III Year-I Semester **L T P C**

3 1 0 3

16CE5T11 - DESIGN & DETAILING OF REINFORCED CONCRETE STRUCTURES

Course Learning Objectives:

The objective of this course is:

- The student can gain the knowledge about the behavior of reinforced concrete elements and load transferring system.
- Familiarize Students with different types of design philosophies.
- Equip student with concepts of design of flexural members.
- Understand Concepts of shear, bond and torsion.
- Familiarize students with different types of compression members and design.
- Understand different types of footings and their design.
- To gain knowledge about different types of loads on structures and different codes of practice.

Course Outcomes:

At the end of successful completion of this course, the student will be able to:

Course Outcomes	Description	Cognitive Level
CO1	Identify the methods which aresuitable for particular structures.	Understand
CO2	Carryout analysis and design of flexural members and detailing.	Analysing
CO3	Decipher concepts of shear, torsion and bond.	Understand
CO4	Design the short and long columns with desirable loading conditions.	Creating
CO5	Design the slabs with desirable loading conditions.	Creating
CO6	Determine the dimensions of the footing with desirable loading conditions.	Evaluating

SYLLABUS:

UNIT –I

Introduction: Working stress method Design codes and handbooks, loading standards – Dead, live, wind and earthquake loads, elastic theory, design constants, modular ratio, neutral axis depth and moment of resistance, balanced, under-reinforced and over-reinforced sections, working stress method of design of singly and doubly reinforced beams.

Limit State Design: Concepts of limit state design – Basic statisticalprinciples – Characteristic loads –Characteristic strength – Partial load and safety factors – representative stress-strain curves for cold worked deformed bars and mild steel bars. Assumptions in limit state design – stress – block parameters – limiting moment of Resistance.

UNIT –II

Design for Flexure: Limit state analysis and design of singly reinforced sections- effective depth- Moment of Resistance- Doubly reinforced and flanged (T and L) beam sections- Minimum depth for a given capacity- Limiting Percentage of Steel- Minimum Tension Reinforcement-Maximum Flexural Steel- Design of Flanged Sections (T&L)- Effective width of flange –Behaviour- Analysis and Design.

UNIT – III

Design for Shear, Torsion and Bond: Limit state analysis and design of section for shear and torsion – concept of bond, anchorage and development length, I.S. code provisions. Design examples in simply supported and continuous beams, detailing.

Limit state design for serviceability: Deflection, cracking and code provision, Design of formwork for beams and slabs.

UNIT – IV

Design of Compression members: Effective length of a column, Design of short and long columns – under axial loads, uniaxial bending and biaxial bending – Braced and un-braced columns – I S Code provisions.

UNIT –V

Footings: Different types of footings – Design of isolated and combined footings - rectangular and circular footings subjected to axial loads, uni-axial and bi-axial bending moments.

UNIT – VI

Slabs: Classification of slabs, design of one - way slabs, two - way slabs, and continuous slabs using IS Coefficients (conventional), design of waist-slab staircase.

NOTE: All the designs to teach in Limit State Method, Following plates should be prepared by the students.

1. Reinforcement particulars of T-beams and L-beams.
2. Reinforcement detailing of continuous beams.
3. Reinforcement particulars of columns and footings.
4. Detailing of One way, Two way and continuous slabs.

INTERNAL EXAMINATION PATTERN:

The total internal marks (40) are distributed in two components as follows:

1. Descriptive (subjective type) examination: 30marks.
2. Assignment: 10 marks

FINAL EXAMINATION PATTERN:

The end examination paper should consist of Part A and Part B. part A consist of two questions in Design and Detailing ,out of which one question is to be answered. Part B should consist of five questions and design out of which three are to be answered. Weightage for Part – A is 40% and Part- B is 60%.

Text Books:

1. Reinforced concrete design by S.Unnikrishna Pillai &DevdasMenon, Tata Mc.Graw Hill, New Delhi.
2. Fundamentals of reinforced concrete by N.C. Sinha and S.K Roy, S. Chand publishers.
3. Reinforced concrete design by N. Krishna Raju and R.N. Pranesh, New age International Publishres, New Delhi.
4. Limit State Design by B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi, publications Pvt. Ltd., New Delhi.

References:

1. Fundamentals of Reinforced concrete design by M.L. Gambhir, Printice Hall of India Private Ltd., New Delhi.
2. Reinforced concrete structural elements – behaviour, Analysis and design by P.Purushotham, Tata Mc.Graw-Hill, 1994.
3. Design of concrete structures – ArthusH.Nilson, David Darwin, and Chorles W. Dolar, Tata Mc.Graw-Hill,3rd Edition, 2005.
4. Reinforced concrete structures, Vol.1, by B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi, publications Pvt.Ltd., New Delhi.
5. Reinforced concrete structures – I.C. Syal&A.K.Goel, S.Chand Publishers.
6. Limit state designed of reinforced concrete – P.C.Varghese, Printice Hall of India, New Delhi.

IS Codes:

1. IS -456-2000 (Permitted to use in examination hall)
2. IS – 875 part (I, II, III, IV)
3. SP-16(Permitted to use in examination hall)

Web References:

1. http://freevideolectures.com/Course/2686/Design-of-Reinforced-Concrete-Structures

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III Year-I Semester

L	T	P	C
3	1	0	3

16CE5T12 - GEOTECHNICAL ENGINEERING - I

Course Learning Objectives:

- To enable the knowledge of availability, types and index properties of soils.
- To enunciate the concept of permeability and seepage through soils for better understanding the discharge through different types of soils.
- To impart the principles of compaction & consolidation of various soils and to determine their relevant data that is used for functional purpose.
- To make the student to understand the concept of shear strength, stresses induced and to determine various parameters.

Course Outcomes:

At the end of successful completion of this course, the student will be able to:

Course Outcomes	Description	Cognitive Level
CO1	Demonstrate how the soils are originated, transported, formed and their classification.	Understand
CO2	Apply the compaction techniques on field and its control.	apply
CO3	Applying the concept of seepage through soil to construct the flow net for water flow calculations	Analyse
CO4	Examine the stress distribution under the loads.	Apply
CO5	Measures shear strength parameters for field conditions.	Evaluation
CO6	Predict the consolidation settlements.	Creating

SYLLABUS:

UNIT – I

Introduction & Index Properties Of Soils: Soil formation – soil structure and clay mineralogy –Adsorbed water – Mass- volume relationship –Relative density – Grain size analysis – Sieve and Hydrometer methods – consistency limits and indices – Various Types of soil Classifications – Unified soil classification and I.S. Soil classification.

UNIT – II

Compaction: Introduction-Types of compaction- Standard proctor test and modified proctor test -Mechanismof compaction – factors affecting – effects of compaction on soil properties-Compaction of clayey soil and sand-Field compaction of soils and field compaction control.

UNIT –III

Permeability: Soil water – capillary rise – One dimensioned flow of water through soils – Darcy's law- permeability – Factors affecting –laboratory determination of coefficient of permeability –Permeability of layered systems. Total, neutral and effective stresses.

Seepage through Soils: Seepage force &seepage pressure; Types of flows and heads-Quick sand condition; Laplace equations; Characteristics of flow net; Uses of flow nets; Seepage through earth dams with horizontal filter; Uplift pressure ;gradient and piping.

UNIT – IV

Stress Distribution In Soils: Stresses induced by applied loads -Boussinesq's and Westergaard's theories for point loads and areas of different shapes– Newmark's influence chart – 2:1 stress distribution method.

UNIT - V

Shear Strength of Soils: Basic mechanism of shear strength - Mohr – Coulomb Failure theories – Stress-Strain behavior of Sands - Critical Void Ratio – Stress-Strain behavior of clays – Shear Strength determination various drainage conditions.

UNIT - VI

Consolidation: Compressibility of soils – e-p and e-log p curves – Stress history – Concept of consolidation - Spring Analogy - Terzaghi's theory of one-dimensional Consolidation – Time rate of consolidation and degree of consolidation – Determination of coefficient of consolidation (c_v) – Over consolidated and normally consolidated clays.

INTERNAL EXAMINATION PATTERN:

The total internal marks (40) are distributed in three components as follows:

1. Descriptive (subjective type) examination: 20marks
2. Objective examination: 10marks.
3. Assignment: 10 marks.

FINAL EXAMINATION PATTERN:

The end examination paper should consist of Part A and Part B. part A consist of six questions in definitions, principles and concepts ,all questions are to be answered. Part B should consist of six questions and out of which four are to be answered. Weightage for Part – A is 20% and Part- B is 80%.

Text Books:

1. 'Basic and Applied Soil Mechanics' by Gopal Ranjan and A.S.R.Rao, New Age International Publishers.
2. 'Soil Mechanics and Foundation Engineering' by V.N.S.Murthy, CBS publishers.
3. 'Soil Mechanics and Foundation Engineering' by Dr.K.R.Arora ,Standard publishers.

REFERENCES:

1. 'Fundamentals of Soil Mechanics' by D.W.Taylor., Wiley.
2. 'An introduction to Geotechnical Engineering' by Holtz and Kovacs; Prentice Hall.
3. 'Soil Mechanics' by M.Palani Kumar, PHI Learning.
4. Soil Mechanics and Foundation Engineering by B. C. Punmia; LaxmiPublications, Delhi.
5. Relevant Indian Standard Code Books.

Web Reference:

1. http://nptel.ac.in/courses/105103097/

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III Year-I Semester

L	T	P	C
3	1	0	3

16CE5T13 - STRUCTURAL ANALYSIS - II

Course Learning Objectives:

The objective of this course is:

- Familiarize Students with Different types of Structures.
- Equip student with concepts of Arches.
- Understand Concepts of lateral Load analysis.
- Familiarize Cables and Suspension Bridges.
- Understand Analysis methods Moment Distribution, Kani's Method and Matrix methods.

Course Outcomes:

At the end of successful completion of this course, the student will be able to:

Course Outcomes	Description	Cognitive Level
CO1	Differentiate Determinate and Indeterminate Structures of Arches.	Applying
CO2	Carryout lateral Load analysis of structures.	Remembering
CO3	Analyze Cable and Suspension Bridge structures.	Analyzing
CO4	Analyze structures by using Moment Distribution Method.	Analyzing
CO5	Analyze structures by using Kani's Method.	Analyzing
CO6	Analyze structures by using Matrix Methods.	Analyzing

SYLLABUS:

UNIT - I

Three Hinged Arches: Classification of arches,Elastic theory of arches – Eddy's theorem - Determination of horizontal thrust, bending moment, normal thrust and radial shear – effect of temperature.

Two Hinged Arches: Determination of horizontal thrust, bending moment,normal thrust and radial shear – Rib shortening and temperature stresses, tied arches.

UNIT-II

Lateral Load Analysis Using Approximate Methods: application tobuilding frames.

(i) Portal method (ii) Cantilever method.

UNIT – III

Cable Structures and Suspension Bridges: Introduction, characteristics ofcable, analysis of cables subjected to concentrated and uniformly distributed loads, anchor cable, temperature stresses, analysis of simple suspension bridge, three hinged and two hinged stiffening girder suspension bridges.

UNIT – IV

Moment Distribution Method: Stiffness and carry over factors –Distribution factors – Analysis of continuous beams with and without sinking of supports – Portal frames – including Sway-Substitute frame analysis by two cycles.

UNIT – V

Kani's Method: Analysis of continuous beams – including settlement ofsupports and single bay portal frames with and without side sway.

UNI – VI

Introduction to Matrix Methods:

Flexibility methods: Introduction, application to continuous beams (maximum of two unknowns) including support settlements.

Stiffness method: Introduction, application to continuous beams (maximum of two unknowns) including support settlements.

TEXT BOOKS:

1. 'Structural Analysis' by T.S.Thandavamoorthy, Oxford university press, India.
2. 'Structural Analysis' by R.C. Hibbeler, Pearson Education, India.
3. 'Theory of Structures – II' by B.C.Punmia, Jain & Jain, Laxmi Publications, India.
4. 'Structural Analysis' by C.S. Reddy, Tata Mc-Graw hill, New Delhi.

REFERENCES:

1. 'Intermediate Structural Analysis' by C. K. Wang, Tata McGraw Hill, India.
2. 'Theory of structures' by Ramamuratam, Dhanpatrai Publications.
3. 'Analysis of structures' by Vazrani&Ratwani – Khanna Publications.
4. 'Comprehensive Structural Analysis-Vol.I&2' by Dr. R. Vaidyanathan&Dr. P. Perumal- Laxmi Publications Pvt. Ltd., New Delhi.

Web Reference:

1. http://nptel.ac.in/courses/105101086/

III Year-I Semester

L	T	P	C
3	1	0	3

16CE5T14- TRANSPORTATION ENGINEERING - I

Course Learning Objectives:

The objective of this course is:

- To impart different concepts in the field of Highway Engineering.
- To acquire design principles of Highway Geometrics and Pavements.
- To learn various highway construction and maintenance procedures.

Course Outcomes:

At the end of successful completion of this course, the student will be able to:

Course Outcomes	Description	Cognitive Level
CO1	Plan highway network for a given area.	Remembering
CO2	Design the Highway geometrics based on highway alignment.	Evaluation
CO3	Design Intersections and prepare traffic management plans.	Creating
CO4	Judge suitability of pavement materials and design flexible and rigid pavements	Evaluation
CO5	Characterize the pavement materials like aggregates, Bituminous materials &construction.	Understand
CO6	Determine traffic speed, volume, travel time and density.	Applying

SYLLABUS:

UNIT - I

Highway Planning and Alignment: Highway development in India; Classification of Roads; Road Network Patterns; Necessity for Highway Planning; Different Road Development Plans – First, second, third road development plans, road development vision 2021, Rural Road Development Plan – Vision 2025; Planning Surveys; Highway Alignment- Factors affecting Alignment- Engineering Surveys – Drawings and Reports.

UNIT – II

Highway Geometric Design: Importance of Geometric Design- Design controls and Criteria-Highway Cross Section Elements- Sight Distance Elements-Stopping sight Distance, Overtaking Sight Distance and Intermediate Sight Distance- Design of Horizontal Alignment-Design of Super elevation and Extra widening- Design of Transition Curves-Design of Vertical alignment-Gradients- Vertical curves.

UNIT – III

Traffic Engineering: Basic Parameters of Traffic-Volume, Speed and Density- Traffic Volume Studies; Speed studies –spot speed and speed & delay studies; Parking Studies; Road Accidents-Causes and Preventive measures - Condition Diagram and Collision Diagrams; PCU Factors, Capacity of Highways – Factors Affecting; LOS Concepts; Road Traffic Signs; Road markings; Types of Intersections; At-Grade Intersections – Design of Plain, Flared, Rotary and Channelized Intersections; Design of Traffic Signals –Webster Method –IRC method.

UNIT – IV

Highway Materials: Sub-grade soil: classification –Group Index – Subgrade soil strength – California Bearing Ratio – Modulus of Subgrade Reaction. Stone aggregates: Desirable properties – Tests for Road Aggregates – Bituminous Materials: Types – Desirable properties -Tests on Bitumen

UNIT – V

Design Of Pavements: Types of pavements; Functions and requirements of different components of pavements; Design Factors

Flexible Pavements: Design factors – Flexible Pavement Design Methods – CBR method – IRC method – Burmister method – Mechanistic method – IRC Method for Low volume Flexible pavements.

Rigid Pavements: Design Considerations – wheel load stresses – Temperature stresses – Frictional stresses – Combination of stresses – Design of slabs – Design of Joints – IRC method – Rigid pavements for low volume roads – Continuously Reinforced Cement Concrete Pavements – Roller Compacted Concrete Pavements.

UNIT – VI

Highway Construction and Maintenance: Types of Highway Construction– Earthwork; Construction of Earth Roads, Gravel Roads, Water Bound Macadam Roads, Bituminous Pavements and Construction of Cement Concrete Pavements. Pavement Failures, Maintenance of Highways, pavement evaluation, strengthening of existing

pavements.**Bituminous paving mixes:** Requirements – Marshall Method of Mix Design. Road construction in water logged areas and black cotton soils.

TEXT BOOKS:

1. 'Highway Engineering'byKhanna S.K., Justo C.E.G and Veeraragavan A, Nem Chand Bros, Roorkee.
2. 'Traffic Engineering and Transportation' Planning by Kadiyali L.R, Khanna Publishers, New Delhi.
3. 'Highway Engineering' by Srinivasa Kumar R, Universities Press, Hyderabad.

REFERENCES:

1. 'Transportation Engineering and Planning' by Papacostas C.S. and PD Prevedouros, Prentice Hall of India Pvt. Ltd; New Delhi.
2. 'Principles of Highway Engineering' by Kadiyali LR, Khanna Publishers, New Delhi.
3. 'Transportation Engineering - An Introduction' byJotinKhisty C, Prentice Hall, Englewood Cliffs,New Jersey.
4. 'Highway Engineering' by Paul H. Wright and Karen K Dixon, Wiley Student Edition, Wiley India (P) Ltd., New Delhi .
5. 'Principles of Transportation Engineering' by ParthaChakroborthy and Animesh Das, PHI Learning Private Limited, Delhi
6. 'Practice and Design of Highway Engineering' by Sharma SK, Principles, S.Chand& Company Private Limited, New Delhi.
7. 'Traffic Engineering' by Mc Shane, WR and RP Roess, Prentice Hall.

Web Reference:

1. http://nptel.ac.in/courses/105101087/
2. http://nptel.ac.in/courses/105104098/
3. http://nptel.ac.in/courses/105101008/

E-Journals: Process-Functional Model of Transportation Mix Concrete
http://file.scirp.org/pdf/JTTs_2014042916230601.pdf

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III Year-I Semester

L	T	P	C
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16CE5L05 - CONCRETE TECHNOLOGY LAB

Course Learning Objectives:

- To impart the various testing methods to determine the basic properties of concrete ingredients.
- To learn various fresh and hardenedproperties of concrete.

Course Outcomes:

At the end of successful completion of this course, the student will be able to:

Course Outcomes	Description	Cognitive Level
CO1	Perform the mix designs, casting the cubes and cylinders.	Creating
CO2	Summarize the concept of workability and testing of concrete.	Understand
CO3	Assess the properties of concrete ingredients.	Evaluation
CO4	Outline the importance of testing of cement and its properties.	Understand
CO5	Understand the separation of different sizes of aggregates.	Understand
CO6	Determine the bulking of sand.	Evaluation

List of Experiments:

At least 10 experiments must be conducted (at least one for each property).

1. Determination of normal Consistency and fineness of cement.
2. Determination of initial setting time and final setting time of cement.
3. Determination of specific gravity and soundness of cement.
4. Determination of compressive strength of cement.
5. Determination of grading and fineness modulus of coarse aggregate by sieve analysis.
6. Determination of specific gravity of coarse aggregate.
7. Determination of grading and fineness modulus of fine aggregate (sand) by sieve analysis.
8. Determination of bulking of sand.
9. Determination of workability of concrete by compaction factor method.
10. Determination of workability of concrete by slump test.
11. Determination of workability of concrete by Vee-bee test.
12. Determination of compressive strength of concrete and its young’s modulus.

13. Non-Destructive testing on concrete (for demonstration).

List of Equipment:

1. Standard set of sieves for coarse aggregate and fine aggregate
2. Vicat's apparatus.
3. Specific gravity bottle.
4. Lechatlier's apparatus.
5. Slump Test Apparatus.
6. Compaction Factor Test Apparatus.
7. Vee- Bee test apparatus
8. Universal testing Machine (UTM) / Compression Testing Machine (CTM).

Text Books:

1. Concrete Technology by M. S. Shetty. – S. Chand & Co.; 2004.
2. Concrete Technology by M. L. Gambhir. – Tata Mc. Graw Hill Publishers, New Delhi.

Reference Books:

1. Properties of Concrete by A. M. Neville – PEARSON – 4th edition.
2. Concrete Technology by A.R. Santha Kumar, Oxford University Press, New Delhi.

Web Reference:

http://freevideolectures.com/Course/3357/Concrete-Technology

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III Year-I Semester

L	T	P	C
0	0	3	2

16CE5L06 - ENGINEERING GEOLOGY LAB

Course Learning Objectives:

The objective of this course is:

- To identify the mega-scopic types of Ore minerals & Rock forming minerals.
- To identify the mega-scopic types of Igneous, Sedimentary, Metamorphic rocks.
- To identify the topography of the site & material selection.

Course Outcomes:

At the end of successful completion of this course, the student will be able to:

Course Outcomes	Description	Cognitive Level
CO1	Identify the minerals and their properties.	Knowledge
CO2	Recognize the rocks and their properties.	Identify
CO3	Determine the behavior of the bedding planes in terms of solving strike and dip.	Applying
CO4	Draw sections for geological maps showing tilted beds.	Understand
CO5	Draw sections for geological maps showing fault beds.	Understand
CO6	Identify the morphological and geological characteristics on maps.	Knowledge

List of Experiments:

1. Physical properties of minerals: Mega-scopic identification of
2. Rock forming minerals – Quartz group, Feldspar group, Garnet group, Mica group & Talc, Chlorite, Olivine, Kyanite, Asbestos, Tourmelene, Calcite, Gypsum, etc…
3. Ore forming minerals – Magnetite, Hematite, Pyrite, Pyralusite, Graphite, Chromite.
4. Megascopic description and identification of rocks.
5. Igneous rocks – Types of Granite, Pegmatite, Gabbro, Dolerite, Syenite, Granite Poryphery, Basalt, etc…
6. Sedimentary rocks – Sand stone, Ferrugineous sand stone, Lime stone, Shale, Laterite, Conglamorate, etc…
7. Metamorphic rocks – Biotite – Granite Gneiss, Slate, Muscovite &Biotiteschist, Marble, Khondalite, etc…

8. Interpretation and drawing of sections for geological maps showing tilted beds, faults, unconformities etc.
9. Simple Structural Geology problems.
10. Bore hole data.
11. Strength of the rock using laboratory tests.
12. Field work – To identify Minerals, Rocks, Geomorphology& Structural Geology.

Text Books:

1. 'Engineering Geology' by N. ChennaKesavulu, Trinity Press (Laxmi Publications), 2nd Edition, 2014.
2. 'Engineering Geology' by SubinoyGangopadhay, Oxford University press.
3. 'Engineering Geology' by D. Venkat Reddy, Vikas Publishing House pvt. Ltd, 2013.
4. 'Engineering Geology' by VasudevKanithi, University Press.

Reference Books:

1. 'Engineering Geology for Civil Engineers' by P.C. Varghese, PHI learning pvt. Ltd.
2. 'Geology for Engineers and Environmental Society' by Alan E Kehew, person publications, 3rd edition.
3. 'Fundamentals of Engineering Geology' by P.G. Bell, B.S.P. Publications, 2012.
4. 'Engineering Geology' by V.Parthesarathi et al., Wiley Publications.
5. 'Environmental Geology' by K.S. Valdiya, McGraw Hill Publications, 2nded.

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III Year - I Semester **L T P C**

0 0 3 2

16CE5L07 - GEOTECHNICAL ENGINEERING LAB

Course Learning Objectives:

The objective of this course is:

- To impart knowledge of determination of index properties required for classification of soils.
- To teach how to determine compaction characteristics and consolidation behaviour from relevant lab tests; to determine permeability of soils.
- To teach how to determine shear parameters of soil through different laboratory tests.

Course Outcomes:

At the end of successful completion of this course, the student will be able to:

Course Outcomes	Description	Cognitive Level
CO1	Determine the dry density of field and OMC.	Evaluation
CO2	Examining the rate of Permeability of soil.	Analyzing
CO3	To know the type of soil excised in field.	Understand
CO4	Determine the specific gravity of soils.	Evaluation
CO5	Know the thickness of Pavement based on CBR Test.	Understand
CO6	Evaluate the shear strength parameters from field and laboratory.	Creating

List of Experiments:

1. Determination of soil Moisture Content.
2. Determination of soil Specific gravity, G.
3. Determination of soil Atterberg's Limits.
4. Determination of Field density-Core cutter and Sand replacement methods.
5. Determination of soil Grain size analysis by sieving.
6. Determination of Permeability of soil - Constant and Variable head tests.
7. Determination of dry density and OMC by using Compaction test.
8. Determination of coefficient of consolidation.
9. Determination of Shear strength parameters by using tri-axial,Vane Shear test and box shear test.
10. Determination of CBR Value.

Additional Experiments:

1. Determination of soil Differential free swells (DFS).
2. Determine the percentage of fineness soil by usingHydrometer Analysis Test.

List of Major Equipment:

1. Casagrande's liquid limit apparatus.
2. Apparatus for plastic and shrinkage limits.
3. Field density apparatus for
    i) Core cutter method.
    ii) Sand replacement method.
4. Set of sieves: 4.75 mm, 2 mm, 1 mm, 0.6 mm, 0.425 mm, 0.3 mm, 0.15 mm, and 0.075 mm.
5. Hydrometer.
6. Permeability apparatus for
    i) Constant head test.
    ii) Variable head test.
7. Apparatus for Compaction test.
8. Apparatus for Consolidation test.
9. Apparatus for CBR test.
10. Box shear test apparatus.
11. Laboratory vane shear apparatus.
12. Hot air oven

Reference:

1. 'Determination of Soil Properties' by J. E. Bowles.
2. IS Code 2720 – relevant parts.

III Year-II Semester **L T P C**

3 1 0 3

16CE6T15 - ENVIRONMENTAL ENGINEERING-I

Course Learning Objectives:

The course will address the following:

- Outline planning and the design of water supply systems for a community/town/city.
- Provide knowledge of water quality requirement for domestic usage.
- Impart understanding of importance of protection of water source quality and enlightens the efforts involved in converting raw water into clean potable water.
- Selection of valves and fixture in water distribution systems.
- Impart knowledge on design of water distribution network.

Course Outcomes:

By the end of successful completion of this course, the students will be able to:

Course Outcomes	Description	Cognitive Level
CO1	List the properties of raw water and waste water.	Remembering
CO2	Identify the water source, treatment and supply.	Applying
CO3	Adopt a water treatment facilities in water supply	Creating
CO4	Demonstrate the physical, chemical and biological unit operations in treatment analysis.	Analysis
CO5	Demonstrate the disinfection and other miscellaneous treatment process.	Analysis
CO6	Plan and design the water distribution networks as per the requirements.	Creating

SYLLABUS:

UNIT–I

Introduction: Importance and Necessity of Protected Water Supply systems, Water borne diseases, Objectives of protected water supply system, Flow chart of public water supply system, Role of Environmental Engineer, Agency activities

Water Demand and Quantity Estimation: Estimation of water demand for a town or city, Per capita Demand and factors influencing it - Types of water demands and its variations-factors affecting water demand, Design Period, Factors affecting the Design period, Population forecasting studies.

UNIT-II

Sources of Water: Lakes, Rivers, Impounding Reservoirs, comparison of sources with reference to quality, quantity and other considerations- Capacity of storage reservoirs, Mass

curve analysis. Groundwater sources of water: Types of water bearing formations, springs, Wells and Infiltration galleries, Yields from infiltration galleries.

Collection and Conveyance of Water: Factors governing the selection of the intake structure, Types of Intakes. Conveyance of Water: Gravity and Pressure conduits, Types of Pipes, Pipe Materials, Pipe joints, Design aspects of pipe lines, laying of pipe lines.

UNIT-III

Quality and Analysis of Water: Characteristics of water–Physical, Chemical and Biological-Analysis of Water – Physical, Chemical and Biological characteristics. Comparison of sources with reference to quality- I.S. Drinking water quality standards and WHO guidelines for drinking water.

UNIT–IV

Treatment of Water: Flowchart of water treatment plant, Treatment methods: Theory and Design of Sedimentation, Coagulation, Sedimentation with Coagulation, Filtration, Maintenance of treatment units.

UNIT-V

Disinfection and softening of water: Theory of disinfection-Chlorination and other Disinfection methods, kinetics, disinfection , Softening of Water, Removal of color and odours - Iron and manganese removal –Adsorption-fluoridation and deflouridation–aeration– Reverse Osmosis-Iron exchange–Ultra filtration.

UNIT–VI

Distribution of Water: Requirements- Methods of Distribution system, Layouts of Distribution networks, Pressures in the distribution layouts, Analysis of Distribution networks: Hardy Cross and equivalent pipe methods-Components of Distribution system: valves such as sluice valves, air valves, scour valves and check valves, hydrants, and water meters–Laying and testing of pipe lines- selection of pipe materials, pipe joints.

Text Books:

1. Environmental Engineering – Howard S. Peavy, Donald R. Rowe, Teorge George Tchobanoglus – Mc-Graw-Hill Book Company, New Delhi, 1985.
2. Civil Engineering Elements of Environmental Engineering – K.N. Duggal, S. Chand &Company Ltd., New Delhi, 2012.

References:

1. Water Supply Engineering – Dr. P.N. Modi
2. Water Supply Engineering – B.C. Punmia
3. Water Supply and Sanitary Engineering – G.S.Birdie and J.S. Birdie

4. Environmental Engineering by D. Srinivasan, PHI Learning Private.

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III Year-II Semester

L	T	P	C
3	1	0	3

16CE6T16 - GEOTECHNICAL ENGINEERING-II

Course Learning Objectives:

- To enable the knowledge of shallow foundation and their bearing capacities.
- To enunciate the principles involved in various field tests.
- To impart the concept of pile foundations and bearing capacities.
- To make the student to understand the concept of settlements.

Course Outcomes:

By the end of successful completion of this course, the students will be able to:

Course Outcomes	Description	Cognitive Level
CO1	Examine the soil strata by conducting the soil exploration.	Create
CO2	Determine the earth pressures on foundations and retaining structures	Evaluating
CO3	Identify the important parameters for design of foundations.	Applying
CO4	Know the suitable foundations for structures and its bearing capacity.	Understanding
CO5	Locate the places of application of theoretical and laboratory knowledge in the field.	Remembering
CO6	Estimate the settlements and determine their magnitude	Evaluating

SYLLABUS:

UNIT – I

Soil Exploration: Need – Methods of soil exploration – Boring and Sampling methods – Field tests – Penetration Tests – Plate load test-Pressure meter –planning of Programme and preparation of soil investigation report.

UNIT – II

Earth and Earth-Retaining Structures: Infinite and finite earth slopes in sand and clay – types of failures – factor of safety of infinite slopes – stability analysis by Swedish arc method, standard method of slices – Taylor's Stability Number-Stability of slopes of dams and embankments –different conditions. Rankine's& Coulomb's theory of earth pressure – Culmann's graphical method - earth pressures in layered soils.

UNIT-III

Shallow Foundations – **Bearing Capacity Criteria:** Types of foundations and factors to be considered in their location - Bearing capacity – criteria for determination of bearing capacity

– factors influencing bearing capacity – analytical methods to determine bearing capacity – Terzaghi's theory – IS Methods.

UNIT-IV

Shallow Foundations – Settlement Criteria: Safe bearing pressure based on N- value – allowable bearing pressure; safe bearing capacity and settlement from plate load test – Types of foundation settlements and their determination - allowable settlements of structures.

UNIT -V

Pile Foundation: Types of piles – Load carrying capacity of piles based on static pile formulae – Dynamic pile formulae– Pile load tests - Load carrying capacity of pile groups in sands and clays.

UNIT-VI

Well Foundations: Types – Different shapes of well – Components of well– functions – forces acting on well foundations - Design Criteria –Determination of staining thickness and plug - construction and Sinking of wells – Tilt and shift.

Text Books:

1. 'Principles of Foundation Engineering' by Das, B.M., - (2011) –6th edition (Indian edition) Cengage learning.
2. 'Basic and Applied Soil Mechanics' by GopalRanjan& ASR Rao,New Age International Pvt. Ltd, (2004).

References:

1. Foundation Analysis and Design'by Bowles, J.E., (1988) – 4th Edition, McGraw-Hill Publishing Company, Newyork.
2. 'Theory and Practice of Foundation Design' by N.N.SOM & S.C.DAS PHI Learning Private limited.
3. 'Fundamentals of Soil Mechanics' by D.W.Taylor., Wiley.
4. 'An introduction to Geotechnical Engineering' by Holtz and Kovacs; Prentice Hall.
5. 'Soil Mechanics' by M.Palani Kumar, PHI Learning.
6. Soil Mechanics and Foundation Engineering by B. C. Punmia; LaxmiPublications,Delhi.
7. Relevant Indian Standard Code Books.

Web Reference:

1. http://nptel.ac.in/courses/105103097/
2. http://www.nptelvideos.in/2012/11/foundation-engineering.html

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III Year-II Semester

L	T	P	C
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16CE6T17 - TRANSPORTATION ENGINEERING – II

Course Learning Objectives:

The objective of this course is to study different modes of transport:

- To know various components and their functions in a railway track.
- To acquire design principles of geometrics in a railway track.
- To know various techniques for the effective movement of trains.
- To acquire design principles of airport geometrics and pavements.
- To know the planning, construction and maintenance of Docks and Harbours.
- To know about the fundamental of airways.
- To know about the different fundamental components of harbour and docks.

Course Outcomes:

By the end of successful completion of this course, the students will be able to:

Course Outcomes	Description	Cognitive Level
CO1	Define good transportation network	Remembering
CO2	Design geometrics in a railway track	Create
CO3	Acquire the techniques for the effective movement oftrains	Understand
CO4	Design geometrics of runway and taxiway by Adapting Airport engineering terminology, basics and buildsknowledge	Creating
CO5	Design Runway Based on terrain.	Creating
CO6	Plan, construct and maintain Docks and Harbours	Analyse

SYLLABUS:

A.RAILWAY ENGINEERING

UNIT – I

Components of Railway Engineering: Permanent way components – Railway Track Gauge - Cross Section of Permanent Way - Functions of various Components like Rails, Sleepers and Ballast –Rail Fastenings – Creep of Rails- Theories related to creep – Adzing of Sleepers- Sleeper density – Rail joints.

UNIT – II

Geometric Design of Railway Track: Alignment – Engineering Surveys - Gradients- Grade Compensation- Cant and Negative Super elevation- Cant Deficiency – Degree of Curve – safe speed on curves – Transition curve – Compound curves – Reverse curves – Extra clearance on curves – widening of gauge on curves – vertical curves – cheek rails on curves.

UNIT – III

Turnouts &Controllers: Track layouts – Switches – Design of Tongue Rails – Crossings – Turnouts – Layout of Turnout – Double Turnout – Diamond crossing – Scissors crossing. Signal Objectives – Classification – Fixed signals – Stop signals – Signalling systems – Mechanical signalling system – Electrical signalling system – System for Controlling Train Movement – Interlocking – Modern signalling Installations.

B.AIRPORT ENGINEERING

UNIT – IV

Air Transportation system: Development of air transportation system with particular reference to India; Aero plane components; Air–craft characteristics. Airport Planning &Design: Airport Master plan – Airport site selection – Air craft characteristics – Zoning laws – Airport classification – Runway orientation – Wind rose diagram – Runway length – Taxiway design – Terminal area and Airport layout – Visual aids and Air traffic control.

UNIT – V

Runway Design: Various Design factors – Design methods for Flexible pavements – Design methods for Rigid pavements – LCN system of Pavement Design – Airfield Pavement Failures – Maintenance and Rehabilitation of Airfield pavements – Evaluation & Strengthening of Airfield pavements – Airport Drainage – Design of surface and subsurface drainage.

C.DOCKS & HARBOURS

UNIT – VI

Water Transportation:

Types of water transportation; advantages and disadvantages of water transportation. Planning, Layout, Construction & Maintenance Of Docks &Harbours: Classification of ports – Requirement of a good port – classification of Harbours – Docks - Dry & wet docks – Transition sheds and workhouses – Layouts; Quays – construction of Quay walls – Wharves – Jetties – Fender systems .Tides - Tidal data and Analysis – Break waters – Dredging – Maintenance of Ports and Harbours – Navigational aids.

Text Books:

1. Railway Engineering by Satish Chandra and Agarwal M.M., Oxford University Press, New Delhi.
2. Airport Engineering by Khanna&Arora - Nemchand Bros, New Delhi Civil Engineering.
3. Docks and Harbour EngineeringbyBindra S.P. - DhanpathiRai& Sons, New Delhi.
4. S. C. Rangawala, Railway Engineering, 25th Ed., Charotar Publishing House Pvt. Ltd., 2015.
5. Airport Engineering by G.V.Rao; Tata McGraw Hill, New Delhi.

References:

1. 'Railway Engineering'bySaxena&Arora - DhanpatRai, New Delhi.
2. 'Transportation Engineering Planning Design' by Wright P.H. &Ashfort N.J. - John Wiley & Sons.
3. 'Airport Engineering' by Virendra Kumar, DhanpatRai Publishers, New Delhi.
4. 'Transportation Engineering' by Srinivasa Kumar R, University Press, Hyderabad.
5. 'Highway, Railway, Airport and Harbour Engineering' by Subramanian KP, Scitech Publications (India) Pvt.Limited,Chennai.
6. S. C. Rangawala, Railway Engineering, 25th Ed., Charotar Publishing House Pvt. Ltd., 2015.
7. Airport Engineering by G.V.Rao; Tata McGraw Hill, New Delhi.

Web Reference:

- http://nptel.ac.in/courses/105107123/

III Year-II Semester

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16CE6T18 - WATER RESOURCE ENGINEERING -I

Course Learning Objectives:

The course is designed to:

- Introduce hydrologic cycle and its relevance to Civil engineering.
- Make the students understand physical processes in hydrology and, components of the hydrologic cycle.
- Appreciate concepts and theory of physical processes and interactions.
- Learn measurement and estimation of the components hydrologic cycle.
- Provide an overview and understanding of Unit Hydrograph theory and its analysis.
- Understand flood frequency analysis, design flood, flood routing.
- Appreciate the concepts of groundwater movement and well hydraulics.
- Learn overview of flood routing and its effects.
- Has to be understood and identify the flood occurring areas nearby.

Course Outcomes:

By the end of successful completion of this course, the students will be able to:

Course Outcomes	Description	Cognitive Level
CO1	Simplify the theories and principles governing the hydrologic processes	Analysing
CO2	Understand the forms of precipitation in real conditions	Understanding
CO3	Apply key concepts to several practical areas of engineering hydrology and related design aspects.	Creating
CO4	Estimate flood magnitude and carry out flood routing	Evaluating
CO5	Demonstrate the recuperation test process in open wells	Understanding
CO6	Design major hydrologic components for a need based structures	Creating

SYLLABUS:

UNIT - I

Introduction: Engineering hydrology and its applications, Hydrologic cycle, hydrological data-sources of data. Precipitation: Types and forms, measurement, rain gauge network, presentation of rainfall data, average rainfall, continuity and consistency of rainfall data,

frequency of point rainfall, Rain fall data in India. Intensity-Duration-Frequency (IDF) curves, Depth-Area-Duration (DAD) curves, Probable Maximum Precipitation (PMP), design storm, problems on average rainfall on towns.

UNIT- II

Abstractions from Precipitation: Introduction, Initial abstractions. Evaporation: factors affecting, measurement, reduction, Analytical methods of Evaporation estimation. Evapotranspiration: factors affecting, measurement, control, potential Evapotranspiration over India.

Infiltration: factors affecting, Infiltration capacity curve, measurement, infiltration indices. Problems on ϕ index and w-index.

UNIT-III

Runoff: Catchment characteristics, Factors affecting runoff, components, computation-empirical formulae, tables and curves, stream gauging, rating curve, flow mass curve and flow duration curve.

Hydrograph analysis: Components of hydrograph, separation of base flow, effective rainfall hyetograph and direct runoff hydrograph, unit hydrograph, assumptions, derivation of unit hydrograph, unit hydrographs of different durations, principle of superposition and S-hydrograph methods, limitations and applications of unit hydrograph, synthetic unit hydrograph. Problems on unit hydrograph.

UNIT-IV

Floods: Causes and effects, frequency analysis- Gumbel's and Log-Pearson type III distribution methods, Standard Project Flood (SPF) and Probable Maximum Flood (MPF), flood control methods and management, Design flood, Design storm.

Flood Routing: Hydrologic storage routing, channel and reservoir routing- Muskingum and Puls methods of routing, flood control in India

UNIT-V

Groundwater: Occurrence, types of aquifers, aquifer parameters, porosity, specific yield, specific capacity, permeability, transmissivity and storage coefficient, types of wells, well loss, Darcy's law, Dupuit's equation- steady radial flow to wells in confined and unconfined aquifers, yield of a open well-recuperation test.

UNIT - VI

Advanced Topics in Hydrology: Rainfall-runoff Modelling, instantaneous unit hydrograph (IUH) - conceptual models - Clark and Nash models, general hydrological models- Chow - Kulandaiswamy model.

Text Books:

1. 'Engineering Hydrology' by Subramanya, K, Tata McGraw-Hill Education Pvt. Ltd, (2013), New Delhi.
2. 'Engineering Hydrology' by Jayarami Reddy, P, Laxmi Publications Pvt. Ltd., (2013), New Delhi.
3. 'Applied hydrology'by Chow V.T., D.R Maidment and L.W. Mays, Tata McGraw Hill Education Pvt.LtTransportation Engineering-Id., (2011), New Delhi.
4. 'Engineering Hydrology'byOjha C.S.P, R. Berndtsson and P. Bhunya, Oxford University Press, (2010).

References:

1. 'Water Resources Engineering', Mays L.W, Wiley India Pvt. Ltd, (2013).
2. 'Hydrology' by Raghunath. H.M., New Age International Publishers, (2010).
3. 'Engineering Hydrology –Principles and Practice' by Ponce V.M., Prentice Hall International, (1994).
4. 'Hydrology and Water Resources Engineering' by Patra K.C., Narosa Publications, (2011).

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III Year-II Semester

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16CE6E01 - WASTE WATER MANAGEMENT

(OPEN ELECTIVE)

Course Learning Objectives:

The course will address the following:

- Enables the student to distinguish between the quality of domestic and industrial water requirements and wastewater quantity generation.
- To impart knowledge on selection of treatment methods for industrial waste water.
- To know the common methods of treatment in different industries.
- To acquire knowledge on operational problems of common effluent treatment plant.

Course Outcomes:

By the end of successful completion of this course, the students will be able to:

Course Outcomes	Description	Cognitive Level
CO1	Analyse the industrial waste quantity and quality requirements.	Analyse
CO2	Identify the treatment methods for industrial wastewater	Applying
CO3	Know the basic theories of industrial waste water management.	Remembering
CO4	Decide the need of common effluent treatment plant for the industrial area in their vicinity	Evaluating
CO5	Examine the effects and treatment methods of liquid waste from the manufacturing industries	Apply
CO6	Examine the effects and treatment methods of liquid waste from the food industries.	Apply

SYLLABUS:

UNIT – I

Industrial water Quantity and Quality requirements: Boiler and cooling waters–Process water for Textiles, Food processing, Brewery Industries, power plants, fertilizers, sugar mills.

UNIT – II

Miscellaneous Treatment: Use of Municipal wastewater in Industries – Advanced water treatment - Adsorption, Reverse Osmosis, Ion Exchange, Ultra filtration, Freezing, elutriation, Removal of Iron and Manganese, Removal of Colour and Odour.

UNIT – III

Basic theories of Industrial Wastewater Management: Industrial waste survey - Measurement of industrial wastewater Flow-generation rates – Industrial wastewater sampling and preservation of samples for analysis - Civil Engineering Wastewater characterization-Toxicity of industrial effluents-Treatment of wastewater-unit operations and processes-Volume and Strength reduction – Neutralization – Equalization and proportioning-recycling, reuse and resources recovery.

UNIT – IV

Industrial wastewater disposal management: discharges into Streams, Lakes and oceans and associated problems, Land treatment – Common Effluent Treatment Plants: advantages and suitability, Limitations and challenges- Recirculation of Industrial Wastes- Effluent Disposal Method.

UNIT – V

Process and Treatment of specific Industries-1: Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Steel plants, Fertilizers, Textiles, Paper and Pulp industries, Oil Refineries, Coal and Gas based Power Plants.

UNIT – VI

Process and Treatment of specific Industries-2: Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Tanneries, Sugar Mills, Distillers, Dairy and Food Processing industries, Pharmaceutical Plants.

Text book:

1. Wastewater Treatment by M.N. Rao and A.K. Dutta, Oxford & IBH, New Delhi.
2. Industrial Wastewater Treatment by KVSG Murali Krishna.
3. Industrial Wastewater treatment by A.D. Patwardhan, PHI Learning, Delhi.
4. Wastewater Treatment for Pollution Control and Reuse, by Soli. J Arceivala, Shyam R Asolekar, Mc-Graw Hill, New Delhi; 3rd Edition.

References:

1. Industrial Water Pollution Control by W. Wesley Eckenfelder, Mc- GrawHill, Third Edition.
2. Wastewater Engineering by Metcalf and Eddy Inc., Tata Mc- Grawhill Co., New Delhi.
3. Wastewater Treatment- Concepts and Design Approach by G.L. Karia& R.A. Christian, Prentice Hall of India.
4. Unit Operations and Processes in Environmental Engineering by Reynolds. Richard, Cengage Learning.

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III Year-II Semester

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16CE6E02 - FUNDAMENTALS OF LIQUEFIED NATURAL GAS
(OPEN ELECTIVE)

Learning Objectives:

The course introduces the student different processes, transportation and storage of liquefied Natural gas (LNG). The students will be able to:

- Gain basic knowledge of LNG and its prospective.
- Learn different liquefaction technologies of LNG.
- Gain knowledge on different functional units on receiving terminals
- Study marine transportation of LNG and its re-gasification at the terminals.
- Understand HSE procedures employed in LNG industry.

Outcomes:

By the end of successful completion of this course, the students will be able to:

Course Outcomes	Description	Cognitive Level
CO1	Outline of LNG industry	Knowledge
CO2	Design a plant for liquefaction of natural gas safety.	Synthesis
CO3	Use the supporting units in LNG plants	Application
CO4	Explain the main components of LNG plants	Comprehension
CO5	Explain types of industries related to LNG	Comprehension
CO6	Memorise the safety , security and environmental issues in LNG plants	Knowledge

SYLLABUS:

UNIT- I

Introduction: Overview of LNG industry: History of LNG industry – Base load LNG – Developing an LNG Project – World and Indian Scenario – Properties of LNG.

UNIT- II

Liquefaction Technologies: Propane precooled mixed refrigerant process – Description of Air products C3MR LNG process – Liquefaction – LNG flash and storage. Cascade process: Description of Conoco-Phillips optimized cascade process – Liquefaction – LNG flash and storage. Other Liquefaction Processes: Description of Linde MFC LNG process- Precooling and Liquefied Petroleum Gas (LPG) recovery – Liquefaction and sub cooling- Trends in LNG train capacity – strategy for grassroots plant- offshore LNG production.

UNIT- III

Supporting Functional Units in LNG Plants: Gas pre-treatment: Slug catcher – NGL stabilization column – Acid gas removal unit – Molecular sieve dehydrating unit – Mercury and sulphur removal unit – NGL recovery – Nitrogen rejection – Helium recovery.

UNIT- IV

Receiving Terminals: Receiving terminals in India – Main components and description of marine facilities – storage capacity – Process descriptions. Integration with adjacent facilities – Gas inter changeability – Nitrogen injection – Extraction of C2+ components.

UNIT- V

LNG Shipping Industry & Major Equipment in LNG Industry: LNG Shipping Industry: LNG fleet – Types of LNG ships – Moss – Membrane – prismatic; Cargo measurement and calculations. Major equipment in LNG industry – Cryogenic heat exchangers: Spiral – Wound heat exchangers – Plate-fin heat exchangers – Cold boxes; Centrifugal compressors – Axial compressors – Reciprocating compressers. LNG pumps and liquid expanders – Loading Arms and gas turbines.

UNIT- VI

Vaporizers: Submerged combustion vaporizers- Open rack vaporizers – Shell and tube vaporizers: direct heating with seawater, and indirect heating with seawater. Ambient air vaporizers: Direct heating with ambient air – Indirect heating with ambient air. LNG tanks. Safety, Security and Environmental Issues: Safety design of LNG facilities – Security issues for the LNG industry – Environmental issues – Risk based analysis of an LNG plant.

Text Book:

1. LNG: Basics of Liquified Natural Gas, I Edition, Stanley Huang, Hwa Chiu and Doug Elliot, PETEX, 2007.

Reference Books:

1. Marine Transportation of LNG (Liquefied) and related products, Richard G. Wooler, Gornell Marine Press, 1975.
2. Marine Transportation of Liquefied Natural Gas, Robert P Curt, Timothy D. Delaney, National Maritime Research Centre, 1973.
3. Natural Gas by Sea: The Development of a New Technology, Roger Rooks, Wither by, 1993.

Web Reference:

1. https://ceonline.austin.utexas.edu/petexonline/file.php/1/ebook_demos/lng/HTML/index

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III Year-II Semester

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16CE6E03 - GREEN FUEL TECHNOLOGY

(OPEN ELECTIVE)

Learning Objectives:

The students will be imparted the knowledge of:

- Various green fuel technologies available worldwide.
- Production of Bio-ethanol from crops, molasses and cellulosic bio mass.
- Production of Bio-diesel from plant seeds, algae, and by utilizing supercritical process.
- Methane gas production utilizing bio digesters.

Outcomes:

By the end of successful completion of this course, the students will be able to:

Course Outcomes	Description	Cognitive Level
CO1	Understand about the biomass to liquids and gaseous fuels	Understand
CO2	Produce the bio ethanol chemical from crops.	Creative
CO3	Examine the bio ethanol chemical from lingo cellulosic bio mass.	Apply
CO4	Understand the bio diesel production technologies.	Understand
CO5	Experimental tests on biodiesel for the production of plant seed oils.	Apply
CO6	Know the concept of bio degrade and bio gas technologies in India.	Remembering

SYLLABUS:

UNIT- I

Introduction: Plant based biofuels- World biofuels scenario- Thermochemical conversion of biomass to liquids and gaseous fuels.

UNIT- II

Bioethanol from crops – Cane sugar: Production of ethanol from molasses – Bioethanol from starchy biomass: Production of starch Saccharifying enzymes – Hydrolysis and fermentation.

UNIT- III Bioethanol from lignocellulosic biomass: Pre-treatment of the substrates- Production of Cellulases and Hemicellulases- Hydrolysis and fermentation.

UNIT- IV

Biodiesel production technologies and substrates– Lipase-catalyzed preparation of biodiesel- Biodiesel production with supercritical fluid technologies; Biodiesel from algae: Alga culture -Challenges- Alga culture for biodiesel production.

UNIT- V

Biodiesel from different plant seeds: Palm oil diesel production and its experimental test on a diesel engine – Biodiesel production using karanja (pongamiapinnata) and jatropha (jatrophacurcas) seed oil – Biodiesel production form rubber seed oil and other vegetable oils.

UNIT- VI

Microbial production of methane: Different types of bio-digesters and biogas technology in India.

Text Books:

1. Hand book of Plant Based Biofuels, Ashok Pandey, CRC Press, 2009.

Reference Books:

1. Biofuels Engineering Process Technology, Caye M. Drapcho, Nghiem PhuNhuan, Terry H. Walker, McGraw-Hill, 2008.

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III Year-II Semester

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16CE6L08 - ENVIRONMENTAL ENGINEERING LAB

Course Learning Objectives:

The course will address the following:

- Estimation some important characteristics of water and wastewater in the laboratory.
- It also gives the significance of the characteristics of the water and wastewater.

Course Outcomes:

By the end of successful completion of this course, the students will be able to:

Course Outcomes	Description	Cognitive Level
CO1	Demonstrate how to perform relevant tests in the laboratory to determine the major characteristics of water and waste water	Apply
CO2	Make use of various equipment's and methods available for examining water and waste water.	Apply
CO3	Determine the characteristics of water and waste water	Evaluating
CO4	Perform the dosage of coagulants added in raw water	Apply
CO5	Know the contents of pollutants present in raw waste water	Understanding
CO6	Estimation of the strength of the sewage in terms of BOD and COD	Evaluating

SYLLABUS:

List of Experiments:

1. Determination of pH and Electrical Conductivity (Salinity) of Water and Soil.
2. Determination and estimation of Total Hardness–Calcium & Magnesium.
3. Determination of Alkalinity/Acidity.
4. Determination of Chlorides in water and soil.
5. Determination and Estimation of total solids, organic solids and inorganic solids and settle able solids by Imhoff Cone.
6. Determination of Iron.
7. Determination of Dissolved Oxygen with D.O. Meter &Wrinklers Method.
8. Determination of N, P, K values in solid waste.
9. Physical parameters – Temperature, Colour, Odour, Turbidity, Taste.
10. Determination of C.O.D.
11. Determination of Optimum coagulant dose.
12. Determination of Chlorine demand.

13. Presumptive Coliform test.

NOTE: At least 10 of the above experiments are to be conducted.

List of Equipment's:

1. pH meter
2. Turbidity meter
3. Conductivity meter
4. Hot air oven
5. Muffle furnace
6. Dissolved Oxygen meter
7. U–V visible spectrophotometer
8. COD Reflux Apparatus
9. Jar Test Apparatus
10. BOD incubator
11. Autoclave
12. Laminar flow chamber
13. Hazen's Apparatus

Text Books:

1. Standard Methods for Analysis of Water and Waste Water – APHA.

2. Chemical Analysis of Water and Soil by KVSG Murali Krishna, Reem Publications, New Delhi.

Reference:

1. Relevant IS Codes.
2. Chemistry for Environmental Engineering by Sawyer and Mc. Carty.

III Year-II Semester

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16CE6L09 - TRANSPORTATION ENGINEERING LAB

Course Learning Objectives:

The objective of this course is:

- To study the properties and judge the suitability of the road materials.
- To study the properties and stability requirements of the Bitumen mixes.
- To carry out surveys for traffic volume, speed and parking.

Course outcomes:

By the end of successful completion of this course, the students will be able to:

Course outcomes	Description	Cognitive level
CO1	Know the bitumen nature and their quality behaviour.	Remembering
CO2	Utilize aggregate and bitumen properties in pavement design.	Apply
CO3	Determine the traffic volume, speed and parking characteristics.	Applying
CO4	Judge the suitability of materials for the road construction.	Applying
CO5	Predecit the optimum bitumen content for the mix design.	Creating
CO6	Design the mix proportions of the bitumen mixes.	Creating

SYLLABUS:

1. ROAD AGGREGATES:

1. To determine the Aggregate Crushing value.
2. To determine the Aggregate Impact value.
3. To determine the specific Gravity and Water Absorption test for aggregates.
4. To conduct the Attrition Test for aggregates.
5. To conduct the Abrasion Test for aggregates.
6. To conduct the Shape tests for aggregates.

2. BITUMINOUS MATERIALS:

1. To determine the Penetration value .
2. To conduct Ductility Test.
3. To determine the Softening Point.
4. To determine the Flash and fire point.
5. To conduct Stripping Test.
6. To determine the Viscosity.

3. BITUMINOUS MIX:

1. To determine the Marshall Stability Number.

4. TRAFFIC SURVEYS:

1. To conduct Traffic volume study at mid blocks.
2. To conduct Traffic Volume Studies (Turning Movements) at intersection.
3. To conduct Spot speed studies.
4. To conduct Parking study.

5. DESIGN & DRAWING:

1. Earthwork calculations for road works.
2. Drawing of road cross sections.
3. Rotors intersection design.

REFERENCES:

8. 'Transportation Engineering and Planning' by Papacostas C.S. and PD Prevedouros, Prentice Hall of India Pvt. Ltd; New Delhi.
9. 'Principles of Highway Engineering' by Kadiyali LR, Khanna Publishers, New Delhi.
10. 'Transportation Engineering - An Introduction' byJotinKhisty C, Prentice Hall, Englewood Cliffs,New Jersey.