

ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

(A Statutory body of the Government of Andhra Pradesh)

PROGRAMME: THREE-YEAR B.Sc.

(With Chemistry, Computer Science and Cement Science., Disciplines)

DOMAIN SUBJECT

Cement Science

(With Learning Outcomes, Unit-wise Syllabus, References, Co-curricular Activities & Model

Q.P for Five Courses of 1, 2, 3 & 4 Semesters)

(To Be Implemented From 2020-21 Academic Year)

SUBJECT EXPERTS

Dr. G. Sumathi

Dept. of Cement Science,

Penna College of Cement Sciences, Boyareddypalli.

ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

(A Statutory body of the Government of Andhra Pradesh)

CBCS – UG SYLLABUS SUBJECT REVIEW COMMITTEE

(To Be Implemented From 2020-21 Academic Year)

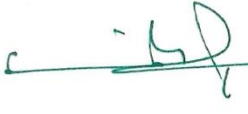

PROGRAMME: THREE-YEAR B.Sc. (With Chemistry, Computer Science and Cement Science Disciplines)

Domain Subject: Cement Science

(With Learning Outcomes, Unit-wise Syllabus, References, Co-curricular Activities & Model Q.P for Five Courses of 1, 2, 3 & 4 Semesters)

Structure of Cement Science Syllabus under CBCS for 3-year B.A. Programme (with domain subject covered during the first 4 Semesters with 5 Courses)

Sl. No.	Code	Sem	Courses	Name of Course(Each Course consists 5 Units with each Unit having 12 hours of class-work)	Hours/Week	Credits	Marks	
							Mid Sem	Sem End
1		I	I	Geology and Mining of Limestone	3	3	25	75
				Physical & Chemical testing of Limestone	3	2		50
2		II	II	Size Reduction and Pre-homogenisation	3	3	25	75
				Size Reduction of materials	3	2		50
3		III	III	Raw Mix Design & Clinker Manufacturing	3	3	25	75
				Regular and Advance Methods of Testing of Clinker	3	2		50
4		IV	IV	Pyro-processing in Cement Manufacture	3	3	25	75
				Testing of Cement by BIS Method	3	2		50
5		Open (either 2/3/4)	"O"	Introduction to Cement and Cement Raw Material	3	3	25	75
				Physical Testing of Cement by BIS Method	3	2		50
				Total		20	125	625


22.1.2021
4000


PROGRAMME: THREE-YEAR B.Sc.

(With Chemistry, Computer Science and Cement Science, Disciplines)

Course Code:

Domain Subject: Cement Science

Semester-wise Syllabus under CBCS

I Year B. Sc. –Semester – I

Course1: GEOLOGY AND MINING OF LIMESTONE

Learning Outcomes:

After successful completion of this course, the student 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.

SYLLABUS

Unit- I: Introduction to Stratigraphy & Geology of Limestone (12 hrs)

1. Introduction to Indian stratigraphy.
2. Brief idea about structural geology - Fold, Fault, Joint, Unconformities.
3. Types of rocks: Igneous, sedimentary and metamorphic rocks.
4. Origin & formation of calcareous rocks.

Unit – II: Distribution and Characteristic of Cement Grade Limestone (12 hrs)

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

Unit –III: Exploration and Deposit Evaluation (12 hrs)

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

Unit - IV: Mining of Limestone (12 hrs)

1. Introduction to 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, Mine production scheduling and planning.
4. Advance methods of limestone mining, Pit Head Quality Control practices.

Unit – V: Environment around Mines (12 hrs)

1. Uses of explosives, 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 Prospecting License(PL) and Mining Lease(ML) application.

Text books / Reference books:

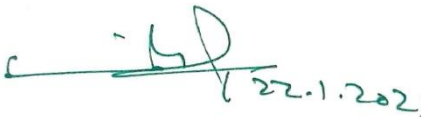
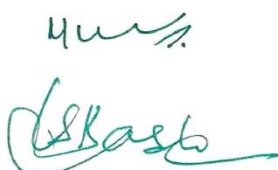
1. Text book of Geology : P KMukherjee
2. A Hand book on Surface Mining Technology: Samir Kumar Dash, Sagarprakashan, Khargpur.
3. Norms for limestone exploration for cement manufacture :NCCBM
4. National Inventory of cement grade limestone deposits in India :NCCBM
5. SME, Mining Engineering Hand Book; Arthur B. Cummins, Ivan A. Given: Society of Mining Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers, Inc, New York.

Practical Component: Physical & Chemical testing of Limestone (3 hours/week/batch)

1. Physical analysis of Limestone.
2. Determination of calcium carbonate and magnesium carbonate of Limestone.
3. Determination of Loss on ignition.
4. Determination of Calcium oxide, Silica.
5. Determination of Alumina, iron oxide and magnesia in limestone.

Recommended co-curricular activities:

1. Assignments on aspects of syllabus
2. Individual student seminars
3. Mines visit


 22.1.2021

Dr. Prasenjit Das

PROGRAMME: THREE-YEAR B.Sc.

(With Chemistry, Computer Science and Cement Science, Disciplines)

Course Code:

Domain Subject: Cement Science

Semester-wise Syllabus under CBCS

I Year B. Sc. –Semester – II

Course1: SIZE REDUCTION AND PRE-HOMOGENISATION

Learning Outcomes:

After successful completion of this course, the student 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

SYLLABUS

Unit- I: Particle Size Analysis (12 hrs)

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: SizeReduction (12 hrs)

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

Unit – III: Size Classification and Separators (12 hrs)

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 (12 hrs)

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.

Unit – V: Stacking Methods (12 hrs)

1. Stacking of blending beds, Chevron method , Windraw method , Areal stock piling , Axial stock piling, continuous stock piling .
2. Alternative 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.
4. Stacking of blending beds namely in longitudinal & circular stockpiles system & their comparison.

Text Books / Reference Books :


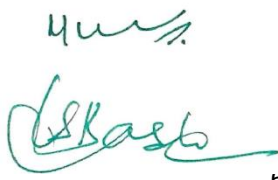
1. Cement Data Book: W. H Duda , VerlagG mBh, Berlin
2. Cement Engineers Hand Book: LabhaanandKolhaans
3. Operational Norms for cement plant: NCCBMpublication

Practical Component: Size Reduction of materials (3 hours/week/batch)

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

Recommended co-curricular activities:

1. Quiz
2. Review analysis
3. Group discussions.


 22.1.2021

 b

PROGRAMME: THREE-YEAR B.Sc.

(With Chemistry, Computer Science and Cement Science, Disciplines)

Course Code:

Domain Subject: Cement Science

Semester-wise Syllabus under CBCS

II Year B. Sc. –Semester – III

Course1: RAW MIX DESIGN & CLINKER MANUFACTURING

Learning Outcomes:

After successful completion of this course, the student 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.

REVISED SYLLABUS

SEMESTER III

Unit- I: Sampling and Pre blending of Cement Raw Materials (12 hrs)

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 (12 hrs)

1. Chemical composition of various types of clinker.
2. Introduction to phase rule, phase diagram: alite, belite, aluminite 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 (12 hrs)

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.

4. Role of additive in clinker formation, various mineralizer and fluxes, their role in manufacture of clinker.

Unit – IV: Cement Grinding (12 hrs)

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 (12 hrs)

1. Role of gypsum in cement hydration process, hydration of Portland cement.
2. Hydration of Portland cement at increased temperature.

Text Books / Reference Books:

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




Practical Component: Regular and Advance Methods of Testing of Clinker

(3 hours/week/batch)

1. Soundnesstest
2. Setting timetest
3. Standardconsistency
4. Heat ofhydration
5. Compressive strength
6. XRD method for analysis of clinker and clinkerphases.
7. XRF for analysis of cement raw materials and Cement clinker.

Recommended co-curricular activities:

1. Assignments
2. Seminars
3. Industry laboratories visit


22.1.2021



PROGRAMME: THREE-YEAR B.Sc.

(With Chemistry, Computer Science and Cement Science, Disciplines)

Course Code:

Domain Subject: Cement Science

Semester-wise Syllabus under CBCS

II Year B. Sc. –Semester – IV

Course1: PYRO-PROCESSING INCEMENTMANUFACTURE

Learning Outcomes:

After successful completion of this course, the student 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

SYLLABUS

Unit- I: Types of Preheaters (12 hrs)

1. Types of Preheater, Comparison, selection of different stages(4/5/6) preheaters.
2. Pre-calciners: Theoretical aspect of Pre-calciners, Basic arrangement, Features of pre-calciners, Present status of pre-calciner development, advantages and dis advantages of different type of pre-calciners, primary air, secondary air, tertiary air.
3. Optimization of kiln output, factors affecting the kiln output.
4. Determination of parameters of kiln evaluation: thermal loading, volumetric loading, % filling etc.,..Norms for pyro processing, kiln operation, kiln bypass system.

UNIT-II Types of kiln (12 hrs)

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 ProcessFans (12 hrs)

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 (12 hrs)

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.
3. Planetary Cooler: General, Design features, Internal heat transfer equipment, Heat transfer and efficiency, Enhanced cooling, Advantages / Disadvantages.
4. 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 (12 hrs)

1. Method of clinker storage: Silos and Gantry, 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, BulkLoading.

Test Books/Reference books:

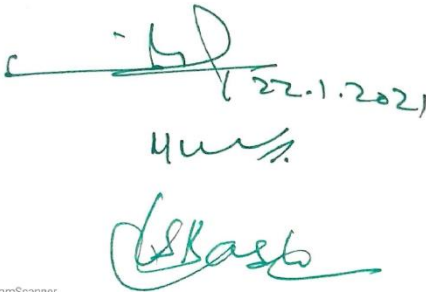
1. Cement Data Book: W. H Duda ,VerlagG mBh,Berlin.
2. Kiln System : Process Technology: Cement Seminar,Holderbank
3. Precalcining System : Process Technology: Cement Seminar,Holderbank
4. Clinker Cooler : Process Technology: Cement Seminar,Holderbank

Practical Component: Testing of Cement by BIS Method (3 hours/week/batch)

1. Determination of loss on ignition
2. Determination of SiO_2
3. Determination of Al_2O_3 & Fe_2O_3
4. Determination of CaO
5. Determination of MgO
6. Determination of SO_3
7. Determination of insoluble residue

Recommended co-curricular activities:

1. Assignments
2. Mini project
3. Poster presentation


22.1.2021
Handwritten signature
Handwritten signature

PROGRAMME: THREE-YEAR B.Sc.

(With Chemistry, Computer Science and Cement Science, Disciplines)

Course Code:

Domain Subject: Cement Science

Semester-wise Syllabus under CBCS

I/II Year B. Sc. –Semester – 2/3/4

Course O: INTRODUCTION TO CEMENT AND CEMENTRAW MATERIAL

Learning Outcomes:

After successful completion of this course, the student 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.

SYLLABUS

Unit- I: Introduction to Cement and Binding Materials (12 hrs)

1. History of binding materials and Cement, Classification of Cement Binders, Lime as Binder, cement and its importance in construction.
2. Cement and its Raw Mill Composition, History of Cement manufacturing process, material composition of cement.
3. various unit operation of cement manufacture, the present status and future of cement industry in India. Sources of cement raw materials.

UNIT-II: Types of Cement-I (12 hrs)

1. Description and use of various type of Cements: Ordinary Port Land Cement (OPC - 33 grade , 43 grade and 53 Grade).
2. Portland Pozzolana Cement
3. Portland Slag Cement

Unit-III: Type of Cement-II (12 hrs)

1. Ordinary & 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, K– type Expansive , M – type Expansive , S – type Expansive, Portland Pozzolanic cement, Super Sulphate cements.
4. High Early Strength cement, Alinite cement, Belite cement, Early strength cement.

Unit-IV Cement Raw Materials (12 hrs)

1. Calcareous Materials: Source of Lime, Limestone, Chalk, Marl.
2. Argillaceous raw materials: Source of Silica, Alumina, Iron Oxide, Shale and effect of coal ash.
3. Additives and Gypsum: Origin and occurrences, distribution/ availability in India.
4. Physical and Chemical Characteristics of various additives such as Bauxite, Iron Ore, Laterite, and gypsum.

Unit – V Alternate Raw Materials (12 hrs)

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, phosphogypsum, jerosite, lead and zinc slag, kimberlite 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.

Text Books/ Reference Books:

1. Norms for limestone exploration for cement manufacture :NCCBM
2. Text Book of Geology : P K Mukherjee
3. Geology of India and Burma : MS Krishnan, CBS Publisher and Distributer, Delhi
4. Chemistry of Cement and Concrete: F M Lea, Arnold, London
5. Cement Industry Data Book, CAM , New Delhi
6. World Cement Directory:CEMBUREAU
7. Cement Data Book: W. H Duda , Verlag G mBh, Berlin.
8. Assessment of utilization of Industrial solid Wastes in cement manufacturing, CPCB

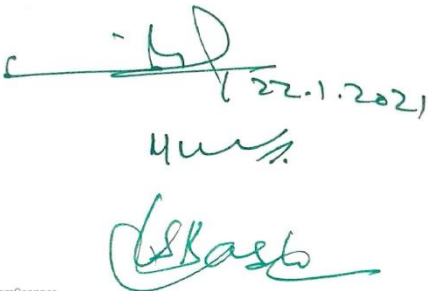
Practical Component: Physical Testing of Cement by BIS Method (3 hours/week/batch)

1. Determination of density
2. Determination of specific surface

3. Determination of normal consistency
4. Determination of setting time
5. Determination of soundness test by Le Chatelier Autoclave
6. Determination of compressive strength
7. Determination of drying shrinkage

Recommended co-curricular activities:

1. Assignments
2. Review analysis
3. Group Discussion.


Handwritten signature and date: 22.1.2021
Handwritten signature: [Signature]

PROGRAM: B.Sc. CEMENT SCIENCE (CBCS) MODEL QUESTION PAPER
&PATTERN

Time: 3Hrs

Max. Marks: 75

Paper –I: **GEOLOGY AND MINING OF LIMESTONE**

SECTION – A

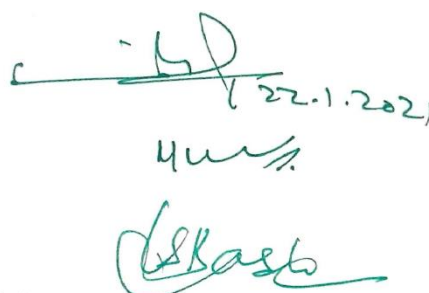
Answer any FIVE of the following (5×5= 25 Marks)

1. Sedimentary rocks.
2. Unconformities.
3. Physical properties of limestone.
4. Cement composition.
5. Limestone specifications for cement plant.
6. Sampling of limestone deposits.
7. Advance methods of limestone mining. Explain briefly.
8. Explosives used in mining.
9. What is Prospecting License(PL) and Mining Lease(ML).
10. Write notes on environmental conditions around limestone mines.

SECTION – B

Answer ALL questions (5×10= 50 Marks)

11. (a) Write an essay on Indian stratigraphy
Or
(b) Discuss in detail the origin and formation of calcareous rocks.
12. (a) Write an essay on the classification of cement grade limestone deposits.
Or
(b) Write an essay on the classification of cement grade limestone deposits.
13. (a) Explain the UNFC classification of limestone deposits.
Or
(b) Write an essay on the national inventory of cement grade limestone deposits in India.
14. (a) Discuss in detail the geological exploration methods of limestone.
Or
(b) Write an essay on the estimation and evaluation of limestone deposits.
15. (a) Explain controlled and sequential blasting.
Or
(b) Write notes on Environmental Impact Analysis (EIA) and Environmental Management Plan (EMP).


22.1.2021
400/1
@Bash