SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE05TPC08	3	1	0	15	15	30	70	100	04
Subject:	Design of Concrete Structures									

Course Learning Objectives:

The objective of this Course is

- To understand the various philosophies of design of concrete structures, related IS Codes
- To understand the design beam for flexure, shear, bond and torsion
- To know the design of slabs and staircase and their detailing
- To learn the design of columns and isolated footings and their 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 by S Unnikrishna Pillai & Devadas Menon
2. Limit State Design of Reinforced Concrete by P.C. Verghese
3. Design of Reinforced Concrete Structures by N Krishna Raju

Course Outcomes

At the end of the course the students shall be able

- To recognise the design philosophy of concrete structures
- To understand the difference between the structural behavior of different reinforced concrete structural elements
- To analyze and design the reinforced concrete structural elements subjected to gravity loads

SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE05TPC09	3	1	0	15	15	30	70	100	04
Subject:	Structural Analysis - II									

Course Learning Objectives:

- The objective of this Course is

- To understand the principles of energy methods and their applications to indeterminate beams and plane frames

- To know the principles of different slope-deflection and moment distribution methods and their applications to indeterminate beams and plane frames

- To study the principles of matrix methods and their applications to beams and frames

- To know the influence lines for indeterminate structures 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 portals by moment distribution due to load and yielding of supports.

UNIT-3: Moment-distribution method. Continuous beams and portals by moment distribution due to load 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 by Devdas Meenon
2. Indeterminate Structural Analysis by C. K. Wang
3. Fundamental of Structural Analysis by Lee.
4. Advanced Structural Analysis by A. K. Jain
5. Structural Analysis (SI units) by R C hibbeler
6. Structural Analysis by L S nagi & R S Jangid

Course Outcomes

At the end of the course the students shall be able

- To identify the suitable method of analysis for the analysis of indeterminate structures.

- To analyse the indeterminate beams and rigid and pin joint plane frames for gravity and wind loads

- To analyse the indeterminate structures and two-hinged arches for moving loads by constructing the influence lines

SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE05TPC10	3	0	0	15	15	30	70	100	03
Subject:	Highway Engineering									

Course Learning Objectives:

The objective of this Course is

- To provide a coherent development to the students for the courses in sector of Engineering like Transportation & Traffic Engineering etc.

- To present the foundations of many basic Engineering tools and concepts related Highway Engineering.

- To give an experience in the implementation of engineering concepts which are applied in field of Transportation Engineering.

- To involve the application of scientific and technological principles of planning, analysis, design and management to highway engineering

Course Content:

UNIT-1: Introduction: Importance of highway transportation, Modes of transportation, characteristics of highway transport. Historical development & planning: Historical development of roads, Road development and planning in India, Necessity of planning, Roads classification, patterns, Planning surveys. Highway alignment and surveys: Engineering Surveys for highway location Maps and Drawing. Highway drainage: Importance, Surface and subsurface 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: Highway Materials: Behavior of highway materials, properties of Subgrade materials and pavement component materials. Tests on subgrade soil, aggregate and bitumen.

UNIT- 5: Pavement Design: Types of pavements, Factors affecting design of flexible and rigid pavements, Design of flexible pavements: Group index, I.R.C. recommended method, California highway department method, U. S. Corp method. Design of Rigid pavement: Westergard's stress analysis of wheel loads for design of pavement, effect of temperature and warping stress in design

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) Transportation Engineering – A.K. Upadhyay (S.K. Kataria & Sons).

5. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications (India), Chennai, 2010.

6. Khanna, S.K. & Justo, C.E.G., Highway Engineering, NemChand & Bros, Roorkee (U.A).

7. Kadiyali, L.R., Traffic Engineering & Transport Planning, Khanna Publishers, New Delhi.

8. Sharma, S.K., Principles, Practice and Design of Highway Engineering, S. Chand & Co., New Delhi.

9. IRC – 37 "Guidelines for Design of flexible Pavements", IRC, New Delhi, 2001.

10. IRC – 67 "Code of Practice for Road Signs", IRC, New Delhi – 2001. 30

11. IRC: 58, 2002: "Guidelines for the Design of Plain Jointed Rigid Pavements for Highways", IRC, N. Delhi, December, 2002.

12. IRC:70, 1977: "Guidelines on Regulation and Control of Mixed Traffic in Urban Areas"

13. IRC:106, 1990: "Guidelines for Capacity of Urban Roads in Plain Areas"

14. IRC-73

15. IRC-12

16. Specifications for Road and Bridge Works – MOST (IRC Publishers) Manual for Survey, Investigation and Preparation of Road Projects – IRC Publication 2001.

Course Outcomes

At the end of the course the students shall be able

- To gain an experience in the implementation of Transportation Engineering on engineering concepts which are applied in field Highway Engineering.

- To get a diverse knowledge of highway engineering practices applied to real life problems.

- To learn to understand the theoretical and practical aspects of highway engineering along with the design and management applications.

SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE05TPC11	3	0	0	15	15	30	70	100	03
Subject:	Soil Mechanics - I									

Course Learning Objectives:

The objective of this Course is

- To understand the engineering properties of soil.

- To develop the basic understanding of characteristics of soil like permeability, seepage.

- To learn the effective stress and vertical stress in soil.

- To learn the significance of compaction and consolidation on the stability of soil.

- To learn shear strength of different type of soils.

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 Gopal Ranjan 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. 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

Course Outcomes

At the end of the course the students shall be able

- To have an understanding of soil capable to behaving in different practical conditions.
- To have an idea of engineering properties of soil suitable for foundation.

SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE05TPC12	3	0	0	15	15	30	70	100	03
Subject:	Environmental Engineering - I									

Course Learning Objectives:

The objective of this Course is

- To learn about various sources of water supply & population forecasting method

- To learn the principles and design of water treatment and distribution.

- To learn about the aspects of air & 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

- To get an insight into the structure of drinking water supply systems, including water transport, treatment and distribution
- To get an understanding of water quality criteria and standards, and their relation to public health,
- To be able to design and evaluate water supply project alternatives on basis of chosen selection criteria.

SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE05THS07*							-	-	00
Subject:	Management (Organizational Behaviour)	3	0	0	-	-	-			

Course Learning Objectives:

The objective of this Course is

- To improve students understanding of human behavior in organization and the ability to lead people to achieve more effectively toward increased organizational performance.

- To understand individual behavior in organizations, including diversity, attitudes, job satisfaction, emotions, moods, personality, values, perception, decision making, and motivational theories.

- To understand group behavior in organizations, including communication, leadership, power and politics, conflict, and negotiations.

- To understand the organizational system, including organizational structures, culture, human resources, and change.

Course Content:

UNIT 1: FOCUS AND PURPOSE: Definition, need and importance of organizational behaviour – Nature and scope – Frame work – Organizational behaviour models.

UNIT 2: INDIVIDUAL BEHAVIOUR: Personality – types – Factors influencing personality – Theories – Learning – Types of learners – The learning process – Learning theories – Organizational behaviour modification. Misbehaviour – Types – Management Intervention. Emotions- Emotional Labour – Emotional Intelligence – Theories. Attitudes – Characteristics – Components – Formation – Measurement- Values. Perceptions – Importance – Factors influencing perception – Interpersonal perception- Impression Management. Motivation – importance – Types – Effects on work behavior.

UNIT 3: GROUP BEHAVIOUR: Organization structure – Formation – Groups in organizations – Influence – Group dynamics – Emergence of informal leaders and working norms – Group decision making techniques – Team building **-** Interpersonal relations – Communication – Control.

UNIT 4: LEADERSHIP AND POWER: Meaning – Importance – Leadership styles – Theories – Leaders Vs Managers – Sources of power – Power centers – Power and Politics.

UNIT 5: DYNAMICS OF ORGANIZATIONAL BEHAVIOUR: Organizational culture and climate – Factors affecting organizational climate – Importance. Job satisfaction – Determinants – Measurements – Influence on behavior. Organizational change – Importance – Stability Vs Change – Proactive Vs Reaction change – the change process – Resistance to change – Managing change. Stress – Work Stressors – Prevention and Management of stress – Balancing work and Life. Organizational development – Characteristics – objectives –. Organizational effectiveness

TEXT BOOKS

1. Stephen P. Robins, Organisational Behavior, PHI Learning / Pearson Education, 11th edition, 2008.
2. Fred Luthans, Organisational Behavior, McGraw Hill, 11th Edition, 2001.

Course Outcomes:

At the end of the course the students shall be able

- To Compare and contrast theories of organizational behavior.

- To analyze management issues as related to organizational behavior.

- To evaluate ethical issues as related to organizational behaviour

- To examine challenges of effective organizational communication

- To examine the differences and similarities between leadership, power, and management.

- To assess the impact of culture on organizational behavior

SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE05PPC04							20	50	1.5
Subject:	Highway Engineering Lab	0	0	3	-	-	30			

Course Learning Objectives:

The objective of this Course is

- To introduce Bitumen and & its engineering behavior.

- To introduce Aggregate & its engineering behavior.

- To introduce Concept of traffic behavior.

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 students shall be able

- To identify engineering properties of aggregate.

- To identify the grade & properties of bitumen.

- To find out peak hour traffic & peak time for a given location on the road.

- To calculate design speed, maximum speed & minimum speed limits of a location through spot speed.

- To draw parking accumulation curve and find out parking duration & turnover of parking lot/stretch

SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE05PPC05							20	50	1.5
Subject:	Soil Mechanics-Lab	0	0	3	-	-	30			

Course Learning Objectives:

The objective of this Course is

- To learn the basic tests analysing engineering properties of soil.
- To learn the practical tests computing bearing capacity of soil.
- To learn the sampling of soil.

Course Content:

Minimum 10 experiments to be performed

1. To determine the water content of soil (%) by Oven dry method.
2. To determine the specific gravity of soil sample by
    a) Pycnometer Bottle Method.
    b) Density Bottle Method.
3. To determine the particle size distribution of a soil by Mechanical Analysis.
4. To determine the grain size distribution by Hydrometer apparatus
5. To determine the liquid limit and Plastic limit of a soil sample and Shrinkage limit of a soil sample.
6. To determine in situ dry density of soil by
    a) Core cutter method.
    b) Sand replacement method.
7. To determine the permeability of soil by
    a) Falling Head Methods.
    b) Constant Head Methods.
8. To determine the shear strength of a coarse grained soil (Direct Shear Test).
9. To determine the compressive shear strength of Clay (Unconfined Compression Test/UCS test).
10. To determine the shear strength of c-φ Soil   (Triaxial Test).
11. To determine the consolidation of soil/Clay sample.

Text Books:

1. Basic and Applied Soil Mechanics by Gopal Ranjan 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

At the end of the course the students shall be able

- To have an understanding of performing various tests on soil accurately giving them practical exposure.

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE06TPC13	3	0	0	15	15	30	70	100	03
Subject:	Water Resources Engineering -I									

Course Learning Objectives:

The objective of this Course is

- To understand the need of Irrigation, types of irrigation systems and Methods of Irrigation.
- To understand the Canal Irrigation systems and design of stable channels in alluvium.
- To understand Water Logging and its Control.
- To know the River behaviour, control and training.
- 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.

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

- To describe about the types of Irrigation systems, and methods of irrigation.
- To design irrigation canals and canal network
- To illustrate about the solution regarding water logging and drainage.
- To illustrate river training work sand Flood Control of river.
- To find out 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:	CE06TPC14	L	T	P	CT-1	CT-II	TOTAL			
Subject:	Environmental Engineering - II	3	0	0	15	15	30	70	100	03

Course Learning Objectives:

The objective of this Course is

- The objectives of this course is to help students develop the ability to apply basic understanding of physical, chemical, and biological phenomena in the sewage

- To understand the concept successful design, operation and maintenance of sewage treatment plant

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 and Wastewater Technology ,Hammer (PHI)

Course Outcomes

At the end of the course the students shall be able

- To estimate sewage generation and design sewer system including sewage pumping stations
- To understand the characteristics and composition of sewage, self-purification of streams
- To perform basic design of the unit operations and processes that are used in sewage treatment

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE06TPC15	3	1	0	15	15	30	70	100	04
Subject:	Design of Steel Structures									

Course Learning Objectives:

The objective of this Course is

- To introduce steel structures and its basic components
- To introduce structural steel fasteners like welding and bolting
- To design tension members, compression members, beams and beam-columns.
- To design column splices and bases Course outcomes
- 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 Structures, 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-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:

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. Steel Structures (Design & Drawing) – A. K. Upadhayay

8. Fundamentals of Structural Steel Design – M. L. Gambhir

9. Limit state Design of Steel Structures – S Kanthimathinathan

10. Design of Steel Structure Volume-I- Ramchandra

11. Design of Steel Structure Volume-II- Ramchandra

12. Design and Analysis of Connections in Steel Structures-Fundamentals and examples-Alfredo Boracchini

13. IS-800:2007- Indian Standard- General Construction in Steel-Code of Pr., & Steel Tables

Course Outcomes

At the end of the course the students shall be able

- To understand design philosophies and behaviour of structural steel
- To analyze and design of tension members
- To analyze and design of columns
- To analyze and design of beams
- To analyze and design of beam-columns
- To analyze and design of simple bolted and welded connections
- To design plate girders

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE06TPC16	3	0	0	15	15	30	70	100	03
Subject:	Soil Mechanics - II									

Course Learning Objectives:

The objective of this Course is

- To understand the effect of backfill on retaining wall.
- To learn the bearing capacity of soil and methods to calculate it.
- To learn the analysis of stability of shallow and deep foundation for superstructure loading.
- To learn about exploration and sampling of soil.

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, Meyhof'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 Gopal Ranjan 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 & Joyanata Maity,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 by P.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

At the end of the course the students shall be able

- To have an understanding of suitable foundation for different practical conditions.
- To have an idea about sampling of soil for various tests.

SYLLABUS	(SEMESTER-VI)						
Subject Code:	CE06TPE01X	CREDITS: 4			SESSIONAL - TA		ESE
Subject:	Professional Elective -1X	L	T	P	CT-I	CT-II	TOTAL
		3	1	-	15	15	30	70

Professional Elective-1A or Professional Elective-1B or Professional Elective-1C or Professional Elective-1D or Professional Elective-1E	Any one subject to be Selected from the Professional Electives (Group-1 i.e. CE06TPE01A or CE06TPE01B or CE06TPE01C or CE06TPE01D or CE06TPE01E)
Professional Electives Group -1	
CE06TPE01A	Structural Analysis by Matrix Methods
CE06TPE01B	Advanced Surveying
CE06TPE01C	Advanced Concrete Design
CE06TPE01D	Railway Engineering
CE06TPE01E	Basics of Computational Hydraulics

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	**CE06TPE01A**	L	T	P	CT-1	CT-II	TOTAL			
Subject:	Structural Analysis by Matrix Methods(Professional Elective -1X)	3	1	0	15	15	30	70	100	04

Course Learning Objectives:

The objective of this course is

- To understand the flexibility and stiffness matrices and their relationship between them

- To understand the analysis of continuous beams by force (flexibility) and displacement (stiffness) methods

- To understand the analysis of rigid and pin jointed plane frames by force and displacement methods

- To differentiate the force and displacement methods

.

Course Content:

UNIT-1: Static indeterminacy, 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 jointed 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. Devdas Menon, "Advanced Structural Analysis", Narosa Publishing House, 2009

2. Asslam Kassimali, "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. Devdas Menon, "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 students shall be able

- To develop stiffness and flexibility matrix for prismatic members
- To do matrix computations to analyse structures

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE06TPE01B	3	1	0	15	15	30	70	100	04
Subject:	Advanced Surveying (Professional Elective -1X)									

Course Learning Objectives:

The objective of this Course is

- To understand about concepts of Astronomical Surveying.

- To know the applications of cadastral surveying in different projects.

- To be capable to compute the accuracy of observations made.

- To learn the theory of triangulations surveying.

- 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 Vidhyarthi Gruh
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

- To be able to understand the aspects of astronomical surveying.

- To be able to define boundaries of construction area of projects.

- To be able to adapt the surveying equipment on the field.

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE06TPE01C									
Subject:	Advanced Concrete Design (Professional Elective -1X)	3	1	0	15	15	30	70	100	04

Course Learning Objectives:

The objective of this Course is

- To understand the design procedures for combined footings.

- To study the design of retaining walls

- To know the design of different types of water tanks

- To learn the design of flat slabs

- 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 Devdas Menon and S U Pillai,

Course Outcomes

At the end of the course the students shall be able

- To design different types of combined footings
- To design cantilever retaining wall
- To design Water tanks resting on ground and Intze tank with staging and foundation
- To design flat slabs
- To design RCC chimneys

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	**CE06TPE01D**	L	T	P	CT-1	CT-II	TOTAL			
Subject:	Railway Engineering (Professional Elective -1X)	3	1	0	15	15	30	70	100	04

Course Learning Objectives:

The objective of this Course is

- Comprehend different parts of the rail track, their functions and its operation system with respect to construction and engineering applications.
- Comprehensive understanding of the main factors involved in constructing, maintaining and operating railway networks.
- Explain essential features and requirements of different types of crossings and signal system, maintenance of tracks and required procedures.
- Provides scope and opportunities to the students of civil engineering for acquiring appropriate knowledge, skills and abilities in order to perform their job effectively related to construction and management of railway

Course Content:

UNIT 1: Introduction to Railways in India: Role of Indian Railways in National Development Railways for Urban Transportation –LRT & MRTS. Alignment of Railway Lines: Engineering Surveys for Track Alignment. Permanent Way: Components and their Functions

UNIT 2: Rails - Types of Rails, Length of rail, Weight of Rail, Rail Joints, Creep of rail, Buckling of rail, Kinks of Rail Fastenings, Coning of Wheels& tilting of rails.
Sleepers –Types, Functions, sleeper density
Ballasts- Types, function, advantage & disadvantage of each type.

UNIT 3: Geometric Design of Railway Tracks: Gradients and Grade Compensation, Super-Elevation, Widening of Gauges in Curves, Transition Curves, Horizontal Curves.

UNIT 4: Points and Crossings, Turnouts: Working Principles, Cross overs.

UNIT 5: Signalling: Types and their function. Station and Yards: Types, Requirements, factors for site selection.

Text Books:

1. Chandra S. and M.M. Agarwal, Railway Engineering, Oxford University Press, New Delhi, India, 2007.

2. Saxena, S.C. and S.P. Arora, Railway Engineering, Dhanpat Rai and Sons, New Delhi, India, 1997.
3. Agarwal, M.M., Indian Railway Track, Prabha and Co., New Delhi, India, 1988.
4. Rangwala, S.C., Principles of Railway Engineering, Charotar Publishing House, Anand, India, 1988.
5. J. S. Mundrey, "Railway Track Engineering", McGraw Hill Publishing Co., 2009

Course Outcomes

At the end of the course the students shall be able to:

- The Students are expected to handle the design, construction, and operation of railroads and mass transit systems that use a fixed guide way.

- The Students are expected to handle the tasks that include determining horizontal and vertical alignment design, station location and design, and construction cost estimating.

- Explain various aspects related to construction and maintenance of Railway.

- Describe various procedures for construction activities related to Railway.

- Supervise Railway

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE06TPE01E	L	T	P	CT-1	CT-II	TOTAL			
Subject:	Basics of Computational Hydraulics (Professional Elective -1X)	3	1	0	15	15	30	70	100	04

Course Learning Objectives:

The objective of this Course is to

- Provide knowledge on application of computational fluid mechanics to different Civil of engineering problems.

- Provide knowledge on conservation law and the numerical approach to solve by converting different form of partial differential equations.

- Provide some experience in the software engineering skills associated with the implementation of MATLAB computer programming and use of Computational Fluid Dynamics (CFD) software.

Course Content:

Unit 1: Introduction, significance of computational hydraulics, discrete forms of the laws of conservation of mass, momentum and energy, examples of free surface flows.

Unit 2: Continuous forms of the conservation laws, lateral inflow's 1-D expansions and contractions, homogeneous and stratified fluid flows.

Unit 3: Introduction to computer programming and computation with MATLAB and using of Computational Fluid Dynamics (CFD) software.

Unit 4: Pipe flow analysis, Open channel flow: Types of Open Channel Flow, Estimation of normal and critical depth, uniform flow computations

Unit 5: Computation of water surface profile (WSP) gradually varied flow estimation using direct step methods.

Text Books:

1. Sreenivas Jayanti, 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

- To understand the governing equations based on conservation principals in fluid flow problems,
- To know the use of finite difference method applied to fluid flow problems,
- To check the output from numerical method as compared to the observed data
- To develop computer skill.

SYLLABUS	(SEMESTER-VI)						
Subject Code:	CE06TOE01X	CREDITS:3			SESSIONAL - TA		ESE
Subject:	Open Elective - 1X	L	T	P	CT-I	CT-II	TOTAL
		3	-	-	15	15	30	70

Open Elective-1A or Open Elective-1B or Open Elective-1C or Open Elective-1D	Any one subject to be Selected from the Open Electives Group (i.e. CE06TOE01A or CE06TOE01B or CE06TOE01C or CE06TOE01D)

Open Electives Group 1	
CE06TOE01A	Metro Systems and Engineering
CE06TOE01B	Rural Technology and Community Development
CE06TOE01C	Remote Sensing and GIS
CE06TOE01D	ICT for Development

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE06TOE01A							70	100	03
Subject:	Metro Systems and Engineering (Open Elective -1X)	3	0	0	15	15	30			

Course Learning Objectives:

- To introduce concepts of different types of mode of transportation and associated facilities.
- To familiarize the students with the concepts of 1-D and 2-D signals, design of 1-D and 2-D filters and various aspects of image processing.
- To study town planning concepts and theories.
- To perceive the concept of urbanization and various growth patterns.
- To study the concepts for different area planning for urban PTS.
- To understand the concept of urban transport scenario, traffic characteristics and transport development.
- To get the knowledge of advanced transportation engineering planning and management techniques.
- 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 System Rapid 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 traveler 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 Impact Assessment: 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. 2. Bob Williams, Intelligent Transport Systems Standards, Artech House Publishers, 2008.
4. Chowdhury, M. A. and Sadek, A, Fundamentals of Intelligent Transportation Systems Planning, Artech House, 2003.
5. E. Bekiaris and Y.J. Nakanishi, Economic Impacts of Intelligent Transportation Systems: Innovations and Case Studies, Elsevier/JAI, 2004. 5. 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)
6. J.M. Sussman, Perspectives on Intelligent Transportation Systems (ITS), Springer, 2005
7. L. Vlacic, M. Parent, F. Harashima, Intelligent Vehicle Technologies – Theory and Applications, Butterworth-Heinemann, 2010.
8. M.A. Chowdhury and A. Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, 2010.
9. R. Stough, Intelligent Transport Systems: Cases and Policies, Edward Elgar, 2001, Artificial Intelligence and Intelligent Transportation Systems, National Academy Press, 2010.
10. Gonzalez R. C. and Woods R. C., "Digital Image Processing", 2nd Ed., Pearson Education, 2007.
11. Jain A. K, "Fundamentals of Digital Image Processing", Prentice Hall, 2007.
12. R.R. Barthwal "Environmental Impact Assessment" New Age International, January 2012.
13. 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 to

- Concepts of different types of mode of transportation and associated facilities with advanced system.
- Identify and differentiate ITS user services and its components.

- Select and provide appropriate ITS technology to solve real-life traffic problems.
- Manage the traffic congestion by acquisition of big data using advanced devices.
- Implement the suitable ITS and services for effective transportation.
- 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:	CE06TOE01B	L	T	P	CT-1	CT-II	TOTAL			
Subject:	Rural Technology and Community Development (Open Elective -1X)	3	0	0	15	15	30	70	100	03

Course Learning Objectives:

The objective of this Course is

- To understand theories and practices in the rural development model.
- To learn and analyse rural life and rural economy.
- To understand different measures in rural development.
- To learn different technologies used in upliftment of rural life.

Course Content:

UNIT 1: INTRODUCTION: RURAL DEVELOPMENT - Concepts and connotations, Basic Elements, Growth vs. Development, Why rural development, Rising expectations and development, Development and Change, Human beings as cause and consequences of development. RURAL ECONOMY OF INDIA - Introduction, size and structure, The characteristics of rural sector, The role of agricultural sub-sector, The role of non-agricultural sub-sector, Challenges and opportunities

UNIT 2: RURAL DEVELOPMENT - MEASURES AND PARADIGMS: MEASURES OF DEVELOPMENT - Introduction, Measures of level of rural development, Measures of income distribution, Measures of development simplified, Concepts and measures of rural poverty. PARADIGMS OF RURAL DEVELOPMENT - Introduction, The modernization theory, The dependency theory of Marxist School, Rosenstein- Rodan's theory of 'Big Push', Lewis' model of economic development, The human capital model of development, The Gandhian Concept of Rural Development theories from other social sciences.

UNIT 3: TECHNOLOGIES FOR RURAL DEVELOPMENT Using Water Resources - The water cycle, Drinking Water, Water quality testing, Water filtering ,Extraction from Groundwater ,Pumps Rope and washer pump ,Manuel pumps, Treadle pump, Irrigation for agriculture, Channel systems, Sprinkler systems, Drip systems Water diversion ,Water storage Building Infrastructures and Creating Energy - Basic energy uses , Energy Sources - Firewood, Solar Energy, Hydro-electricity, Hydro-mechanical, Wind Energy, Energy Storage, Connecting to the Electrical Network, Environmental Use of ICT in Rural and agricultural development - Education, Healthcare, Agriculture, Business, Resource Mapping, Digital and Social Media Marketing Decision Support Systems for soil conservation and farm management Waste Management and Sanitation.

UNIT 4: COMMUNITY DEVELOPMENT: Introduction, Service Learning and community development, Theory and practice of community development, Community development issues. The diverse meaning of community development, the knowledge base of community development, International community development.

UNIT 5: COMMUNITY DEVELOPMENT - RURAL ENTREPRENEURSHIP: Different forms of Rural Entrepreneurship, Significance , Business planning for a new venture: the concept of planning paradigm, Forms of business enterprises-Sole proprietorship, partnership and corporations, Product and Process development, Marketing analysis and competitive analysis, strategies; Financial resources; debt financing, banks and financial institutions and other non-bank financial sources; Government programmes : direct loan assistance and subsidies; Industrial and legal issues for rural enterprises.

Text Books:

1. Rural Development: Principles, Policies and Management" - Katar Singh , Sage Publications.

2. Introduction to Community Development - Theory, Practice and Service Learning", Edited by J W Robinson, Sage Publications.

3. G. N. Tiwari, Solar Energy: Fundamentals, Design, Modelling and Applications, Narosa, 2002.

4. "Fundamentals of Entrepreneurship", H. Nandan, Third Edition, PHL Learning Pvt. Ltd.,

5. Monetary Economics-Institutions, Theory and Policy", First Edition, S B Gupta, S Chand Publications, ISBN – 9788121904346.

Course Outcomes: At the end of the course the students shall be able to

- Understand rural development model.
- Learn different measures in rural development and its impact on overall economy.
- Understand and learn importance of technologies in rural and community development.
- Understand challenges and opportunities in rural development.

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE06TOE01C							70	100	03
Subject:	Remote Sensing and GIS (Open Elective -1X)	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this Course is

- To understand the basic concept of Remote Sensing and know about different types of satellite and sensors.

- To illustrate Energy interactions with atmosphere and with earth surface features, Interpretation of satellite and topo sheet maps.

- To understand different components of GIS and Learning about map projection and coordinate system.

- To develop knowledge on conversion of data from analogue to digital and working with GIS software.

Course Content:

UNIT 1: INTRODUCTION AND CONCEPTS : Introduction of Remote Sensing – Energy sources and Radiation principles, Energy equation, EMR and Spectrum, EMR interaction with atmosphere scattering, absorption, EMR interaction with earth surface features reflection, absorption, emission and transmission, Spectral response pattern , vegetation, soil, water bodies- Spectral reflectance.

UNIT 2: AERIAL PHOTOGRAPHY AND PHOTOGRAMMETRY: Introduction- Terrestrial and Aerial photographs - vertical and oblique photographs - height determination contouring - photographic interpretations - stereoscopy – parallax bar- Flight Planning- Photo Interpretation, Applications of aerial photos-photo theodolite.

UNIT 3: SATELLITE REMOTE SENSING PRINCIPLES: Data acquisition –Procedure, Reflectance and Digital numbers- Intensity Reference data, Ground truth, Analog to digital conversion, Detector mechanism-spectro- radiometer-ideal remote sensing system – characters of real and successful remote sensing system- platforms and sensors- orbits types – resolution

UNIT 4: REMOTE SENSING SATELLITES:Land observation satellites, characters and applications, IRS series, LANDSAT series, SPOT series, High resolution satellites, character and applications, CARTOSAT series, IKONOS Series, QUICKBIRD series, Weather/Meteorological satellites, INSAT series, NOAA, GOES, NIMBUS Applications, Marine observation satellites OCEANSAT.

UNIT 5: BASICS OF GIS: Introduction, concepts , information system , components of GIS, History, Geospatial data architecture, Operations, geographic co-ordinate systems, map projections, concepts, input data for GIS , display ,types of output products. GIS categories, Level and scale of Measurement, importance of data quality.

Text Books:

1. M. Anji Reddy, Textbook of Remote Sensing and Geographical Information systems, BS Publications, Hyderabad. 2011. ISBN: 81- 7800-112-8.
2. A.M.Chandra and S.K. Gosh. Remote Sensing and GIS, Narosa Publishing Home, New Delhi 2009.
3. Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman Remote sensing and image interpretation John Wiley & Sons, 2008.
4. George Joseph, Fundamentals of Remote Sensing Universities Press, Hyderabad

Course Outcomes

At the end of the course the students shall be able

- To understand the concepts of Photogrammetry and compute the heights of objects;

- To understand the principles of aerial and satellite remote sensing, able to comprehend the energy interactions with earth surface features, spectral properties of water bodies;

- To understand the basic concept of GIS and its applications, know different types of data representation in GIS;

- To understand and Develop models for GIS spatial Analysis and will be able to know what are the questions that GIS can answer and

- To apply knowledge of GIS software and able to work with GIS software in various application fields.

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE06TOE01D	3	0	0	15	15	30	70	100	03
Subject:	ICT for Development (Open Elective -1X)									

Course Learning Objectives:

The objective of this Course is to provide a

- Multi-disciplinary platform along with an emphasis on modern day real time applications.
- Due to the day to day changes in the field of science and technology, ICT program of Engineering will facilitate and provide an opportunity to equip with the skills and knowledge required to design, implement & manage a variety of Information system.

Course Content:

Unit-1: ICT Fundamentals; Information Technology philosophy, Need of information technology, Logic of Information, Cybernetics, Definitions(Peirce, Shannon-Weaver, Bateson), Information and society, Information Processing cycle, Impact of information on the society, IT act of India (Just Introduction), ICT models (brief), Analog Communication, Digital Communication, Data Communication, Structure of Communication, Transmission modes (Simplex, half duplex, Full duplex), Synchronous and Asynchronous transmission, Serial and Parallel communication, Need of Modulation, Antenna Height/length, Energy, Band-Edge Ratio, Multiplexing, Amplitude modulation, Definition, Mathematical derivation and calculation of modulation index, power, Frequency spectrum, Frequency modulation, Definition, Mathematical Derivation and calculation of frequency deviation Frequency spectrum.

Unit-2: Data Networks; Models of Network Computing (Centralize Computing, distributed Computing, collaborative Computing), Client Server Network and Peer to Peer Network, Network Topologies (Bus, Mesh, Star, Ring), Various types of computer Network (LAN, MAN, WAN), Types of switching network (Circuit and Packet), Need of layered mechanism, OSI Model (brief description of each layer), TCP/IP Model(brief description of each layer).

Unit-3: Physical View of ICT; Multiplexing, Definition and need, Time Division Multiplexing, Frequency Division Multiplexing, Code Division Multiplexing, Orthogonal Frequency Division Multiplexing, Identification of various transmission media, Wired media (Coaxial, Twisted Paid cable and their connectors), Wireless media (Microwave, Radio), Application of wireless media in satellite Communication, block diagram, important Definitions, Network Connecting devices (Switch, Router, Repeater, Bridges, Gateway) 3.4 IEEE standards for LAN(Introduction only).

Unit-4: Network Addressing; IPv4 addressing, Need of IP address, IPv4 addressing scheme, Address space and notations, Mask, netid, hosted, Sub-netting and super-netting, Classful and classless notations, Network address translations, IPv6 addressing, Need for IPv6 migration, IPv6 addressing scheme, Hexadecimal column notation, Uni-cast addresses, multicast addresses, anycast addresses Reserved addresses and local addresses, Address mapping (logical to physical, physical to logical), Ping and trace-route commands.

Unit-5: Protocols and Data Transportation; UDP and TCP protocols, Connectionless and connection oriented communication, Reliable and Unreliable communication UDP and TCP protocols, Data traffic and congestion management, DNS, Domain, domain name, domain zone, root server, Domain types, Address resolution, Address mapping, Address, mapping address to names, recursive resolution, iterative resolution, caching) Protocols(introduction only), Data link layer protocols, ARP,RARP,ICMP protocols (only brief explanation), Routing (brief explanation), Routing table, Uni-cast routing protocols and multicast routing protocols), SMTP, POP, IMAP, WWW and HTTP.

Text Books:

1. Richard Heeks, "Information and Communication Technology for Development". Routledge; 1 edition (November 7, 2017)
2. Nureni and Yekini "Information Communication Technology", Hasfem Publication center Shomolu
3. Sreekumar T.T., "ICTs and Development in India", Anthem Press.

   Ravichandran A. "Fundamentals of Information Technology", Khanna Publishers
4. James Irvine and David Harle "Data Communications and Networks", Wiley-Blackwell; 1 edition (22 October 2001)
5. Achyut S. Godbole and Atul Kahate "Data Communications and Networks", 2nd Edition, June 13, 2011, McGraw-Hill Education
6. Keshav S. "An Engineering Approach to Computer Networking", Pearson Education India; 1 edition (2002)
7. Prakash C. Gupta, "Data Communication and Computer Networks", 2nd Edition, Jan 2014 PHI Learning Pvt. Ltd.

Course Outcomes

At the end of the course the students shall be able

- To understand the importance of information and information communication technology.
- To understand basic concept of analog communication.
- To Identify network, severs, topologies and networking component
- To understand protocols and IEEE standards

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE06PPC06	0	0	3	-	-	30	20	50	1.5
Subject:	Environmental Engineering Lab									

Course Learning Objectives:

The objective of this Course is

- To determine the physical, chemical and biological characteristics of water and wastewater through practical tests.

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

Course Content:

Determination of the following Parameters in the given Water Sample:

1. Turbidity by Nephelometer.

2. TDS and fixed solids by Gravimetric method.

3. pH using pH-meter.

4. Carbonate, Bi-Carbonate & Hydroxide Alkalinity.

5. Dissolved Oxygen [DO] using DO meter.

6. Concentration of Chlorides.

7. Optimum coagulant dose for coagulation by Jar test apparatus.

8. Chlorine Demand of Water.

9. Total Hardness and Calcium Hardness.

10. Study of Weather Monitoring Station.

11. Study of Sound Level Meter.

Course Outcomes

- Students will be able to know the procedure for quantifying quality parameters for water and sewage

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
		L	T	P	CT-1	CT-II	TOTAL			
Subject Code:	CE06PPC07	0	0	3	-	-	30	20	50	1.5
Subject:	Computer Applications in Civil Engg. Lab									

Course Learning Objectives:

The objective of this Course is

- To understand the need for software tools for analysis and design of Civil Engineering Structures.
- 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 students shall be able

- The students shall be able to analyse, determinate and Indeterminate Civil Engineering Structures.
- To design various RCC components of buildings and other Civil Engineering Structures