(SEMESTER V)

SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE205TPC09	L	T	P	CT-I	CT-II	TOTAL	70	100	04
Subject:	Design of Concrete Structures-I	3	1	0	15	15	30			

Course Learning Objectives:

1. To understand the various philosophies of design of concrete structures using IS Codes.
2. To understand the design beam for flexure, shear, bond and torsion
3. To know the design of slabs and staircase with their detailing.
4. To learn the design of axially and eccentrically loaded columns.
5. To know about different types of footings and their reinforcement detailing.

Course Content:

UNIT-1: Introduction to design of concrete structures-limit state analysis and design of beams for flexure, bond.

UNIT-2: Shear and torsion

UNIT-3: One way slabs, staircases, Two-way slabs

UNIT-4: Axially and eccentrically loaded columns. (Uniaxial only)

UNIT-5: Footings – different types of isolated footings, synthesis of limit state and working Stress methods.

Text Books:

1. Reinforced Concrete Design - S Unnikrishna Pillai &Devadas Menon
2. Limit State Design of Reinforced Concrete - P.C. Verghese
3. Design of Reinforced Concrete Structures - N Krishna Raju

Course Outcomes

After successful completion of this course, the students will be able

CO1: To adopt limit state design philosophy for deign of reinforced concrete.
CO2: To carry out the design of RC structural elements for flexure, bond, shear and torsion.
CO3: To implement the design slabs and staircases as per LSD.
CO4: To do the design of RC structural columns subjected to axial and eccentric loads.
CO5: To propose and design the type of footing for a RC structure.

SYLLABUS	**(SEMESTER-V)**	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE205TPC10	L	T	P	CT-I	CT-II	TOTAL	70	100	04
Subject:	Structural Analysis - II	3	1	0	15	15	30			

Course Learning Objectives:

The objective of this course is

1. To understand the principles of energy methods and their applications to indeterminate beams and plane frames
2. To know the principles and applications of slope deflection method to the indeterminate beams and rigid frames
3. To study the principles of moment distribution method and its applications to indeterminate beams and rigid joint plane frames
4. To study the principles of matrix methods and their applications to beams
5. To apply the Muller Breslau Principle for the construction of influence lines to indeterminate beams and two-hinged arches

Course Content:

UNIT-1: Analysis of indeterminate beams by Consistent Deformation methods, Analysis of indeterminate rigid plane frames and truss using energy method.

UNIT-2: Slop Deflection Method: Continuous beams and rigid joint plane frames by slope deflection method due to loads and yielding of supports.

UNIT-3: Moment-distribution method. Continuous beams and rigid joint plane frames by moment distribution method due to loads and yielding of supports.

UNIT-4: Introduction to Flexibility matrix and Stiffness Matrix methods: Applications of the methods to simple indeterminate beams.

UNIT-5: Analysis of symmetrical two hinge arches (parabolic and circular). Influence lines for propped cantilevers, continuous beams using Muller-Breslau's principle.

Text Books:

1. Structural Analysis –Devdas Meenon
2. Indeterminate Structural Analysis - C. K. Wang
3. Fundamental of Structural Analysis -Lee
4. Advanced Structural Analysis - A. K. Jain
5. Structural Analysis (SI units) - R C Hibbler
6. Structural Analysis - L S Nagi& R S Jangid

Course Outcomes

At the end of the course the students shall be able

CO1: To identify the suitable method of analysis for the analysis of indeterminate beams and trusses and analyse the same using consistent deformation method and energy method

CO2: To analyse the indeterminate beams and rigid joint plane frames by slope deflection method and moment distribution method

CO3: To analyse the indeterminate beams and rigid joint plane frames by moment distribution method

CO4: To apply and analyse the indeterminate beams using matrix methods

CO5: To construct the influence lines for stress resultants in indeterminate beams and two-hinged arches and analyse the same for moving loads

SYLLABUS	**(SEMESTER-V)**	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE205TPC11	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Transportation Engineering	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this Course is

1. To understand the importance of transportation and characteristics of highway transport
2. To study the geometric design of highway.
3. To understand the traffic characteristics
4. To know the pavement materials and pavement design
5. To explaindifferent parts of railway track, their functions geometric design of railway.

Course Content:

UNIT-1: Introduction: Importance of transportation, Modes of transportation, characteristics of highway transport.

Highway development & planning: Road development and planning in India, Roads classification, patterns, Planning surveys, Highway alignment and surveys, Highway drainage.

UNIT- 2: Geometric Design: Cross Section elements, Sight Distance, Design of horizontal and vertical Alignment.

UNIT -3: Traffic Engineering: Traffic characteristics, studies such as volume, density, Speed, 'O' and 'D' and their uses, Traffic control devices and road accidents.

UNIT-4: Pavement Materials: Behaviour of highway materials, properties of Subgrade materials and pavement component materials. Tests on subgrade soil, aggregate and bitumen.

Pavement Design: Design of flexible pavements and rigid pavements

UNIT- 5: Railway Engineering: 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. Geometric Design of Railway Track: Alignment, Engineering Surveys, Gradients, Grade Compensation, Cant and Negative Super elevation, Cant Deficiency, Compensation On Curves

Text Books:

1. Principle and Practices of Highway Engineering – Kadiyali& Lab (Khanna Publishers, Delhi)
2. Highway Engineering – S. K. Khanna& C.E.G. Justo (Khanna Publishers, Delhi)
3. Highway Engineering – Rangawala S.C. (Charotar Publishers)
4. A textbook of Transportation Engineering – S.P. Chandola (S. Chand)
5. Transportation Engineering – A.K. Upadhyay (S.K. Kataria& Sons)

Reference Book:

MoRTH (2013). "Specifications for Road and Bridge Works". Indian Roads Congress, New Delhi.

Course Outcomes

At the end of the course the studentsshall be able

CO1: To propose modes of transportation, transportation planning and survey.
CO2: To design cross section elements, sight distance, horizontal and vertical alignment.
CO3: To implement traffic studies, traffic regulations and carryout control and intersection designs.
CO4: To determine the properties of pavement materials and design flexible and rigid pavements as per IRC specification
CO5: To describe the components of Railway track, different Gauges and carryout geometric design.

SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE205TPC12	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Soil Mechanics - I	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this Course is:

1. To impart knowledge to classify the soil based on index properties and to assess their engineering properties based on the classification.
2. To familiarize the students about the fundamental concepts of compaction & flow through soils.
3. To impart knowledge to stress transformation and its distribution.
4. To develop the basic concept of shear strength of soils and its engineering aspects.
5. To learn about the significance of settlement of soils and calculations.

Course Content:

Unit 1: Introduction to Soil Mechanics and Geotechnical Engineering, Complexity of Soil Nature, Soil Formation and Soil Types. Index Properties of Soil: Basic Definitions, Phase Relationships, Classification of Soils-The Unified Soil Classification System and Indian Standard Soil Classification System, Soil Structure and Clay Minerals.

Unit 2: Soil Compaction: Definition and Compaction Theory, Laboratory Compaction Tests-Standard Proctor Compaction Test & Modified Compaction Test, Factors Affecting Compaction, Effect of Compaction on Engineering Properties of Soil , Field Compaction and Controls.Principle of Effective Stress, Capillarity and Permeability:Principle of Effective Stress, Capillarity in Soils, Effective Stress under Different Field Conditions, Seepage Pressure, Quick Sand Condition, Permeability, Darcy's Law, Determination of Permeability, Permeability of Stratified Soils, Absolute Co-efficient of Permeability, Factors Affecting Permeability , Seepage through Soils-Laplace's Equation, Flow Nets.

Unit 3: Vertical Stresses below Applied Loads: Stresses due to Applied Loads, Boussinessq and Westergaard Theories for Vertical Stresses under Concentrated Loads, Uniformly Loaded Circular and Rectangular Areas, Pressure Bulb, Variation of Vertical Stress under Point Load along the Vertical and Horizontal Planes, Newmark's influence chart.

Stability of Soil Slopes: Introduction, Types of Slope Failures, Slip Circle Method, Determination of Centre of Most Critical Slip Circle, Taylor's Stability Charts, Stabilization of Soil Slopes.

Unit 4: Shear Strength:Introduction, Stress at a Point and Mohr's Stress Circle**,** Normal and Shear Stresses on a Plane, Mohr-Coulomb Failure Criterion, Laboratory Tests for Shear Strength Determination, Shear Strength Parameters, Direct shear test, Triaxial shear test, Unconfined Compression Test and Vane Shear test, Shear Strength Characteristics of Normally Consolidated and Reconsolidated Clays, Factors Affecting Shear Strength.

Unit 5: Compressibility: Introduction to Compressibility, Consolidation, Effects of Soil Type, Stress History and Effective Stress on Compressibility , Factors Affecting Consolidation and Compressibility Parameters, Normally Consolidated and Over Consolidated Soils, Types of Consolidation, Terzaghi's Theory of 1-D Consolidation and Time Rate of Consolidation.

Text Books:

1. Basic and Applied Soil Mechanics by GopalRanjan and A.S.R. Rao, New Age Int.(P) Ltd., Pub., New Delhi.
2. Soil Mech. and Foundation Engg.Geotech. Engg. Series (PB 2018) by V. N. S. Murthy, CBS Pub., New Delhi.
3. Soil Mech. and Foundations by Dr.BC.Punmia, Ashok Kr. Jain &Arun Kr. Jain, Laxmi Pub. (P) Ltd, New Delhi.
4. Soil Mechanics by Robert V. Whitman & T. William Lambe, Wiley India Pvt Ltd. New Delhi.
5. Soil Mechanics and Foundation Engineering by Purushotama Raj, Pearson Publications, New Delhi.
6. Soil Mechanics and Foundation Engineering (Geotechnical Engineering) by Dr. P. N. Modi, Standard Book House (Rajsons Publications Pvt Ltd) New Delhi-110002.
7. Essentials of Soil Mechanics and Foundations by McCarthy, D.F. Prentice-Hall, 2006.
8. Geotechnical Engineering – Principles and Practices by Coduto, D.P. PHI.Pvt.Ltd. New Delhi, 2010.

Course Outcomes

On completion of the course, the student is expected to be able

CO1: To identify various types of soils and its properties, formulate and solve engg. problems
CO2: To determine compaction as well as flow through soil medium and its impact in Engineering application.
CO3: To solve engineering problems by drawing stress diagramwith the understanding of stress distribution in loaded soil medium.
CO4: To calculate the shear strength of soils and use it forthe design of foundations.
CO5: To evaluate settlement due to consolidation of soil.

SYLLABUS	**(SEMESTER-V)**	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE205TPC13	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Environmental Engineering - I	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this course is

1. To learn the water sources, demand and water quantity estimations technique.
2. To know the water characterization, and various physical and chemical treatment techniques.
3. To learn the basics of water supply, purification and treatment
4. To learn filtration, coagulation and softening techniques & mechanism for water treatment and distribution systems.
5. To study air and noise pollution.

Course Content:

UNIT 1: Introduction: Necessity and importance of water supply schemes. Water demand: Classification of water demands, Estimation of quantity of water required by a town, per capita demand, factors affecting per capita demand, design period and population forecasting, variation in water demand. Sources of water supply. Surface sources and underground sources, Intake works, site selection, type of intake works.

UNIT 2: Quality of water: Common impurities, physical, chemical and biological characteristics of water, water quality standards for municipal and domestic supplies. Water Processing: Object of water processing, flow diagrams of typical ground water system and surface water systems. Sedimentation Theory of sedimentation, sedimentation tanks and its types, design parameters related with sedimentation tanks, sedimentation with coagulations, coagulants and coagulant aids, Jar test for determining coagulant dosage.

UNIT 3: Filtration; Theory of filtration, slow sand and rapid sand filters, Construction and operation. Disinfection, Methods of disinfection, Chlorination, Types of chlorination, Break Point chlorination.

UNIT 4: Softening: Methods of Softening, Iron Removal, Fluoridisation. Distribution System: Methods of distribution, layout of distribution system, methods of analysis, pressure in the distribution system, distribution reservoirs, functions and its types, storage capacity of distribution reservoir.

UNIT 5: Air Pollution: Introduction, causes, sources, characteristics, effects of air pollution on plants, humans, animals and materials and atmosphere, air pollution control methods and equipment. Noise Pollution: Definition, sources, effects of noise pollution on humans, animals and non-living things, methods of noise control.

Text Books:

1. Water Supply Engineering – S.K. Garg (Khanna Publication).
2. Water Supply Engineering – B.C. Punmia (Laxmi Publication, New Delhi)
3. Environmental Engineering – Peavy& Rowe (Tata McGraw Hill, New Delhi).
4. Water Supply and Sanitary Engineering – G.S. Birdi (DhanpatRai Publications).
5. Introduction to Environmental Science – Y. Anjaneyulu (B.S. Publications)
6. Environmental Science and Engineering – Henry and Heinke (Pearson Education)

Course Outcomes

At the end of the course the students shall be able

CO1: To determine the various sources and demand of water, design period etc.
CO2: To propose the uses of pumps, calculate its capacities, costing, head loss, etc. and plan distribution systems.
CO3: To evaluate the characteristicof water quality and determine the influence of the different parameter in the design of water treatment plant (water quality parameters).
CO4: To describe and analyse sedimentation, coagulation, flocculation, filtration, disinfection and water softening.
CO5: To identify the air and noise pollution and implement its control methods.

SYLLABUS	**(SEMESTER-V)**	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE205TPC14	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Estimation and Costing	3	0	0	15	15	30			

Course Objective

To introduce students to the

- Classify Basic concepts, techniques and applications of Estimation and costing.
- Understand how to prepare a detailed estimate for a residential building and calculate the Quantities for various items of work like roads canals etc.
- Analyse the rates for various items of work and to prepare an abstract estimate
- Identify the preparation of bar bending schedule for reinforcement works and create various Tender documents for bidding purpose.
- Understand valuation and standard specification in construction.

Course Content:

UNIT – 1:

General items of work in buildings–Standard units – Principles of working out quantities for detailed and abstract estimates – Approximate method of estimating. Detailed estimates of buildings.

UNIT – 2:

Earthwork for Roads and Canals

UNIT – 3:

Rate Analysis - working out data for various items of work over head and contingent changes.

UNIT – 4:

Reinforcement bar Bending and bar requirement schedule; Contracts – Types of Contracts –
Contract Documents – Conditions of Contract

UNIT – 5:

Valuation of Buildings, Standard specifications for different items of building construction

TEXTBOOKS:

1. Estimating and Costing by B. N. Dutta, UBS publishers, (2000).
2. Estimating and Costing by G. S. Birdie.

REFERENCE BOOKS:

1. Standard schedule of rates and standard data book by public works department.
2. I.S. 1200 (Parts I to XXV – 1974/method of measurement of building and Civil Engineering works – B.I.S)
3. Estimation, costing and specifications by M. Chakraborthi; laxmi publications.
4. National building code

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

CO1: Understand the preparation of an Abstract Estimate for a Residential Building and demonstrate knowledge of professional and ethical responsibilities and the impact of engineering solutions on the society and also be aware of contemporary issues.

CO2: Demonstrate the calculation of earth work quantity for roads and canals and evaluate the rates for various items of work.

CO3: Analyse the units for various quantities of items of work.

CO4: Design and Prepare Bar bending schedule for reinforcement works and understand how to prepare a Notice inviting tender document for bidding.

CO5: Evaluate the valuation of building and preparation of standard specifications for different items of building construction and create new technologies to develop concrete estimating methods for more ethical and enhanced usage.

SYLLABUS	**(SEMESTER-V)**	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE205PPC04	L	T	P	CT-I	CT-II	TOTAL	20	50	1
Subject:	Transportation Engineering Lab	0	0	2	-	-	30			

Course Learning Objectives:

The objective of this course is

- To study the physical properties of road aggregate & their laboratory test.
- Determine the properties of bitumen.
- Determine the CBR value for subgrade soil.

Course Content:

Minimum 10 experiments to be performed

1. To determine the crushing value of the given aggregate sample.
2. To determine 10% finer value of the given aggregate sample.
3. To determine the abrasion value of the given aggregate sample by los angles apparatus.
4. To determine the impact value of the given aggregate sample.
5. To determine the elongation index of the given aggregate sample.
6. To determine the flakiness index of the given aggregate sample.
7. To determine the water absorption of the given coarse aggregate.
8. To determine the specific gravity of the given coarse aggregate.
9. To determine the penetration value of the given bitumen material.
10. To determine the softening point of the given bitumen material.
11. To determine the ductility of the given bitumen material.
12. To determine the viscosity of the given bitumen material
13. CBR Test

Course Outcomes

At the end of the course the studentsshall be able

CO1: To recognise the knowledge about different physical properties of aggregates by performing different test on road aggregates.

CO2: To determine the various properties of bitumen by performingvarious tests on it.

CO3: To compute the strength of subgrade soil by CBR test.

SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE205PPC05	L	T	P	CT-I	CT-II	TOTAL	20	50	1
Subject:	Soil Mechanics Lab	0	0	2	-	-	30			

Course Learning Objectives:

The objective of this Course is:

- To learn the basic tests for classification of different soils.
- To conduct compaction tests for laboratory and in –situ.
- To learn the sampling of soil.

Course Content:

Minimum 10 experiments to be performed

Determination of Index Properties

1. To determine the specific gravity of soil sample by , a) Pycnometer Bottle Method., b) Density Bottle Method.
2. To determine the particle size distribution of a soil by a) by Mechanical Analysis/IS Sieve Method., b) by Hydrometer apparatus.
3. Liquid limit and Plastic limit Tests.
4. Shrinkage limit and Differential free swell test.

Determination of In -Situ Density and Compaction Characteristics

5. To determine the minimum moisture content (OMC) at maximum dry density (MDD) of soil by, a) Light weight Proctor Test, b) Heavy Weight Proctor Test.
6. To determine in situ dry density of soil by a) Core cutter method. b) Sand replacement method.

Determination of Engineering Properties- Part A

7. To determine the permeability of soil by a) Falling Head Methods, b) Constant Head Methods.
8. To determine the shear strength parameters a) Direct shear test in cohesionless soil., b) Unconfined compression test in cohesive soil

Determination of Engineering Properties- Part B

9. To determine the shear strength parameters for a) Tri-axial compression test in c-φ Soil (Demonstration only). b) One dimensional consolidation test (Determination of co-efficient of consolidation only), c) Laboratory vane shear test in cohesive soil.
10. California Bearing Ratio Test.

TextBooks:

1. Soil Engineering Laboratory Instruction Manual" published by Engineering College Co- operative Society, Anna University, Chennai, 2010.
2. "Saibaba Reddy, E. Ramasastri, K. "Measurement of Engineering Properties of Soils", New age International (P) limited publishers, New Delhi, 2008.
3. Lambe T.W., "Soil Testing for Engineers", John Wiley and Sons, New York, 1951. Digitized 2008.
4. IS Code of Practice (2720) Relevant Parts, as amended from time to time, Bureau of Indian Standards, New Delhi.
5. G.Venkatappa Rao and Goutham .K. Potable, "Geosynthetics Testing – A laboratory Manual", Sai Master Geoenvironmental Services Pvt. Ltd., 1st Edition 2008.
6. BrajaM.Das., "Soil Mechanics: Laboratory Manual", Oxford University Press, eighth edition, 2012

REFERENCES:

1. Basic and Applied Soil Mechanics by GopalRanjan and A.S.R. Rao, New Age International (P) Limited, Publishers, New Delhi-110002.
2. Soil Mechanics and Foundations by Dr. B. C. Punmia, Ashok Kr. Jain &Arun Kr. Jain, Laxmi Publications (P) Ltd, New Delhi-110002

Course Outcomes

On completion of the course, the student is expected to be able to:

CO1: Conduct tests to determine the index properties of soils
CO2: Determine the density and compaction characteristics in laboratory as well as in situ.
CO3: Conduct tests to find permeability and shear strength of soils (c & φ)
CO4: Understand various tests to find c & φ parameters, compressibility and CBR value.

(SEMESTER VI)

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206TPC15	L	T	P	CT-I	CT-II	TOTAL	70	100	04
Subject:	Design of Steel Structures	3	1	0	15	15	30			

Course Learning Objectives:

The objective of this course is

1. To list mechanical properties of structural steel and outline general aspect of design philosophies.
2. To design and classify the use of steel fastener.
3. To determine tensile and compressive strength of structural steel member.
4. To understand design examples of Beam, Beam Column, Column Splices and Column Base
5. To introduce the design of eccentric connections, plate girders.

Course Content:

UNIT 1: Introduction: General, types of Steel, mechanical behaviour of steel, measures of Yielding, measures of Ductility, types of Structural system, Structural Steel Sections.Methods of Structural design: Introduction- Design Philosophies-Working Stress method-Ultimate Strength method-Load and Resistant factor- Limit State Method-Partial safety factor Load combinations-Classification of Cross sections- General aspects in the design.

UNIT 2: Design of Steel fasteners: Types of fasteners – Riveted connections- Bolted connections- Assumptions-Failure of bolted joints – Strength of bolted joints – Design examples – Design of Welded connections – Butt weld-fillet weld – Design examples.

UNIT 3: Design of Tension Members: General – Modes of Failure of Tension member- Analysis of Tension members- Example - Design steps – Design examples – Lug angles – Design.Design of Compression Members: General – Strength of Compression members- Design Compressive strength- Example on analysis of Compression members – Design of Angle struts – Design Examples- Built up Columns- Design of Lacing – Design of Battens-Design Examples- Design of Roof members.

UNIT 4: Design of Beams: General- Lateral Stability of Beams- Bending Strength of Beams – Plastic Section Modulus - Design Examples.Design of Beam Columns: Behaviour of members under combined loading – Modes of Failures – Design Examples.Design of Column Splices and Column Base: Design of Column Splice-Design Examples- Design of Column Base- Slab Base- Gusseted Base- Design Examples.

UNIT 5: Design of Eccentric Connections: Design of Brackets- Type-1 and Type 2 – Moment Resistant connections - Design Examples.Design of Plate Girder: General- Components of Plate Girder- Optimum depth – Bending Strength – Shear Strength – Shear Buckling- Simple Post critical method- Tension Field method- Stiffeners-Bearing-Transverse stiffeners - Design Examples.

Text Books:

1. Limit state Design of Steel Structures – S K Duggal.
2. Design of Steel structures: By Limit State Method– S. S. Bhavikatti.
3. Design of Steel Structures- K. S. Sai Ram
4. Design of Steel Structures-Limit States Method-N. Subramanian
5. Comprehensive Design of Steel Structures – Dr B.C.Punmia, Ashok Kr.Jain, Arun Kr. Jain
6. Design of Steel Structures- S. Ramamrutham
7. Fundamentals of Structural Steel Design – M. L. Gambhir
8. Limit state Design of Steel Structures – S Kanthimathinathan
9. Design of Steel Structure Volume-I- Ramchandra
10. Design of Steel Structure Volume-II- Ramchandra
11. Design and Analysis of Connections in Steel Structures-Fundamentals and examples-Alfredo Boracchini
12. IS-800:2007- Indian Standard- General Construction in Steel-Code of Pr., & Steel Tables

Course Outcomes

At the end of the course the studentsshall be able

CO1: Define mechanical properties of structural steel and Implement the limit state design philosophy.
CO2: Design/Evaluate the riveted, bolted and welded connection in steel structure.
CO3: Design/Evaluate tension and compression members
CO4: Design/Evaluatebeam and column element.
CO5: Design/Evaluatean eccentric connection and a plate girder.

SYLLABUS	**(SEMESTER-VI)**	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206TPC16	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Environmental Engineering - II	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this Course is

1. To help students develop the ability to apply basic understanding of physical, chemical, and biological phenomena in the sewage
2. To understand the concept successful design, operation and maintenance of sewage treatment plant
3. To study about the Aerobic Treatment units.
4. To learn about the Anaerobic Treatment units.
5. To study the various process performed with Municipal Solid Wastes.

Course Content:

UNIT 1: Objective, design period, Physical, Chemical and Biological characteristics. Waste water sampling, self-purification of natural streams, effluents Standards, Oxygen Sag Curve, sources of sewage. Design of sanitary sewers, minimum size of sewer, velocities in sewers and gradient of sewers. Sewer appurtenances viz. manholes, street inlets, flushing devices, Vent pipes etc.

UNIT 2: Waste Water primary Treatment: characteristics of wastewater. Effluent discharge standards, Primary, secondary and tertiary treatment of wastewater. Types of screens, design of screen chamber, sources of grit, design of grit chamber, disposal of grit, oil and grease removing skimming tanks, design of PST with inlet and outlet details, primary sludge and its disposal

UNIT 3: Aerobic Treatment UNITs: Biological principle of ASP, SVI, sludge bulking and control; biological principle of Trickling filter, re-circulation, operational troubles; Rotating biological contactor. Low cost treatment methods: Principle of Oxidation pond, symbiosis, principle of Aerated Lagoons, aeration method, Principle of Oxidation Ditches, sewage farming, ground water recharge.

UNIT- 4: Anaerobic Treatment UNITs: Septic tanks, biological Principle, method of treatment and disposal of tank effluent. Anaerobic digester, principle of anaerobic digestion, Stages of digestion, bio-gas production. Sludge disposal methods, advantages and disadvantages, Design of STP.

UNIT 5: Municipal Solid Wastes: Characteristics, generation, collection & transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment & disposal), environmental & health implications, disposal of solid waste by land filling, composting and incineration methods. Hazardous waste management, environmental and health implications due to Exposure, incineration, landfill disposal, site remediation, disposal of refuse by Composting.

TEXT BOOKS:

1. Environmental Engineering – Peavy& Rowe (Tata McGraw Hill, New Delhi).
2. Waste Water Engineering – S.K. Garg (Khanna Publication).
3. Manual on sewerage & sewage Treatment published by Ministry of UrbanDev. GOI,Ministry of Urban development
4. Waste Water Engineering – Metcalf Eddy (Tata McGraw Hill, New Delhi).
5. Hazardous Waste management: M.D. LaGrega, P.L. Buckingham, J.C.Evans
6. Manual on Municipal Solid Waste Management: CPHEEO (Ministry of Urban Dev.)
7. Environmental Engineering-II.P.Venugopala Rao Tata McGraw Hill
8. Water andWastewater Technology ,Hammer (PHI)

Course Outcomes

At the end of the course the studentsshall be able

CO1: To understand the basic phenomena of Sewage and sewerage.
CO2: To estimate waste water quantity and can design the sewerage system.
CO3: To understand basic methodology for wastewater treatment (screening, grit chambers, sedimentation, biological treatment and chemical treatment) and to understand various processes of Aerobic & Anaerobic treatment units.
CO4: To design unit operations specific to wastewater treatment and to control & monitor wastewater treatment facilities.
CO5: To understand solid & hazardous wastes management, waste processing options and design

SYLLABUS	**(SEMESTER-VI)**	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206TPC17	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Water Resources Engineering -I	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this Course is

1. To understand the need of Irrigation, types of irrigation systems and Methods of Irrigation.
2. To understand the Canal Irrigation systems and design of stable channels in alluvium.
3. To understand Water Logging and its Control.
4. To know the Riverbehaviour, control and training.
5. To know the Reservoir Planning, Hydrograph and Flood Routing and it principle.

Course Content:

UNIT 1: Introduction: Need for Irrigation, advantages and disadvantages of irrigation, types of irrigation systems – Flow irrigation, lift irrigation. Methods of Irrigation: Introduction, requirement of irrigation methods, surface and sub-surface irrigation. Water Requirement of crops: Introduction, water requirement of crop, crop season and crops of India, crop period and base period, delta, duty of water, relationship between delta, duty and base period, factors affecting duty.

UNIT 2: Canal Irrigation: Classification of canal, parts of canal irrigation system, canal alignment, typical canal cross section, command areas, losses in irrigation systems. Design of stable channels in alluvium. Introduction, Kennedy's silt theory, Lacey's Theory, Lacey's regime equations, Lacey's shock theory, Design of channels by Kennedy's and Lacey's theories, maintenance of irrigation channels.

UNIT 3: Water Logging and its Control. Causes and ill effects of water logging, prevention and control, reclamation of water logged lands, surface drainage. Design of Lined Channels. Introduction, benefits of lining, types of lining, economics of lining, procedure and design of lined canals.

UNIT 4: River behaviour, control and training. Objects, river characteristics, classification of river training works, methods of river training embankments, bank protection, cut-offs, meandering causes and parameters. Flood Control; Introduction, channel improvement, flood ways evacuation and flood plain zoning.

UNIT 5: Reservoir Planning: Introduction, type of reservoirs, investigation for reservoir planning, site selection criteria for reservoir, basic terms and definitions of reservoir, storage zones of a reservoir, mass curve and demand curve, determination of reservoir capacity, reservoir losses, reservoir sedimentation, factors affecting sedimentation, type of sediment load, life of reservoir, safe field. Applications of GIS in Reservoir Planning.

TEXT BOOKS:

1. Irrigation Engineering and Hydraulic Structures – S.K. Garg (Khanna Publications)
2. Irrigation Engineering – B.C. Punmia (Laxmi Publications)
3. Irrigation, Water Resources and Water Power Engineering – Dr. P.N. Modi (Standard Book House)
4. Theory and Design of Irrigation Structures (Volume – I & II) – Varshney (Nem Chand & Bros.)
5. Irrigation and Water resources Engineering – Asawa G.L. (New Age International Publications)
6. Fundamentals of Irrigation Engineering – Bharat Singh (Nem Chand & Bros)
7. Water Resources Engineering Larry -W. Mays (Wiley, John & Sons)

Course Outcomes

At the end of the course the studentsshall be able

CO1: To describe about the types of Irrigation systems, and methods of irrigation.
CO2: To design irrigation canals and canal network
CO3: To propose solutions regarding water logging and drainage.
CO4: To plan and design river training works and flood control of river.
CO5: To evaluate the capacity of reservoir and use Flood Routing principle for Reservoir Planning.

SYLLABUS	**(SEMESTER-VI)**	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206TPC18	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Soil Mechanics - II	3	0	0	15	15	30			

Course Learning Objectives:

1. To impart knowledge of site investigation programme and to design samplers to obtain different soil samples.
2. To learn the basic concept of earth pressure & different theories of calculation of earth pressure.
3. To familiarize the students for the geotechnical design of different type of foundations and calculate the bearing capacity of soils.
4. To impart knowledge about deep foundations and it group efficiency of pile foundations.
5. To impart basic knowledge of well foundations.

Course Content:

Unit 1: Soil Exploration: Introduction, Different Phases of Soil Explorations, Methods of Subsurface Exploration- Trail Pits, Boring Methods, Sounding Test and Geophysical Explorations, Samples and Samplers, Soil Exploration Reports and Bore Log.

Unit 2:Earth Pressures: Introduction, Effect of Wall Movement on Earth Pressure, Earth Pressure at Rest, Rankine's Earth Pressure Theory and its Limitations, Coulomb's Theory of Earth Pressure, Culmann's Graphical Method, Additional Earth Pressure due to Surcharge.

Unit 3: Shallow foundations: Types of shallow foundations and choice, basic requirements, significance of these foundations. Bearing capacity of foundation: Introduction, Bearing Capacity and its Different Forms, Modes of Shear Failure, Evaluation of Bearing Capacity- Prandtl's Method, Terzaghi's Bearing Capacity, Skempton's Method, Meyerhof's Method ,Hansen's and Vesic's Assumptions and IS Code Recommendations, Estimation of Bearing Capacity Based on Field Methods-Standard Penetration Test, Static Penetrations Test and Plate Load Test, Settlement of Shallow Foundations.

Unit 4: **Pile Foundations**: Introduction, Classifications of Piles, Cast in Situ Pile Construction, Selection of Pile Type, and Pile Load Capacity in Compression- Static Pile Load Formulae, Pile Load Test, Dynamic Pile Formulae, Group Action of Piles, Negative Skin Friction, Group Efficiency of Piles and Settlements.

Unit 5:**Well Foundation**: Introduction, Types of Well or Caissons, Components of Well Foundation, Shapes of Wells, Depth of Well Foundation, Forces Acting on Well Foundation, Construction and Sinking of a Well.

Text Books:

1. Basic and Applied Soil Mechanics by GopalRanjan and A.S.R. Rao, New Age International (P) Limited, Publishers, New Delhi-110002.
2. Textbook of Soil Mechanics and Foundation Engineering Geotechnical Engineering Series (PB 2018) by V. N. S. Murthy , CBS Publication, New Delhi.
3. Soil Mechanics and Foundations by Dr. B. C. Punmia, Ashok Kr. Jain &Arun Kr. Jain, Laxmi Publications (P) Ltd, New Delhi-110002.
4. Foundation Engineering by B. C. Chattopadhay&JoyanataMaity,PHI Learning Private Limited, Delhi-110092.
5. Soil Mechanics by Robert V. Whitman & T. William Lambe, Wiley India Pvt Ltd. New Delhi.
6. Soil Mechanics And Foundation Engineering byP.Purushotama Raj, Pearson Publications, New Delhi.
7. Geotechnical Engineering by B. M. Das, Bharat Singh, SamsherAlam.
8. Soil Mechanics and Foundation Engineering (Geotechnical Engineering) by Dr. P. N. Modi, Standard Book House (Rajsons Publications Pvt Ltd) New Delhi-110002 .

Course Outcomes

On completion of the course, the student is expected to be able

CO1: To demonstrate an ability to plan of site investigation to select geotechnical design parameters and type of foundation.
CO2: To demonstrate an ability to calculate earth pressure on retaining walls.
CO3: To demonstrate an ability to design shallow foundations (combined footings and raft footings), its component or process as per the needs and specifications.
CO4: To demonstrate an ability to find group efficiency of pile foundations.
CO5: To evaluate well foundations and its sinking problems.

<table>
<tr><td>SYLLABUS</td><td colspan="7">(SEMESTER-VI)</td></tr>
<tr><td>Subject Code:</td><td>CE206TPE01X</td><td colspan="3">CREDITS: 3</td><td colspan="3">SESSIONAL :
TA</td><td rowspan="2">ESE</td></tr>
<tr><td rowspan="2">Subject:</td><td rowspan="2">Professional Elective -1X</td><td>L</td><td>T</td><td>P</td><td>CT-I</td><td>CT-II</td><td>TOTAL</td></tr>
<tr><td>3</td><td>0</td><td>-</td><td>15</td><td>15</td><td>30</td><td>70</td></tr>
<tr><td colspan="5">Professional Elective-1A
or
Professional Elective-1B
or
Professional Elective-1C
or
Professional Elective-1D
or
Professional Elective-1E</td><td colspan="4">Any one subject to be Selected
from the Professional Electives</td></tr>
<tr><td colspan="9">Professional Electives Group -1</td></tr>
<tr><td colspan="5">CE206TPE01A</td><td colspan="4">Structural Analysis by Matrix Methods</td></tr>
<tr><td colspan="5">CE206TPE01B</td><td colspan="4">Advanced Surveying</td></tr>
<tr><td colspan="5">CE206TPE01C</td><td colspan="4">Advanced Concrete Design</td></tr>
<tr><td colspan="5">CE206TPE01D</td><td colspan="4">Construction Engineering Materials</td></tr>
<tr><td colspan="5">CE206TPE01E</td><td colspan="4">Basics of Computational Hydraulics</td></tr>
</table>

SYLLABUS	**(SEMESTER-VI)**	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	**CE206TPE01A**	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Structural Analysis by Matrix Methods	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this course is

1. To understand the flexibility and stiffness matrices and their relationship between them
2. To understand the analysis of continuous beams by force (flexibility) and displacement (stiffness) methods
3. To understand the analysis of rigid and pin jointed plane frames by force and displacement methods
4. To differentiate the force and displacement methods

Course Content:

UNIT-1: Staticindeterminacy, kinematic indeterminacy;Matrix concepts and Matrix analysis of structures**:** Flexibility and Stiffness; Flexibility Matrix; Stiffness matrix; Relationship between Flexibility matrix and Stiffness matrix; Force displacement methods;Indeterminate Beams: Introduction; Analysis of indeterminate beams by flexibility and stiffness methods; Comparison of flexibility and stiffness methods;

UNIT-2: Rigid Joint Plane Frames: Introduction; Static indeterminacy; Analysis of rigid joint plane frames by flexibility method.

Unit-3:Rigid Joint Plane Frames: Introduction; Kinematic indeterminacy; Analysis of rigid joint plane frames by Stiffness matrix method.

UNIT-4: Pin-jointed Plane Frames (Trusses): Introduction; Static indeterminacy of pin joint truss; Analysis of pin joint plane frames (trusses) by flexibility method.

Unit-5: Introduction; Kinematic indeterminacy of a Pin-jointed plane frame; Analysis of pin joint plane frames (trusses) by stiffness method.

Text Books:

1. DevdasMenon, "Advanced Structural Analysis", Narosa Publishing House, 2009
2. AsslamKassimali, "Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 1999.
3. Weaver W. and Gere J. M., “Matrix Analysis of Framed Structure”, CBS Publishers, Delhi.
4. Amin Ghali, Adam M Neville and Tom G Brown, "Structural Analysis: A Unified Classical and Matrix Approach", Sixth Edition, 2007, Chapman & Hall.
5. DevdasMenon, "Structural Analysis", Narosa Publishing House, 2008.
6. McGuire, W., Gallaghar R. H. &Zimian, R. D. “Matrix structure analysis”, John Willey Publication
7. G S Pandit& S P gupta, “Structural Analysis-A Matrix Approach”

Course Outcomes

At the end of the course the studentsshall be able

CO1: To develop stiffness and flexibility matrix for prismatic members and analyses the indeterminate beams using the flexibility and the stiffness methods.
CO2: To apply and analyses the rigid joint plane frames by using the flexibility matrix method
CO3: To analyse the rigid joint plane frames using the stiffness matrix method
CO4: To compute the member forces in a plane truss using the flexibility matrix method.
CO5: To do the analysis of trusses by applying the stiffness matrix method

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	**CE206TPE01B**	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Advanced Surveying	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this Course is

1. To understand about concepts of Astronomical Surveying.
2. To know the applications of cadastral surveying in different projects.
3. To be capable to compute the accuracy of observations made.
4. To learn the theory of triangulations surveying.
5. To learn about various advanced equipment of surveying

Course Content:

UNIT 1: Triangulation and Baseline Measurements: Triangulation figures or systems, station marks, signals, towers, baseline measurement by rigid bars, flexible apparatus, problems, satellite station and reduction to centre.

UNIT 2: Theory of Errors: Types and sources of errors, theory of least squares, method of weights, method of correlates, angle and station adjustment, figure adjustment. Land Surveys: Layouts, measurements.

UNIT 3: Aerial photogrammetry : Introduction, Principle, Uses, Aerial camera, Aerial 6 10 photographs, Definitions, Scale of vertical and tilted photograph,, Ground Co-ordinates, Displacements and errors, Ground control, Procedure of aerial survey, Photomaps and mosaics, Stereoscopes, Parallax bar.

UNIT 4: Field Astronomy: Introduction, purposes, astronomical terms, determination of azimuth, latitude, longitude and time corrections to the observations.

UNIT 5: Remote Sensing Introduction, Principles of energy interaction in atmosphere and earth surface features, Image interpretation techniques, visual interpretation, Digital image processing, Global Positioning system.

Geographical Information System Definition of GIS, Key Components of GIS, Functions of GIS, Spatial data, spatial information system Geospatial analysis, Integration of Remote sensing and GIS and Applications in Civil Engineering.

Text Books:

1. Borden D. Dent, Jeffrey Troguson, Thomas W. Hodler, Cartography: Thematic Map Design, McGraw-Hill Higher Education, 2008.
2. Gopi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education India, 2007.
3. Hoffman.B, H.Lichtenegga and J.Collins, Global Positioning System - Theory and Practice, Springer -Verlag Publishers, 2001.
4. Punmia B. C, Ashok K. Jain, Arun K. Jain, Higher Surveying, Laxmi Publications, 2005.
5. Surveying Vol. I, II and III by Dr. B.C. Punamia, Laxmi Publishers. New Delhi
6. Surveying and Levelling Vol. I and II by T.P Kanetkar and S.V Kulkarni, Pune VidhyarthiGruh
7. Surveying Vol. I, II and III by Dr. K.R. Arora, Standard Book House. New Delhi
8. Surveying Vol. I and II by S. K. Duggal, Tata Mcgraw Hill, New Delhi
9. Surveying and Levelling by N.N. Basak, Tata Mcgraw Hill, New Delhi
10. Surveying and Levelling by R. Agor, Khanna Publishers, New Delhi
11. Advanced Surveying by R. Agor, Khanna Publishers, New Delhi
12. Fundamentals of Surveying by Roy, S.K., Prentice Hall India, New Delhi
13. Surveying and Leveling by Subramanian, R., Oxford University Press, New Delhi
14. Remote Sensing and GIS by B Bhatia, Oxford University Press, New Delhi.
15. Remote sensing and Image interpretation by T.M Lillesand,. R.W Kiefer,. and J.W Chipman, 5th edition, John Wiley and Sons India
16. Surveying theory and practice 7th Edition by James M Anderson and Adward M Mikhail Tata McGraw Hill Publication.

Course Outcomes

At the end of the course the students shall be able

CO1: To implement the concept of triangulation surveying used in geodetic surveying.
CO2: To adopt the concept of Field Astronomykeeping in view its importance.
CO3: To use Remote sensing & GIS in advance methods of surveying.
CO4: To apply the corrections in observations knowing the theory of errors.
CO5: To analyse aerial photographs for the calculation of various surveying parameters.

SYLLABUS	**(SEMESTER-VI)**	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	**CE206TPE01C**	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Advanced Concrete Design	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this course is

1. To understand the design procedures for combined footings.
2. To study the design of retaining walls
3. To know the design of different types of water tanks
4. To learn the design of flat slabs
5. To know the design of RCC chimneys

Course Content:

UNIT 1: Combined Footings: Simple Rectangular, trapezoidal footings (with and without central beam); Strap footing; raft foundation.

UNIT 2: Types of retaining walls; Cantilever Retaining wall design; Counterfort retaining wall (demonstration only)

UNIT 3: Water tanks resting on ground; Intze type water tank design.

UNIT 4: Large span concrete roofs, Introduction– classification- behaviour of flat slabs - direct design and equivalent frame method- Codal provisions - waffle slabs.

UNIT-5: Chimneys, analysis of stresses in concrete chimneys- uncracked and cracked sections- Codal provisions- design of chimney.

Text Books:

1. Purushothaman, P., Reinforced Concrete Structural Elements-, Tata McGraw Hill, 1986
2. Ashok K Jain, Reinforced Concrete –Nem Chand Bros. Roorkee , 1998
3. Jain and Jaikrishna, Plain and Reinforced Concrete – Vol I and II Nem Chand Bros., Roorkee, 2000.
4. Taylor C Pere, Reinforced Concrete Chimneys, Concrete publications, 1960
5. Design of deep girders, Concrete Association of India, 1960
6. Advanced Reinforced Concrete Design by N Krishna Raju
7. Mallick and Gupta, Reinforced Concrete, - Oxford and IBH, 1982
8. BIS codes (IS 456 , IS 2210, IS 4998, IS 3370, SP 16, SP 24, SP 34).
9. IRC Codes (IRC 5, IRC 6, IRC 21)
10. Reinforced Concrete Design by DevdasMenon and S U Pillai,

Course Outcomes

At the end of the course the studentsshall be able

CO1: To design different types of combined footings
CO2: To design cantilever retaining wall
CO3: To design Water tanks resting on ground and Intze tank with staging and foundation
CO4: To design flat slabs
CO5: To design RCC chimneys

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	**CE206TPE01D**	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Construction Engineering Materials	3	0	0	15	15	30			

Course Learning Objectives:

1. To introduce various construction materials on the basis of various classifications.
2. To understand about various mortar making materials & its classification.
3. To understand the emerging role of using polymers as construction material.
4. To introduce about various modern construction materials.

Course Content:

UNIT-1: Construction Materials

Classifications of Construction Materials. Consideration of physical, Mechanical, thermo-physical Properties, characteristics behaviour under stress, Selection criteria for construction materials, green building materials.

UNIT–2: Materials for making Mortar and concrete

Lime manufacture, properties, hardening of lime, types of lime, lime concrete uses. Cement, pozzolanic material, aggregates, water, admixtures - characteristics, properties and uses. Types of mortars, special mortars, their properties and applications.

UNIT-3: Polymers in civil engineering

Rubber and plastics, properties, effect of temperature on mechanical properties. Uses and application. Polymers, fibres and composites, Fibre reinforced plastic. Architectural use and aesthetics of composites. Adhesives and sealants. Structural elastomeric bearings and resilient seating. Moisture barriers, Polymer foams and polymers in Building Physics. Polymer concrete composites

UNIT- 4: Metals & Ceramics

Types of structural steels, special steel, alloy steel, stainless steel, light gauge steel, Corrosion of concrete and reinforcing steel in various environments. Ceramic Materials: Classification, Refractories, glass, glass wool, mechanical, thermal and electrical properties, fire resistance materials, Uses and application.

UNIT-V: Modern Materials

Glass – Sealants for joints – Fibre glass reinforced plastic – Clay products – Refractories – Composite materials – Types – Applications of laminar composites – Fibre textiles– Geo-membranes and Geo-textiles for earth reinforcement.

Text Books:

1. Rangawala S.C. Engineering Materials Chortor Publications 1991.
2. S.K. Duggal Building Materials, New Age International Publications 2006.
3. Bruntley L.R Building Materials Technology Structural Performance & Environmental Impact McGraw Hill Inc 1995.
4. R Chudley Construction Technology, Vol I - IV Longman Group Construction Ltd. 1973.

Course Outcomes-On completion of this course the student will be able:

CO1: To distinguish and applyvarious construction materialsas per their physical, mechanical, thermo-physical properties.

CO2: To analyse various materials and use in civil engineering applicationsas per their composition, microstructure, and engineering behaviour.

CO3: To develop mortar and concrete from the required ingredients materials.

CO4: To use polymers required for civil engineering applications.

CO5: To adopt steel, concrete, ceramics, glass, refractories, composites, geotextiles, as per their properties and requirement.

SYLLABUS	**(SEMESTER-VI)**	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	**CE206TPE01E**	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Basics of Computational Hydraulics	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this Course is to

1. Provide knowledge on application of computational fluid mechanics to different Civil of engineering problems.
2. Provide knowledge on conservation law and the numerical approach to solve by converting different form of partial differential equations.
3. Provide some experience in the software engineering skills associated with the implementation of MATLAB computer programming and use of Computational Fluid Dynamics (CFD)software.
4. To study the analysis of Open Channel Flow
5. To learn about water surface profiles.

Course Content:

Unit1: Introduction, significance of computational hydraulics, discrete forms of the laws of conservation of mass, momentum and energy,examples of free surface flows.

Unit2: Continuous forms of the conservation laws, lateral inflow's 1-D expansions and contractions, homogeneous and stratified fluid flows.

Unit3: Introduction to computer programming and computation with MATLAB and using of Computational Fluid Dynamics (CFD)software.

Unit4: Pipe flow analysis, Open channel flow: Types of Open Channel Flow, Estimation of normal and critical depth, uniform flow computations

Unit5: Computation of water surface profile (WSP) gradually varied flow estimation using direct step methods.

Text Books:

1. SreenivasJayanti,Computational Fluid Dynamics for Engineers and Scientists, Springer, 2018.
2. J.D. Hoffman, Numerical Methods for Engineers and Scientists, CRC Press, Special Indian Edition, 2011.
3. K. A Hoffmann, Computational Fluid Dynamics, Engineering Education System, 2000.
4. M.H. Choudhary, Applied Hydraulic Transients, Van Nostrand Reinhold, New York, 1997.
5. M.B. Abbot & A.W. Minns, Computational Hydraulics, Ashgate Publication, 1994.
6. J.D. Anderson, Computational Fluid Dynamics, McGraw Hill, 1995.
7. C.B. Vreugdenhill, Computational Hydraulics: An Introduction, Springer-Verlag, Berlin, 1989.
8. M.B. Abbott & J.A. Gunge, Engineering Applications of Computational Hydraulics –Pitman Books Ltd., 1982.

Course Outcomes

At the end of the course the students shall be able

CO1: To evaluate the governing equations based on conservation principals in fluid flow problems,
CO2: To apply finite difference method to the fluid flow problems.
CO3: To evaluate the output from numerical method as compared to the observed data
CO4: To analyse and model fluid dynamics using Matlab andCFD software.
CO5: To apply the computational methods in open channel flow.

SYLLABUS	**(SEMESTER-VI)**						
Subject Code:	CE206TOE01	CREDITS:3			SESSIONAL - TA		ESE
Subject:	Open Elective	L	T	P	CT-I	CT-II	TOTAL
		3	-	-	15	15	30	70
CE06TOE01		Metro Systems and Engineering					

SYLLABUS	**(SEMESTER-VI)**	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206TOE01	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Metro Systems and Engineering	3	0	0	15	15	30			

Course Learning Objectives:

1. To introduce concepts of different types of mode of transportation and associated facilities.
2. To understand the concept of urban transport scenario, traffic characteristics and transport development.
3. To study the Intelligence Transport System
4. To understand ITS user services and its components.
5. To understand the approach and utility of Environmental Impact Assessment for the urban infrastructural measures.

Course Content:

Unit 1:Modes of Transportation:Transportation parameters- Traffic and Transport Problems of a city, Mass transport system, Modes of transportation & characteristics, Public transport system, public private transport system, Advantages and disadvantages of Public transport system. Role of transportation in mass transportation, advanced modes.

Transportation Infrastructure- Green bays, control stations, mitigation buildings, separator lanes and safety islands.

Unit 2:Urban Public Transport SystemRapid transit systems: BRTS, Bus Lane system, Advantages and limitations in Indian Scenario, Rail System. Types of rail system, advantages and disadvantages of rail system, sky walk and under bridge and its advantages. Advances in infrastructure.Urban Pedestrian Safety- Skyways, Intersection subways, halt stations, crossing measures, flexibility in accessibility.

Unit 3: ITS Background and Telemetric systems:Definitions, features and objectives of ITS, History of ITS and its development over the world, telemetric concept, transport telemetric, telemetric structure, ITS taxonomy, ITS application areas, uses, and application overview, ITS implication through AI, ITS based regression models.

Unit 4:ITS components, tools and strategies:Components of user services; advanced traffic management system, advanced traveller information systems, advanced vehicle control system, commercial vehicle operational management, advanced public transportation system, electronic payment system, advanced rural transportation, security and safety systems, urban traffic control, benefits and limitations, traffic calming systems, freight management by ITS.

Unit 5:Environmental ImpactAssessment: Description of proposed activity, structural audits, analysis of site selection procedure, baseline conditions / major concerns, green building and its advantages, description of potential positive and negative environmental, social, economic and cultural impacts including cumulative, regional, temporal and spatial considerations, significance of mitigation plans and monitoring plans (impacts and mitigation efforts)

Text Books:

1. Kadialy L.R.," Traffic Engg. and Transport Planning", 8thedition, Khanna Publishers, 2011.
2. O. Flaherty C.A., "Traffic Engineering and Transport Planning", 2006.
3. AUSTROADS, The Implication of Intelligent Transport Systems for Road Safety, Austroads Incorporated, 1999.
4. Bob Williams, Intelligent Transport Systems Standards, Artech House Publishers, 2008.
5. Chowdhury, M. A. and Sadek, A, Fundamentals of Intelligent Transp. Sys. Planning, Artech House, 2003.
6. E. Bekiaris and Y.J. Nakanishi, Economic Impacts of Intelligent Transportation Systems: Innovations and Case Studies, Elsevier/JAI, 2004.
7. IET Intelligent Transport Systems and 15th International IEEE Conference on Intelligent Transportation Systems (ITSC), 16-19 September, 2012. (http://digital-library.theiet.org/content/journals/iet-its)
8. J.M. Sussman, Perspectives on Intelligent Transportation Systems (ITS), Springer, 2005
9. L. Vlacic, M. Parent, F. Harashima, Intelligent Vehicle Tech. – Theory and Appl., Butterworth-Heinemann, 2010.
10. M.A. Chowdhury and A. Sadek, Fundamentals of Intelligent Transport. Systems Planning, Artech House, 2010.

11. R. Stough, Intelligent Transport Systems: Cases and Policies, Edward Elgar, 2001, Artificial Intelligence and Intelligent Transportation Systems, National Academy Press, 2010.
12. Gonzalez R. C. and Woods R. C., "Digital Image Processing", 2nd Ed., Pearson Education, 2007.
13. Jain A. K, "Fundamentals of Digital Image Processing", Prentice Hall, 2007.
14. R.R. Barthwal "Environmental Impact Assessment" New Age International, January 2012.
15. A.R. Gajbhiye& S.R. Khandeshwar N.S. Raman, "Environmental Impact Assessment", I.K. International, 2014

Course Outcomes: At the end of the course, students will be able

CO1: To implement the concept of urban transport scenario, traffic characteristics and transport development.
CO2: To adopt the concepts of different mode of transportation and associated facilitieswith advanced system.
CO3: To Identify and differentiate ITS user services and its components.
CO4: To plan and design appropriate ITS technology to solve real-life traffic problems.
CO5: To propose the mitigation plan for the EIA for the urban infrastructure.

SYLLABUS	**(SEMESTER-VI)**	Periods/ Week			Internal Assessment (IA)	ESE	Grand Total	Credits
Subject Code:	CE206PPC06	L	T	P	IA	20	50	1
Subject:	Environmental Engineering Lab	0	0	2	30			

Course Learning Objectives:

The objective of this Course is

1. To understand about the equipment used to conduct the test procedures and Perform the experiments in the lab.
2. To determine the physical, chemical and biological characteristics of water and waste water through practical tests.
3. To determine optimum dosage of coagulant and other critical tests to find the quality of water.
4. To examine and Estimate water, waste water and create Develop a report on the quality aspect of the environment.
5. To compare the water with prescribed standards set by the local governments.

Course Content:

1. Determination of the following Parameters in the given Water Sample:
2. Turbidity by Nephelometer.
3. TDS and fixed solids by Gravimetric method.
4. pH using pH-meter.
5. Carbonate, Bi-Carbonate & Hydroxide Alkalinity.
6. Dissolved Oxygen [DO] using DO meter.
7. Concentration of Chlorides.
8. Optimum coagulant dose for coagulation by Jar test apparatus.
9. Chlorine Demand of Water.
10. Total Hardness and Calcium Hardness.
11. Study of Weather Monitoring Station.
12. Study of Sound Level Meter.

Course Outcomes

Students will be able:

CO1: To know about the equipment used to conduct the test procedures and perform the experiments in the lab.

CO2: To determine the physical, chemical and biological characteristics of water and waste water through practical tests.

CO3: To determine optimum dosage of coagulant and other critical tests to find the quality of water.

CO4: To Examine and Estimate water, wastewater and create Develop a report on the quality aspect of the environment.

CO5: To compare the water with prescribed standards set by the local governments.

SYLLABUS	**(SEMESTER-VI)**	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206PPC07	L	T	P	CT-I	CT-II	TOTAL	20	50	1
Subject:	Computer Applications in Civil Engg. Lab	0	0	2	-	-	30			

Course Learning Objectives:

The objective of this Course is

1. To understand the need for software tools for analysis and design of Civil Engineering Structures.
2. To use the software tools for Modelling, Analysis and Design of Civil Engineering Structures

Course Content:

Minimum 10 problems to be solved either by using STAAD Pro/Excel Programming

USING MS EXCEL Programs

1. Analysis of simple beams
2. Design of simply supported RCC beams
3. Design of columns
4. Design of isolated footing (Flat, stepped and sloped)
5. Design of combined footings
6. Design of cantilever retaining walls
7. Design of slabs (one way and Two way)

USING STAAD Pro

8. Analysis of simple beams and Frames (2-D)
9. Analysis of multi storey frames for DL and LL
10. Analysis of multi storey frames for DL, LL, WL/EQL
11. Design of structural elements
12. Analysis and design of combined footing
13. Analysis and design of roof truss
14. Analysis of simple beams for rolling loads

Course Outcomes

At the end of the course the studentsshall be able

CO1: To analyse 2D and 3D frames using MS EXCEL
CO2: To design RCC beams, columns, footing, cantilever retaining walls and slabs using MS EXCEL
CO3: To analyse beams and frames (2-D),multi storey frames for DL, LL, WL/EQL using STAAD Pro
CO4: To design various RCC components of buildings using STAAD Pro
CO5: To analyse and design roof truss and simple beams for rolling loads using STAAD Pro