizing silos, continuous homogenizing silos.
3. Stacking of blending beds namely in longitudinal & circular stockpiles system & their comparison.

Unit V Stacking Methods

1. Stacking of blending beds, Chevron method , Windraw method , Areal stock piling , Axial stock piling, continuous stock piling .
2. Alterative stock piling Equipments used for reclaiming material from stockpiles such as scraper, bucket wheel, bucket wheel with slewing boom and drum re-claimers.
3. Blending bed theory: batch & continuous homogenization; Fuller's one- eight blending method.

SEMESTER-III

COURSE 5: SIZE REDUCTION AND PRE-HOMOGENIZATION

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Perform Sieve Analysis
2. Operate Jaw Crusher
3. Handle Crushing rolls
4. Calculate Critical Speed of Ball Mill
5. Maintain Grinding Bed of VRM

V. Practical Syllabus:

1. To carry out differential and cumulative screen analysis of solid particles.
2. To study performance of Jaw Crusher and find out its crushing efficiency.
3. To study performance of Crushing Rolls and find out its crushing efficiency.
4. To study performance of Ball Mill and find out its crushing efficiency.
5. To study performance of Vertical Roller Mill and find out its crushing efficiency.

VI. References:

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
4. Introduction to the Principles of Size Reduction of Particles by Mechanical Means By Richard R. Klimpel
5. Size Reduction of Divided Solids, Author: Jean-Paul Duroudier

VII. Co-curricular Activities:

1. Quiz
2. Review analysis
3. Group discussions.
4. Seminars
5. Assignments

SEMESTER-III

COURSE 6: MATERIAL HANDLING SYSTEMS IN CEMENT INDUSTRY

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. Understand the usage of different material handling equipment in cement industry.
2. Identify the characteristics of product and process layouts and their needs in terms of materials handling.
3. Determine specific load conditions and economics of material handling systems.

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Describe plant layout and material flow cycle
2. Evaluate Direct and Indirect cost
3. Select Material Handling Equipment
4. Explain Elevators, Conveyors and Feeders.
5. Understand Plant Layout design procedures

III Syllabus: (Total Teaching Hours: 45)

Unit I Introduction to Material Handling

1. Objective and Benefit of better handling, limitation and negative aspects. Importance, Objective plant layout and material flow cycle, material handling equation.
2. Principle of material handling: Systems, material handling. The Material Flow, Simplification, Gravity, Space Utilization, safety and mechanization Equipment Selection.
3. Flexibility, Dead Weight, Motion, Idle time, Maintenance, Control capacity and performance.

Unit – II Material Handling at Workplace

1. Equipment Cost Determination: Evaluation of Direct and Indirect cost
2. Determination of Total Handling cost of material handling.
3. Methods to minimize cost of material handling- Maintenance of material handling equipments, safety in handling ergonomics of material handling equipment. Design, miscellaneous equipments.

Unit III Basic Handling Equipment Types & Systems

1. Equipment classifications. The Unit load Concept: Types of Unit load, advantages and disadvantages, Planning the Unit load systems, Unit load Efficiency.
2. Selection of Material Handling Equipment: Cranes, Hoists, Monorail.
3. Industrial Vehicles Container and supports, Auxiliary Equipment.

Unit- IV Material Handling and Feeding Systems

1. Various systems of material handling; haulage and transportation from mines, trucks, dumpers etc.
2. General introduction, Characteristics, Working and applications of - Conveyors, Elevators.
3. Feeders, Weighing equipment.

Unit V Plant Layout for Material Handling

1. Introduction – classification of layout, advantages and limitations of different layouts.
2. Layout design procedures, over view of the plant layout.
3. Process lay out and product lay out selection, specification, implementations and fallow up comparison of product and process lay out

SEMESTER-III

COURSE 6: MATERIAL HANDLING SYSTEMS IN CEMENT INDUSTRY

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Perform Volumetric analysis
2. Handle titration apparatus
3. Quantify the oxidizable pollutants in water
4. Analyze the water quality
5. Estimate the salinity of water

V. Practical Syllabus:

1. Determination of Dissolved Oxygen
2. Determination of Biological Oxygen demand (BOD)
3. Determination of Chemical Oxygen demand (COD)
4. Determination of Suspended, Dissolved and Total solids in water.
5. Estimation of Chlorides in water.

VI. References:

1. Material Handling System Design: James M Apple, Gerogia Institute of Technology, The Ronald press company, New York.
2. Introduction to Materials handling by Siddharth Ray.
3. Materials Handling Handbook by David Mulcahy
4. "Bulk Material Handling by Conveyor Belt 6" by Michael T Myers
5. "Design and Selection of Bulk Material Handling Equipment and Systems: Volume I: Mining, Mineral Processing, Port, Plant and Excavation Engineering" by Peter Hilgraf

VII. Co-curricular Activities:

1. Review Analysis
2. Industry Visit
3. Quiz
4. Assignments
5. Plant lay our Chart Preparation

SEMESTER-III

COURSE 7: RAW MIX DESIGN AND CLINKER MANUFACTURING

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. Understand the concept of raw mix design of clinker & its importance in the composition and quality of clinker.
2. Description of operations in a cement kiln and manufacture of Clinker
3. Describe types of grinding process and grinding mills in finish grinding of cement.

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Define modulus of cement raw materials.
2. Describe clinker manufacturing process.
3. Evaluate constituents in clinker phase using Bauge's calculation.
4. Explain 3 grinding mills.
5. Emphasise gypsum effect in cement hydration process.

III Syllabus:

Unit I Sampling and Pre blending of Cement Raw Materials

1. Estimation of Silica Modulus, Alumina Modulus, Hydraulic Modulus, Lime Saturation Factor.
2. Liquid Content, method proportioning, 2,3 and 4 component mixes, impact of moduli values on cement manufacturing process and quality of clinker.
3. Calculation of lime consumption factor.

Unit II Clinker Manufacturing Process

1. Chemical composition of various types clinker.
2. Introduction to phase rule, phase diagram: alite , belite, aluminate and ferrite phase, cement component and their phase relation.
3. Binary and ternary compounds of cement and formation of eutectic.

Unit III Bauge's Calculation

1. Clinker minerals, absorption of constituents in clinker phases, chemical reaction during clinkerization.
2. Role of minor constituents in clinkerization.
3. Thermo chemistry of clinker formation. Mineralizer.

Unit IV Cement Grinding

1. Introduction, types of Grinding processes, different types of grinding mills.
2. Detailed study of Ball mill, Vertical roller mill and Roller press mill.
3. Finish grinding system.

Unit V Hydration of Calcium Silicate Phases

1. Role of gypsum in cement hydration process, hydration of Portland cement.
2. Hydration of Portland cement at increased temperature.
3. Role of additive in clinker formation, various mineralizer and fluxes, their role in manufacture of clinker.

SEMESTER-III

COURSE 7: RAW MIX DESIGN AND CLINKER MANUFACTURING

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Determine volatile matters
2. Handle Muffle furnace
3. Use filtration techniques
4. Estimate the amount Iron-oxide in clinker
5. Assess the quality of Clinker

V. Practical Syllabus:

1. Determination of Insoluble Residues in OPC Clinker
2. Determination of SiO_2 in OPC Clinker
3. Determination of R_2O_3 in OPC Clinker
4. Determination of Fe_2O_3 in OPC Clinker
5. Determination of CaO in OPC Clinker

VI. References:

1. Chemistry of Cement and Concrete, Arnold, London.: F. M.Lea,
2. Cement Data Book: W. H Duda , VerlagG mBh,Berlin
3. Chemistry of Portland Cement, Reinhold, New York :R. H.Bouge.
4. Cement and Concrete Chemistry Authors: Kurdowski, Wieslaw
5. Handbook on Concrete Mixes (based on indian standards)

VII. Co-curricular Activities:

1. Assignments
2. Seminars
3. Industry laboratories visit
4. Quiz
5. Group Discussions

SEMESTER-III

COURSE 8: SAFETY, HEALTH AND ENVIRONMENT SCIENCE

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. This course also emphasis on the knowledge of loss prevention, personal safety, industrial safety, hazard analysis, toxicology and personal proactive equipments.
2. To learn and understand the importance of safety and their uses in work environment.
3. Promote the knowledge of pollution control equipment, their design aspects and various techniques to reduce the concentration of pollutants.

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Identify accident type and causes
2. List cement kiln dust characteristics
3. Identify dust and gas emission sources
4. Follow pollution control measures in Mines
5. Utilize Environment Management Tools

III Syllabus:

Unit I Safety

1. Introduction to process of safety, Importance of safety, type of accident & causes, direct and indirect effect of accident, accident and loss statistics.
2. 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.
3. Measure of risk , laws, rules and regulation conserving safety in cement plant for prevention of accident, managerial aspect of safety.

Unit II Dust Generation and Control

1. Both fugitive and point source of dust emissions in cement plant, classification of particle size distribution of dust.
2. Cement kiln dust characteristics, dust emission standards, health effects on workers exposure to dust, method of adoption to control of dust at the source.
3. Dust control equipment, such as gravity setting chamber, cyclones, ESP, Bag house filters and ESP with GCT efficiency of collection

Unit III Air Pollution Control

1. Emission source of CO, CO2, NOx and Sox, concerns about green-house gas emissions and climate change, health concern.
2. Source model- release and flow of toxic gases and particulates from the stack factors affecting their dispersion and modelling.
3. Measuring equipment of exit gases ,SOx, NOx and CO. Regulatory requirements, equipment required to control gaseous pollutants, recent development.

Unit IV Noise Abatement & Solid Waste

1. Noise of running machinery and mills, method of noise suppression, balancing of equipment, noise barriers, effect of plantation, effect on human heath, regulatory requirement.
2. Noise - abatement techniques, Waste water – treatment methods and reuse.
3. 3 Solid and Hazardous Waste – Management, Measures for pollution control in Mines.

Unit V Environment Management

1. Introduction to various Environmental Act & Regulations, Environment Protection Act 1986, Water (Prevention and Control of Pollution) act, Water (Prevention and Control of Pollution) act, Air (Prevention and Control of Pollution) act, Forest (Conservation) Act.
2. Hazardous Waste (Management, Handling and trans-boundary movement) Rules, Solid Waste Management Rules, Mines Act, Factory Act, Corporate Responsibility for ENV Protection (CREP).
3. 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).

SEMESTER-III

COURSE 8: SAFETY, HEALTH AND ENVIRONMENT SCIENCE

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Handle fire extinguisher
2. Use safety valves, pressure relief valves
3. Measure sound intensity
4. Find heat of hydration of cement
5. Find out turbidity in water sample

V. Practical Syllabus:

1. Study of Fire Extinguishers
2. Study of safety valves, pressure relief valves etc.
3. Determination of sound intensity (decibel meters)
4. Determination of Heat of Hydration Cement
5. Determination of Turbidity

VI. References:

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
5. Basic environmental technology: Jerry; A. Nathanson.

VII. Co-curricular Activities:

1. Safety Awareness Rally
2. Students Demonstration on PPE
3. Quiz
4. Environmental day celebration
5. Eco clubs

SEMESTER-IV

COURSE 9: FUELS AND FIRING SYSTEMS

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. Understand solid, liquid and gaseous fuel properties, analysis, process and handling.
2. Use simple symbol equations to explain combustion reactions and calculate theoretical air requirement for combustion.
3. Apply the knowledge for flame stabilization in various types of industrial burners.

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Differentiate fuels
2. Analyze Flue gas
3. Choose appropriate fuel for 3 types of firing systems.
4. List safety precautions
5. Classify lubricants

III Syllabus:

Unit I Introduction to fuels

1. Type of fuels, Coal, Lignite, Oil and Natural Gas.
2. Geological Origin and distribution of coal, Lignite and Oil and Natural gas. Distribution of coal and lignite deposits in India.
3. Introduction to alternative fuels for cement manufacture.

Unit II Characteristics of Fuels

1. Physical characteristics of different types of fuels - and Chemical characteristics of different types of fuels, Ultimate and Proximate analysis of coal.
2. Calculation of theoretical air requirement, preparation and handling of fuel, safety hazards.
3. Flue gas analysis, Otto Halfmann's byproduct Oven method, Preparation Coke from Coal

Unit III Firing System – I

1. Introduction to various types of firing systems in cement plant, their advantages and disadvantages.
2. Coal Firing System: Introduction, classification, selection criteria for coal firing.
3. Pulverized coal ash flame, Pulverized coal ash burner.

Unit IV Firing System - II

1. Oil Firing System: Introduction to Fuel oil, Fuel Oil transport and storage, Fuel oil Atomization, Fuel oil Burners, Control loops in fuel oil plant.
2. Gas firing System: Natural gas, Natural gas preparation, Natural gas burners, Flame adjustment, safety precautions.
3. Production and Characterization of Alternative Fuels, Performance and Emission Characteristics, Future Scope.

Unit V Flames and Burners

1. Introduction, types of flame, flame characteristics, flame adjustment, flame momentum, Secondary firing and pre-calcinator, Combustion Indications.
2. Burners, types of burners , application
3. Lubricants- Classification, Characteristics and Applications

SEMESTER-IV

COURSE 9: FUELS AND FIRING SYSTEMS

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Analyze the moisture in coal
2. Determine volatile matters
3. Handle the furnace
4. Estimate fixed carbon in fuel
5. Calculate Gross Calorific value

V. Practical Syllabus:

1. Determination of Moisture content of Coal
2. Determination of Volatile Matter present in Coal
3. Determination of Ash Content present in Coal
4. Determination of Fixed Carbon present in Coal
5. Determination of Gross Calorific Value of Coal

VI. References:

1. Fuels and combustion : Samir Sarkar, New Delhi Reference Books:
2. Firing System: Process Technology: Cement Seminar, Holderbank
3. Flame & Burners : Process Technology: Cement Seminar, Holderbank.
4. Refractory Lining of Cement Kiln System : Process Technology: Cement Seminar, Holderbank
5. Cement Data Book: W. H Duda , Verlag G m Bh,Berlin.

VII. Co-curricular Activities:

1. Assignments
2. Seminars
3. Cement Industry visits
4. Industry experts interaction
5. Review Analysis

SEMESTER-IV

COURSE 10: EIA AND EMP OF CEMENT PLANT

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. Understand the importance of Social Impact Assessments and public participation in the EIA process.
2. Identification of mitigating strategies, such as prevention and control, for each environmental component, as well as a restoration and resettlement strategy.
3. Describe all monitoring procedures required to identify environmental impacts.

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Check water quality
2. Utilize 5 techniques to control pollution
3. Understand impacts of Cement plant on Environment
4. Demonstrate 6 Environment Management Acts
5. Identify ambient air quality

III Syllabus:

Unit I Introduction

1. The Environment, Interaction of Humans and Environment.
2. Role of an engineer in Environmental improvement. Present Environmental Scenario: socio economic studies , buffer zone , demographic profile.
3. Environmental quality , air environment , micro-meteorology, dust environment , water quality , noise level.

Unit II Sources of Pollution in Cement Industry

1. Air Pollution – Sources, Ambient Air Quality, Fugitive dust, Point Source – Green House Gas, particulate matter (PM), SO2, NOx, CO, HCl, HF, Heavy Metals, Dioxins & Furans, TOC, TVOC etc.
2. Water pollution – Sources, Consumption, waste water generation, storm water.
3. Noise pollution – Sources, Solid and Hazardous Waste – utilization.

Unit III Environmental Impact Assessment

1. 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.
2. Impact on safety , impact on environmental quality , ambient air quality , impact on water quality , impact on noise levels.
3. Mathematical modelling for dispersion of air pollutants, Battelle Environmental Evaluation System.

Unit IV Environment Management Act

1. 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,
2. Forest (Conservation) Act, Hazardous Waste (Management, Handling and trans boundary movement) Rules, Solid Waste Management Rules, Corporate Responsibility for ENV Protection (CREP).

3. Environment Management Tools :EMS – ISO 14001, Environmental Audit / Statement, Clean Development Mechanism (CDM).

Unit V Environmental Management Plan

1. Socio economic factors, rehabilitation , compensatory afforestation , welfare measures, environmental quality , ambient air quality , green belt development , water quality , noise levels control measures ,
2. Occupational health, disaster and hazard management.
3. Post Project environmental monitoring programme : organisational structure , monitoring scheme, equipments required for monitoring , budgetary provision for EMP.

SEMESTER-IV

COURSE 10: EIA AND EMP OF CEMENT PLANT

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

1. Estimation of Hardness of water
2. Perform volumetric titrations
3. Select suitable Indicator
4. Operate PH meter
5. Use Conductometer

V. Practical Syllabus:

1. Estimation of Hardness of water
2. Determination of Alkalinity of water
3. Determination of Acidity of water
4. Operate and calibrate of pH meter
5. Determine of Conductivity of water

VI. References:

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

VII. Co-curricular Activities:

1. Assignments
2. Health camps
3. Quiz
4. Poster Presentation
5. Eco clubs

SEMESTER-IV

COURSE 11: REFRACTORY ENGINEERING

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. Understand properties, types and the importance of refractories for cement production.
2. Implement most appropriate installation techniques.
3. To explain how refractory materials respond to different service conditions and issues related to their quality and reliability.

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Classify refractories
2. Understand lining of Kiln
3. Illustrate properties of refractories
4. Select suitable refractories
5. Apply Kiln startup & Stoppage procedures

III Syllabus:

Unit I Fundamentals of Refractory

1. Refractory classification, importance of refractories for cement production,
2. Types of refractories, its application, factors effecting wear of refractories in cement industry.
3. Castables, its types and composition, mortars.

Unit II Drying and Firing Phase Diagram

1. Drying and firing phase diagram, Manufacture and properties of silica, alumina silicate refractories.
2. Periclase, magnesite, magensite-chrome, dolomite, high and low temperature insulating refractories.
3. Acid proof bricks and carbon based refractories.

Unit III Properties and Measurements

1. Properties and measurement of cold crushing strength, refractoriness under load, hot modulus of rapture creep behavior.
2. Abrasive resistance, thermal spalling, reaction of refractories.
3. Slag, glasses, Carbon monoxide, acids, alkalise, flue gases, corrosion of regenerated refractories by flue gases.

Unit IV Subdivision of Burning Process of Refractories

1. Subdivision of burning process & selection of refractory in kiln drying zone, preheating zone, calcining zone, transition zone, sintering zone, cooling zone.
2. Lining of preheater, kiln hood, coolers.
3. Features of refractory installation (brick joints, lining methods, rotating methods, screw jack method etc).

Unit V Selection of Refractories

1. Selection of refractories and castables for different location of Cement plant.
2. Procedure for laying start up and stoppage of kiln for cement plant.
3. Measures to improve refractory life in rotary kiln in cement plant, cost effectiveness, case studies for payback calculation.

SEMESTER-IV

COURSE 11: REFRACTORY ENGINEERING

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

1. Handle Hot Air Oven
2. Use Platinum Crucibles
3. Perform filtration process
4. Estimate Iron oxide
5. Handle Muffle Furnace

V. Practical Syllabus:

1. Estimation of Loss on Ignition
2. Estimation of Total Silica present in Iron ore
3. Estimation of Al_2O_3 present in Iron ore
4. Estimation of Fe_2O_3 present in Iron ore
5. Determination of CaO & MgO present in Iron ore

VI. References:

1. Refractory Engineering and Kiln Maintenance in Cement Plant: J P Saxena, CRC Press, Technology & Engineering
2. Refractory Lining of Cement Kiln System : Process Technology: Cement Seminar, Holderbank
3. Hand Book of Industrial Refractories Technology: Stephen C, Carniglia Godon L Barma, Noyes Publication
4. Refractory Linings: Thermo mechanical Design and Applications: Charles Schacht, CRC Press, Technology & Engineering.
5. Cement Data Book: W. H Duda , Verlag G m Bh, Berlin.

VII. Co-curricular Activities:

1. Seminars
2. Cement Industry Rotry Kiln Visit
3. Interaction with Cement Industry Experts
4. Group Discussions on selection of refractories
5. Field Work

SEMESTER-V

COURSE 12: PYRO PROCESS IN CEMENT INDUSTRY

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. Classify various types of clinker coolers in cement manufacturing.
2. Equipment operation and processes such as the Kiln, Preheater, and process fans.
3. Explain thermal heat calculations, sizing of kiln.

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Evaluate kiln parameters
2. Categorise pre-heaters and pre-calciners
3. Operate 6 process fans
4. Differentiate 4 clinker coolers
5. Explain grinding aids

III Syllabus:

Unit I Types of Preheaters

1. Types of Preheater, Comparison, selection of different stages(4/5/6) preheaters.
2. Pre-calciners- Features, advantages and dis advantages of pre-calciners. Primary air, Secondary air, Tertiary air.
3. Optimization of kiln output, factors affecting the kiln output. Determination of parameters of kiln evaluation: thermal loading, volumetric loading, % filling, kiln bypass system.

UNIT-II Types of kiln

1. Rotary Kiln, different type of clinkerisation process. Advantages and Disadvantages of each process; Dry process, Semidry process. Wet Process; Long wet process Kiln.
2. Introduction to preheater and pre-calcinator. Modern rotary kiln, Thermal heat calculation, sizing of kiln.
3. Heat balance of kiln, air balance of kilns, inlet seal, Methods used to feed raw meal in the kilns.

UNIT-III Process Fans

1. Purpose of fan, types of fans, their application.
2. Concept of pressure, velocity pressure, total pressure in an air stream.
3. Characteristic curves of fans, fan laws, comparison and selection of principal types of fans.

UNIT-IV Cooling of Clinker

1. Purpose of clinker cooling, types of coolers: Grate Cooler, Reciprocating grate cooler, History, Design features of modern coolers, Cooler control, Cooler de dusting, Non-ventilating cooler, Travelling grate cooler.
2. Rotary Cooler: General design, Cooling performance, Advantages / Disadvantages. Planetary Cooler: General design features, Internal heat transfer equipment, Heat transfer and efficiency, Enhanced cooling, Advantages / Disadvantages.
3. Other Systems: g-cooler, Shaft cooler Comparison of Coolers : Range of application, Operating data and heat balance, Capital and operating costs.

UNIT –V Clinker Storage

1. Method of clinker storage**:** Silos and Gantry, Clinker Shipment. Gypsum and other additives, grinding aids. Types of cement grinding system and their comparison,
2. Cement conveying to storage, single and multi component silos.
3. Cement packing & Transportation, Bulk Loading.

SEMESTER-V

COURSE 12: PYRO PROCESS IN CEMENT INDUSTRY

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Handle Hot Air Oven
2. Use Silica Crucibles
3. Perform filtration process
4. Estimate Iron Oxide
5. Handle Muffle Furnace

V. Practical Syllabus:

1. Determination of Loss on Ignition of Kiln Feed.
2. Estimation of SiO_2 present in Kiln feed
3. Determination of Al_2O_3 present in Kiln feed
4. Determination of Fe_2O_3 present in Kiln feed
5. Estimation of CaO present in Kiln feed

VI. References:

1. Cement Data Book: W. H Duda ,Verlag G mBh,Berlin.
2. Kiln System : Process Technology: Cement Seminar, Holderbank
3. Precalcining System : Process Technology: Cement Seminar, Holderbank
4. Clinker Cooler : Process Technology: Cement Seminar,Holderbank
5. Rotary Kilns: Transport Phenomena and Transport Processes (2nd edition) by A.A. Boateng

VII. Co-curricular Activities:

1. Assignments
2. Mini project
3. Poster presentation
4. Cement Industry Rotary Kiln Visit
5. Interaction with Cement Industry Experts

SEMESTER-V

COURSE 13: SPECIAL CEMENTS AND PERFORMANCE OF CEMENT

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. Know various types of special cements manufacturing, properties & its application.
2. To get a broad perspective of special cement performance.
3. To understand durability consideration of concrete

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Describe Cement Kilns developments
2. Classify kilns based on reaction zone length
3. Operate and control the temperatures of kiln at multiple locations
4. Explain preheater, kiln tube and cooler design aspects
5. Identify internal cycles of inorganic elements

III Syllabus:

Unit I Characteristics of Cementious Materials

1. Characteristic of fly ash, Granulated blast furnace slag, other Pozzolanic materials for cement production.
2. Introduction to Geopolymeric cement, alternate Cementious materials other than OPC
3. Performance of Blended Cement, advantages of Portland Pozzolana Cements (PPC) and Portland Slag Cement (PSC).

Unit II Special Cements

1. Introduction, Sorel cement, Very High Strength Cement, Decorative Portland Cements, Chemical Cements.
2. Special Portland Type Cements, Calcium Aluminate Cement
3. Production of Low Energy Cements, Gypsum Plaster Cement, Portland Cements with Improved Reactivity, Alkali Activated Slags and Other Alumino Silicates.

Unit III Performance requirements

1. Performance Requirement of cement: Concrete and mortars, introduction to various infrastructure and use of cement.
2. Requirement of setting, strength and durability of different concrete constructions, effect of chemical composition and physical characteristic of cement on performance.
3. Fineness and particle size distribution, tailoring performance of cements.

Unit IV Operational Problems

1. Operational Problems - Cause and measure to solve them- Coating, ball formation, cyclone jamming, other emerging conditions.
2. Wear in cement plant- abrasion, erosion, corrosion, causes and control measures.
3. Durability consideration of concrete, sulphate attacks, corrosion of reinforcing steel in concrete, attack by acid and other aggressive agencies.

Unit V Maintenance

1. Maintenance strategies, preventive maintenance, condition monitoring for predictive Maintenance.
2. Check for kiln alignment and shell ovality, annual maintenance, shutdown Maintenance.
3. Economic life of refractories , and machineries, check lists, shutdowns, upset kiln conditions- causes and controls.

SEMESTER-V

COURSE 13: SPECIAL CEMENTS AND PERFORMANCE OF CEMENT

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Use filtration techniques
2. Operate Muffle furnace
3. Perform Separation techniques
4. Perform various weighing techniques
5. Perform various titration methods

V. Practical Syllabus:

1. Determination of CaO in Cement
2. Estimation of Al_2O_3 present in Cement
3. Determination MgO present in Cement
4. Calculation of SO_3 present in Cement
5. Determination of Chlorides present in Cement

VI. References:

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
5. Cement Data Book: W. H Duda , Verlag G m Bh,Berlin

VII. Co-curricular Activities:

1. Seminars
2. Construction Sites Visit
3. Industry lab Visit
4. Quiz
5. Assignments

SEMESTER-V

COURSE 14: CEMENT GRINDING, PACKING AND LOADING FOR DISPATCH

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. Select the suitable grinding aid for finish grinding of Portland cement clinker.
2. Discuss various types of cement packing methods.
3. Understand the mechanical components, working and methods feeding in various conveying systems.

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Describe Cement Kilns developments
2. Classify kilns based on reaction zone length
3. Operate and control the temperatures of kiln at multiple locations
4. Explain preheater, kiln tube and cooler design aspects
5. Identify internal cycles of inorganic elements

III Syllabus:

Unit I Finish Grinding

1. Materials involved in finish grinding- Portland cement clinker, Blast furnace slag, pozzolanas, fly-ash, sulphates.
2. Fineness and particle size distribution, Mill atmosphere, grinding aids.
3. Storage of cement-storage in the cement works, storage in the construction site.

Unit II Packing

1. Storage of cement**,** Precautions for Proper Storage of Cement
2. Introduction, types of packing, sacks,
3. In-line packing machines, Rotary packers, fully automation operation, sack magazine.

Unit III Dispatch of Cement

1. Dispatch in sacks, individual sack loading, Pelletization, direct loading, bulk loading.
2. Loading installations, weighing systems, loading of clinker and crushed stone.
3. Big Bag dispatch, shrink wrapping, automation of dispatch procedures.

Unit IV Handling and Feeding Systems

1. General introduction, Belt conveyors and steel band conveyors. Bucket elevators- general explanation, Belt bucket elevators, chain bucket elevators, swing bucket elevators.
2. Chain Conveyors- Flight conveyors, continuous flow conveyors, apron conveyors.
3. Vibratory conveyors,screw conveyors, pneumatic conveyors, Feeders, Weighing equipment.

Unit V Pollution Control Equipments

1. Air - Control measures for improving ambient air quality (AAQ) and fugitive dust, AAQ – Monitoring methods.
2. 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.
3. Stack monitoring for particulate matter and gases. GHG control – Blended cement, use of alternate fuels, carbon sequestration.

SEMESTER-V

COURSE 14: CEMENT GRINDING, PACKING AND LOADING FOR DISPATCH

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Handle Hot Air Oven
2. Use Silica Crucibles
3. Perform filtration process
4. Estimate oxides
5. Handle Muffle Furnace

V. Practical Syllabus:

1. Determination of Loss on Ignition of Cement
2. Estimation of Insoluble Residues in Cement
3. Estimation of SiO2 present in Cement
4. Calculate the amount of R2O3 present in Cement
5. Determine the amount of Fe2O3 present in Cement

VI. References:

1. Cement Engineers Handbook IV Edition by B. Kohlhaas.
2. Cement engineers hand book by Otto Ladahn.
3. Cement Data Book: W. H Duda , Verlag G m Bh,Berlin vol.1& 2.
4. Transport Processes in Concrete ByRobert Cerny, Pavla Rovnanikova
5. Measurements and Applications By Peter Claisse

VII. Co-curricular Activities:

1. Ball mill visit
2. Packing plant Visit
3. Roto packer observation
4. Quiz
5. Seminars

SEMESTER-V

COURSE 15: ALTERNATIVE FUELS AND RAW MATERIALS FOR CEMENT PRODUCTION

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. Comprehensive overview of using alternative fuels in cement plants
2. To know the use of Alternative Raw Materials in the clinker
3. Reduce greenhouse gas (GHG) emission caused by combustion of fossil fuels (coal, petcoke and etc) in cement plants by utilization of alternative fuels.

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Describe Alternate raw materials
2. Explain Alternate fuels
3. Differentiate 5 alternate fuels
4. Apply emission monitoring methods.
5. Demonstrate Waste Heat Recovery

III Syllabus:

Unit I Alternate Raw Materials

1. 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,
2. 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.
3. 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

1. 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.
2. Characteristics of alternate fuels, various handling & pre-processing equipment of alternate fuels.
3. Advantages and disadvantages of alternate fuels. Environmental consideration in use of alternate fuels in cement kiln.

Unit – III Properties of Alternative Materials

1. Introduction to generation and availability of coal ash, types of coal ash and its usages. Fly ash – characteristics, classification, chemical and physical properties, phase composition, Mechanical and chemical activation. 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.
2. 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.
3. Manufacturing ofPortland 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 Environmental Protection Act

1. Hazardous waste, Rules under the environmental protection act, Guide line for collection, storage and transportation of hazardous waste.
2. Pre-processing to prepare homogeneous waste mixes suitable for co- processing.
3. Emission standards for co-processing of alternate fuel and raw materials and hazardous waste in cement plant, methods of emission monitoring.

Unit - V Energy Recovery

1. Recovery of energy from in cement industry-Possible Heat Sources such as Kiln Shell, clinker cooler, kiln system exit gas.
2. Waste heat recovery/thermal energy storage applications: Sensible Heat Storage.
3. Waste Heat Recovery Power Plants in Cement Industry - Waste Heat Sources and their Potential, Broad System Concept of Waste Heat Recovery Power Plant.

SEMESTER-V

COURSE 15: ALTERNATIVE FUELS AND RAW MATERIALS FOR CEMENT PRODUCTION

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Use mixing techniques
2. Use filtration techniques
3. Estimate the amount oxides in Gypsum
4. Handle Muffle furnace
5. Perform various weighing techniques

V. Practical Syllabus:

1. Determination of combined water % of Gypsum
2. Determination of insoluble matter of Gypsum
3. Estimation of amount of R_2O_3 in Gypsum
4. Determination of amount of CaO present in Gypsum
5. Estimation of Sulphuric anhydride present in Gypsum

VI. References:

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.

VII. Co-curricular Activities:

1. Awareness Programme on Alternate Raw materials
2. Cement Industry Visit
3. Group discussion on impact of Alternative Fuels
4. Quiz
5. Assignments

SEMESTER-VII

COURSE 16: KILN SYSTEMS AND THEORY

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. Learn the kiln design, operation in a cement kiln and controls.
2. Describe different types of heat transfer in a rotary kiln
3. Understand a series of chemical reaction are takes place in the different zones of the kiln as per difference in temperature

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Describe Cement Kilns developments
2. Classify kilns based on reaction zone length
3. Operate and control the temperatures of kiln at multiple locations
4. Explain preheater, kiln tube and cooler design aspects
5. Identify internal cycles of inorganic elements

III Syllabus:

Unit I Kiln Systems – I

1. History, types of Rotary Kilns,
2. Heat transfer- Thermal work required in a cement kiln, Heat profile, Heating the feed, Heat transfer calculations, Heat Balances.
3. Chemistry of Kiln feed and Clinker, Bogue formulas for clinker and cement constituents, Influence of feed composition and burnability.

Unit II Kiln Systems - II

1. Reaction zones in various kiln system –Long wet process kilns, Dry process kiln, Semi dry kiln, Pre-heater and Pre-calciner kilns
2. Coating and ring formation in a Rotary kiln – Burning zone, uphill of the burning zone. Moment of material through the kiln
3. The air circuit in the Rotary kiln – Cooler air circuit, Kiln ait circuit, the discharge air circuit.

Unit III Kiln System Design

1. Introduction, The process related to design, Heat Consumption related to design,
2. Modern kiln designs and their operation – SP kiln system, ILC kiln system, SLC kiln system.
3. Kiln control strategy, Kiln operation and kiln expert system, Choice of Kiln system, Dimensioning.

Unit IV Kiln Components

1. Pre-heater cyclone Design aspects and Operation , Pre-calciner Design aspects and Operation
2. Kiln tube Design aspects and Operation
3. Grate cooler Design aspects, Operation, Control and regulation, Efficiency

Unit V Inorganic chemistry in the kiln system

1. Introduction, S, Cl, Na and K species in the rotary kiln, calciner and lower preheater cyclones.
2. Release and Capture of Inorganic Volatile Elements - High-temperature reactions between SO2 and limestone, Removal of chlorine from the kiln system.

3. Equilibrium calculations on influence of reducing conditions- Influence of reducing conditions, Relative stability of sulfates towards reducing conditions , Concluding remarks about thermodynamic equilibrium calculations.

SEMESTER-VII

COURSE 16: KILN SYSTEMS AND THEORY

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Prepare sample for X-ray Diffraction
2. Use filtration techniques
3. Estimate the amount oxides in Gypsum
4. Handle Muffle furnace
5. Perform various weighing techniques

V. Practical Syllabus:

1. XRD method for chemical analysis of cement
2. XRF for analysis of cement and raw materials
3. Optical microscopic studies of clinker
4. Optical microscopic studies of limestone
5. Optical microscopic studies of concrete

VI. References:

1. Combustion of large solid fuels in cement rotary kilns, Nielsen, Anders Rooma.
2. The Cement Plant Operations Handbook, Philip A Alsop, PhD.
3. Design and Operations, Charles E. Baukal, JR.
4. The Rotary Cement Kiln, 1998 · 8.88 MB · 4,187 Downloads· English, by Kurt E. Peray.
5. Refractory Lining of Cement Kiln System : Process Technology: Cement Seminar, Holderbank

VII. Co-curricular Activities:

1. Seminars
2. Industry lab Visit
3. Quiz
4. Assignments
5. Cement Industry Rotary Kiln Visit

SEMESTER-VII

COURSE 17: ADMIXTURES COMPOSED CEMENT AND ITS USES

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. Learn different types of aggregates, admixtures & know the mechanism of hydration of cement.
2. Explain Properties, Hydration reactions of composed materials when it's added to the Ordinary Portland cement.
3. Discuss Formation, treatment and use of composites in composite cement preparation.

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Classify Admixtures and effects
2. Explain hydration chemistry of Portland and composite cements
3. Examine Formation, treatment, hydration of composite cements
4. List out the effects of pore structure on composite cement properties
5. Demonstrate properties of calcium aluminate and rapid hardening cements

III Syllabus:

Unit I Admixtures and special uses of cements-1

1. Retarding admixtures and Accelerating admixtures**,** Organic retarders and accelerators**,** Retarders, Mechanism of retardation, Practical retarders and Organic accelerators
2. Inorganic accelerators and retarders - Accelerators of setting and hardening, Mode of action, Effects on the composition and structure of the hydration products
3. Water reducers and super plasticizers - Mode of action of water reducers and super plasticizers, Zeta potential, Rheology and nature of the sorbent phases and Reasons for the enhanced dispersing power of super plasticizers, Air-entraining agents and grinding aids.

Unit II Admixtures and special uses of cements-2

1. Pozzolanic or Mineral Admixtures, Pozzolanic Materials: Natural Pozzolans, Artificial Pozzolans (Fly ash, Blast Furnace Slag, Silica Fume, Metakaoline and Surkhi)
2. Specialty admixtures: Polymer dispersions Or Lattices, thickening a gents/ Viscosity modifiers, Foaming agents, Expanding agents, corrosion inhibitors
3. Oil well cementing: Types of cement and of admixture, Effects of temperature and pressure.

Unit III Composite cements-1

1. Blast furnace slag (Slag cement) - Formation, treatment and use in composite cements, Factors affecting suitability for use in a composite cement, X-ray diffraction and microstructure of slags, Internal structures of slag glasses.
2. Hydration chemistry of slag cements, X-ray microanalysis, Activation of slag glasses, Alkali-activated slag cements and Super sulfated cements.
3. Fly ash (pulverized fuel ash) low in CaO - Factors governing suitability for use in composite cements, Rates of consumption of clinker phases and fly ash and contents of calcium hydroxide, Microstructure and compositions of the hydration products, Stoichiometry of fly ash cement hydration and the nature of the pozzolanic reaction.

Unit IV Composite cements-2

1. Natural pozzolanas: Properties, Hydration reactions, Silica fume (condensed silica fume, micro silica): Properties, Hydration reactions.
2. Other mineral additions: Class C fly ash, Other pozzolanic or hydraulic additions and Calcium carbonate and other mineral additions.
3. Pore structures and their relation to physical properties, Calculated porosities for pastes containing slag or fly ash, modelling of pore structure, Experimental determination of porosities and pore size distributions, Relations between pore structure and physical properties.

Unit V Calcium aluminate, expansive and other cements

1. Calcium aluminate cements – Manufacture, Reactivities of the phases and methods of studying hydration, Hydration reactions and products, Setting times; mixing and placing, Microstructural development, Hardening; effects of conversion, Chemical admixtures.
2. Expansive cements - Types of expansive cement, Mechanism of expansion in Type K cements.
3. Other cements - Very rapidly hardening cements, Energy reduction in the manufacture of cements and Alinite cements.

SEMESTER-VII

COURSE 17: ADMIXTURES COMPOSED CEMENT AND ITS USES

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Identify suitable composition of clinker
2. Use Fly-ash in PPC preparation
3. Demonstrate mixing techniques
4. Study performance of PPC
5. Identify performance of PSC

V. Practical Syllabus:

1. Preparation of laboratory scale clinker
2. Preparation of PPC flyash based in the laboratory
3. Preparation of PSC in the laboratory
4. Performance study of PPC prepared in the lab
5. Performance study of PSC prepared in the lab

VI. References:

1. Cement Data Book: W. H Duda , Verlag G m Bh,Berlin.
2. Norms for limestone exploration for cement manufacture : NCCBM
3. Text Book of Geology : P K Mukherjee
4. Geology of India and Burma : MS Krishnan, CBS Publisher and Distributer, Delhi
5. Chemistry of Cement and Concrete: F M Lea, Arnold, London

VII. Co-curricular Activities:

1. Assignments
2. Industry Visit
3. Quiz
4. Individual student seminars
5. Preparing Charts

SEMESTER-VII

COURSE 18: CEMENT INDUSTRY BEST ABATEMENT TECHNIQUES (BAT)

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. Understand technologies and organisational measures with minimum environmental impact and acceptable
2. Describe why the selection process & Techniques are so important for Control of Potential Emissions
3. To know the purpose and types of coolers in cement industry.

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Discuss the behaviour of volatile components
2. List out the Factors Influencing BAT Selection
3. Use 3 homogenization and storage methods
4. Select thermal treatment of heating and cooling for clinkerization.
5. Identify and reduce the emission from a pyro processing system

III Syllabus:

Unit I Special Characteristics of the Cement Production Process

1. The cement manufacturing process: Introduction, a high temperature process, Input turned into product, A high materials volume process.
2. A process with inherent combustion gas cleaning technology, atmospheric emissions governed by volatile components in the raw materials, behaviour of volatile components.
3. Limited impact on the environment, a large potential for contributions to ecological improvement.

Unit II Factors Influencing BAT Selection

1. Best Abatement Techniques- Introduction, BAT selection, factors influencing BAT selection.
2. Integrated Pollution Prevention and Control (IPPC) – Introduction, IPPC Aspects of Direct Importance to the Cement Industry.
3. Capital Investments, Candidate BATs, Emission Limit Values (ELVs)

Unit III Available Techniques for Cement Production

1. Raw Materials Pre-blending and Storage, Secondary Raw Materials Storage and preparation.
2. Raw grinding – Metering methods, Comminution methods, Separation, Product Transport to Storage, Dry grinding, Wet grinding.
3. Homogenisation and Storage of Raw Meal-Introduction, Batch type Homogenising Silo Systems (BHS), Continuous Homogenising Silo System (CHS), Continuous Blending and Storage Silo (CBS)

Unit IV Drying, Pre-heating, Pre-calcining and Sintering Process

1. Long Rotary Kilns, Grate preheater kilns, Suspension preheater kilns, Four stage cyclone preheater kilns, 4 to 6 stage cyclone preheaters with precalciner kilns
2. Clinker coolers - Rotary Coolers, Grate coolers, Vertical coolers
3. Conventional & Alternative Fuels Storage, Preparation and Firing

Unit V Available Techniques for Control of Potential Emissions

1. Control of Dust Emissions from Major Point Sources, Abatement Techniques, Control of Dust Emission from Clinker Coolers, Control of Dust Emission from Cement Mills.
2. Control of NOx-emissions - Control of SO2-emissions.
3. Control of volatile organic compounds (VOC)-emissions, Control of Heavy metal emissions, Reduction of Odours, Reduction of Vibrations

SEMESTER-VII

COURSE 18: CEMENT INDUSTRY BEST ABATEMENT TECHNIQUES (BAT)

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Handle a set of sieves
2. Use Vicat apparatus
3. Demonstrate mixing techniques
4. Find soundness of cement
5. Identify specific gravity of cement

V. Practical Syllabus:

1. Determination of Fineness of Cement by Blain's Apparatus
2. Determination of Density of Cement
3. Determination of Drying shrinkage of cement
4. Calculation of Heat of Hydration of cement
5. Determination of specific gravity of Cement

VI. References:

1. "Sources and Reduction of HM-Emissions", "Holderbank" Manual on Environment,
2. Dr. I. Jmlach, Report N° MA 95/3389/E
3. "Dedusting, HMC/Process Technology, Cement Course", P. Kutschera, 1996
4. "Emission Reduction Measures Proposed By FLS", P. Kutschera / U. Gasser /R Hasler
5. "Sources and Reduction of NOx-Emissions", P. Kutschera, PT 96/14160/E

VII. Co-curricular Activities:

1. Assignments
2. Industry ESP Visit
3. Quiz
4. Individual student seminars
5. Preparing Charts

SEMESTER-VIII

COURSE 19: ROTARY KILN OPERATING PROCEDURES

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. To ensure standard operation procedures for kiln safe operation.
2. To know three common techniques for burning clinker in a rotary kiln
3. Understand The most important control parameter in any type of kiln system

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Apply 4 clinker burning techniques
2. Recognize safe standard operating procedures for fuel systems
3. Follow kiln shutdown and optimization procedures
4. Describe rotary kiln bed phenomenon
5. Explain granular particulate materials flow model

III Syllabus:

Unit I Kiln Operating and Control Methods

1. Clinker Burning Techniques, Manual Control, Automatic Control, Automatic Controllers, Tuning (programming).
2. Kiln Control Loops – Single Closed Loop Control, Cascade (Computer) Control Loop.
3. Kiln Control Variables – Burning Zone, Kiln Exit Gas Analysis, Fuel Rate Control, Kiln Speed Control.

Unit II Fuel Systems

1. Fuel Handling and Coal Grinding, Fuels Burners and Flames, Testing Coal Burners for Tip Velocity.
2. Clinker Cooler Control – Critical Variables in Cooler Control, Under-grate Pressure and Air-flow Rate Control, Clinker Residence Time.
3. Particle Size of Clinker, Operation of Cooler Fans, Clinker and Air Distribution in the Cooler, Secondary Air Temperature Control, Hood-Draft (Pressure) Control.

Unit III Kiln Exit Gas Temperature Control& Kiln Starts, Shutdowns

1. Back-end Temperature, Back-end Draft Control – Long Drive and Wet Process Kilns, Pre-heater & Pre-calciner Kilns.
2. Feed Rate Control, Kiln Starts, Kiln Stops and Shutdowns.
3. Kiln Cycles, 3 basic Variables and Controls, 27 Basic Kiln Conditions.

Unit IV Basic Description of Rotary Kiln Operation

1. Bed Phenomenon, Geometrical Features and their Transport Effects, Transverse Bed Motion.
2. Experimental Observations of Transverse Flow Behaviour. Axial Motion, Dimensionless Residence Time.
3. Emergency Conditions, Safety and Accident Prevention

Unit V Granular Flows in Rotary Kilns and Maintenance

1. Flow of Granular Materials, Particulate Flow Behaviour in Rotary Kilns, Overview of the observed flow behaviour in Rotary Drum.
2. Particulate Flow Model in Rotary Kilns – Model description, Simplifying Assumptions, Governing Equations for momentum, Conservation.

3. Maintenance- Failure Modes, Computerised Maintenance Management System (CMMS), Releability-centred Maintenance, maintenance Cost Management, Maintenance Cost Organization, Mobile Equipment Maintenance.

SEMESTER-VIII

COURSE 19: ROTARY KILN OPERATING PROCEDURES

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Study cement industry Cooling Tower
2. Analyze Shell and tube Heat Exchanger
3. Operate Rotary Drier
4. Understand use of Fluidised Bed Drier
5. Monitor Heat transfer through Composite walls

V. Practical Syllabus:

1. Study of Cooling Tower
2. Analysis of Shell and tube Heat Exchanger
3. Analysis of Rotary Drier
4. Study of Fluidised Bed Drier
5. Study of Heat transfer through Composite walls

VI. References:

1. "Sources and Reduction of VOC-Emissions", J. Waltisberg, "Holderbank" Manual on Environment, Report No. VA 95/4330/E
2. "Sources and Reduction of HM-Emissions", "Holderbank" Manual on Environment, Dr. I. Jmlach, Report N° MA 95/3389/E
3. "Dedusting, HMC/Process Technology, Cement Course", P. Kutschera, 1996
4. "Emission Reduction Measures Proposed By FLS", P. Kutschera / U. Gasser /R Hasler
5. "Sources and Reduction of NOx-Emissions", P. Kutschera, PT 96/14160/E

VII. Co-curricular Activities:

1. Assignments
2. Industry Coolers Visit
3. Quiz
4. Individual student seminars
5. Presentation

SEMESTER-VIII

COURSE 20: ENERGY EFFICIENCY TECHNOLOGIES IN CEMENT INDUSTRY

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. Apply Energy efficiency techniques
2. Classify flames
3. Apply Atomization

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Select Energy efficiency technologies
2. Apply Oxygen Enrichment Technology
3. Utilize the optimization of mills operation processes
4. Understand optimization processes
5. Apply 3 process optimization methods

III Syllabus:

Unit I Energy Efficiency Technologies and Measures – I

1. Raw Material Preparation - High-Efficiency Fans and Variable Speed Drives for Mill Vents – Technology Description, Energy Performance, Capital & Operational Cost, Factors for Implementation, Cost Effectiveness Priority. Pre-grinding for Ball Mills - Technology Description, Energy Performance, Capital & Operational Cost, Relevant Factors for Implementation, Cost Effectiveness Priority.
2. Fuel Preparation - High-Efficiency Fans and Variable Speed Drives for Mill Vents- Technology Description, Energy Performance, Capital & Operational Cost, Relevant Factors for Implementation, Cost Effectiveness Priority.
3. Clinker Production- Process Controls and Optimization- Technology Description, Energy Performance, Capital & Operational Cost, Factors for Implementation, Cost Effectiveness Priority. Modern Multi-Channel - Technology Description, Energy Performance, Capital & Operational Cost, Relevant Factors for Implementation, Cost Effectiveness Priority.

Unit II Energy Efficiency Technologies and Measures – II

1. Burners, Low-Pressure Drop Cyclones for Suspension Pre-heaters - Technology Description, Energy Performance, Capital & Operational Cost, Factors for Implementation, Cost Effectiveness Priority.
2. Waste Heat Recovery for Power Production, Oxygen Enrichment Technology - Technology Description, Energy Performance, Capital & Operational Cost, Factors for Implementation, Cost Effectiveness Priority.
3. Clinker Cooling- Optimizing Heat Recovery, Variable Speed Drives for Cooler Fans - Technology Description, Energy Performance, Capital & Operational Cost, Factors for Implementation, Cost Effectiveness Priority.

Unit III Optimizing the Operation of Mills

1. Finish Grinding- Process Control and Management in Finish Grinding, Replacing a Ball Mill with a Vertical Roller Mill, High-Pressure Grinding Rolls, or Horo mill for Finish Grinding.

2. Optimizing the Operation of a Cement Mill, High-Pressure Roller Press as a Pre-grinding Step for Ball Mills, Improved Grinding Media for Ball Mills, High-Efficiency Classifiers, High-Efficiency Fans for Cement Mill Vents.
3. General Measures - High-Efficiency Motors and Efficient Drives, Variable Speed Drives, Preventative Maintenance, Compressed Air System Optimization and Maintenance, Compressed Air System Maintenance, Reducing Leaks in Compressed Air Systems, Compressor Controls.

Unit IV Process Optimization – I

1. Introduction to Process Optimization, Formulation of Various Process Optimization Problems and their Classification.
2. Basic Concepts of Optimization-Convex and Concave Functions, Necessary and Sufficient Conditions for Stationary Points.
3. Optimization of One Dimensional Functions, Unconstrained Multivariable Optimization-Direct Search Methods.

Unit V Process Optimization – II

1. Bracketing methods, Exhaustive Search Method, Bounding Phase Method Region Elimination Methods: Interval Halving Method, Fibonacci Search Method, Golden Section Search method.
2. Point-Estimation method, Successive Quadratic Estimation Method. Indirect first Order and Second Order Method.
3. Gradient-Based Methods- Newton-Raphson Method, Bisection Method, Secant Method, Cubic Search Method. Root-finding using Optimization Techniques.

SEMESTER-VIII

COURSE 20: ENERGY EFFICIENCY TECHNOLOGIES IN CEMENT INDUSTRY

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Apply filtration techniques
2. Perform Sieve Ananlysis
3. Identify the nature of Packed beds
4. Understand effect of Pressure drop
5. Study Porosity of Liquid fluidized bed

V. Practical Syllabus:

1. To study the filtration characteristics of Leaf and sparkle filter.
2. To carry out differential and cumulative screen analysis of given sample of solid particles.
3. To study the pressure drop characteristics through packed beds.
4. To study the pressure drop and porosity in Air fluidized bed.
5. To study the pressure drop and porosity in Liquid fluidized bed

VI. References:

1. Chemical Process Safety: Roy E. Sanders, Butter Worth Heinemann, New Delhi
2. Improving Thermal and Electrical Efficiency at Cement Plant, International Finance Corporation.
3. T.F. Edgar and D.M. Himmelblau Optimization of Chemical Processes – McGraw Hill (1989)
4. K. Urbanier and C. McDermott - Optimal Design of Process Equipment – John Wiley (1986) Kalyanmoy Deb ,Optimization for engineering design, , Prentice Hall of India.
5. G.S. Beveridge and R.S. Schechter, Optimization theory and practice, Mc Graw Hill, Newyork, 1970.

VII. Co-curricular Activities:

1. Presentations
2. Industry Visit
3. Group Discussion
4. Individual student seminars
5. Review analysis

SEMESTER-VIII

COURSE 21: COMBUSTION TECHNOLOGY

Theory Credits: 3 3 hrs/week

I Learning Objectives:

1. Understand thermodynamic laws
2. Explain combustion phenomena
3. Classify gas burners

II Learning outcomes:

Students after successful completion of the course will be able to…

1. Apply laws of thermodynamics to combustion process.
2. Understand the physics of different flames
3. Describe solid fuel burners design, Performance and configurations
4. Explain Atomization, Types of Atomizers
5. Analyze alternative fuel types, their combustion characteristics and performance

III Syllabus:

Unit I Combustion Thermodynamics and Kinetics

1. Combustion Process, Modes of Combustion Processes, Emissions and Environment
2. Combustion Stoichiometry,First law applied to Combustion – Standard Enthalpy, Standard Heat of Reaction, Adiabatic Flame Temperature. Second Law Applied to Combustion – Equilibrium Constant, Equilibrium Flame Temperature.
3. Chemical Kinetics- Types of reactions, Reaction Mechanisms, Rate equations.

Unit II Combustion Phenomena

1. Premixed Flames – Laminar Premixed flames and Flame Speed, Basic Characteristics of Turbulent Premixed Flames, Stability of Premixed Flames, Quenching Distance.
2. Non-premixed Flames-Laminar Get Diffusion Flames, Turbulent Diffusion Flame, Flame height correlations.
3. Flames from Condensed Fuels - Evaporation and Burning of Isolated Fuel Droplets, Combustion of a Carbon Particle.

Unit III Solid Fuel Systems

1. Combustion of Solid Fuels, Types of Solid Fuel Burners, Advantages and Disadvantages.
2. Design, Performance and Emission Characteristics of Grate Burners, Fluidized Bed Burners and Pulverized Burners.
3. Gasification of Solid Fuels, Types of Gasification Systems, Design, Performance and Emission Characteristics.

Unit IV Burners for Liquid Fuels

1. Types of Burners for Liquid Fuels - Wick burners, Pre-vaporizing burner, Vaporizing burner, Porous burner, Atomizing burner.
2. Atomization, Types of Atomizers – Pressure Automizer, Rotary Automizer, Twin Fluid Atomizers
3. Introduction to Spray Combustion, General Design Procedure, Operation of Liquid Fuel Burners

Unit V Burners for Gaseous Fuels

1. Classification of Gaseous Burners - Co-flow Burners, Swirl burners, Atmospheric Entrained Air Burners.
2. Stability, Performance and Emission Characteristics of Gaseous Fuel Burners, Design
3. Alternative Fuels - Production and Characterization of Alternative Fuels, Performance and Emission Characteristics, Future Scope

SEMESTER-VIII

COURSE 21: COMBUSTION TECHNOLOGY

Practical Credits: 1 2 hrs/week

IV. Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Perform Proximate analysis
2. Operate Hot Air Oven
3. Handle the furnace
4. Calculate Fixed Carbon content
5. Use various crucibles

V. Practical Syllabus:

1. Calculation of Hydrogen % of Coal
2. Determination of Carbon content present in Coal
3. Determination of Nitrogen content present in Coal
4. Determination of Sulphur content present in Coal
5. Determination of Oxygen content present in Coal

VI. References:

1. Fuels and combustion : Samir Sarkar, New Delhi Reference Books:
2. Firing System: Process Technology: Cement Seminar, Holderbank
3. Flame & Burners : Process Technology: Cement Seminar, Holderbank.
4. Combustion Technology- Essentials of Flames and Burners, Athena Academics, Vasudevan Raghavan, Wiley.
5. D. B. Spalding, Some Fundamentals of Combustion, 1955, Academic Press Inc., New York.

VII. Co-curricular Activities:

1. Assignments
2. Industry Visit
3. Group Discussion
4. Individual student seminars
5. Review analysis