Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute under Mumbai University) Andheri (W), Mumbai – 400058

COURSE CONTENTS - Regulation 22
Sem. VII and Sem VIII

Year 2025-26 B.Tech. (Civil) ENGINEERING

Academic Year 2025-2026

Course Contents for Sem VII for Regulation 22

Programme Outcomes and Programme Specific Outcomes

Programme Outcomes (POs) and **Programme Specific Outcomes (PSOs)** as per **NBA guidelines** for **B.Tech in Civil Engineering** at institutions like **SPCE (Sardar Patel College of Engineering), Mumbai**. SPCE typically aligns its outcomes with AICTE/NBA graduate attributes.

1. **Engineering Knowledge:**
   Apply mathematics, science, and engineering fundamentals to solve complex problems.
2. **Problem Analysis:**
   Identify and analyze complex problems using principles of science and engineering.
3. **Design/Development of Solutions:**
   Design solutions that meet specified needs with societal and environmental considerations.
4. **Investigations:**
   Conduct research and experiments to draw valid conclusions.
5. **Modern Tool Usage:**
   Use modern tools and techniques for engineering practice with awareness of limitations.
6. **The Engineer and Society:**
   Assess societal, health, safety, and legal aspects in engineering solutions.
7. **Environment and Sustainability:**
   Understand the impact of engineering solutions on the environment and promote sustainability.
8. **Ethics:**
   Apply ethical principles and professional responsibilities.
9. **Individual and Team Work:**
   Work effectively as an individual and in diverse teams.
10. **Communication:**
    Communicate effectively in both technical and non-technical contexts.
11. **Project Management and Finance:**
    Apply engineering and management principles in projects and teams.
12. **Life-long Learning:**
    Engage in lifelong learning to keep pace with technological change.

PSO 1:
To simulate and analyse problems in civil engineering domains such as structural, geotechnical, hydraulics and water resources, transportation, geoinformatics, building design, materials & construction, construction management, civil engineering economics & estimation, and environmental engineering using advanced tools and laboratory techniques.

PSO 2:
To formulate sustainable civil engineering solutions for societal challenges through innovative projects, aiming to bring transformational changes in rural and urban developme

SEM – VII
Regulation 22

Design of Concrete Structures PC-BTC701

Course Code	Course Name
PC-BTC 701	Design of Concrete Structures

Course pre-requisites	Design of RCC Elements

Course Objectives

The objectives of this course are

1. To develop Civil Engineering graduates with a clear understanding of concepts, and practical knowledge of modern Civil Engineering techniques
2. To apply the structural analysis knowledge to design real life RCC structures for safety serviceability and economy.
3. To achieve effective communication, inculcate leadership and ethics to deal with social, environmental and economic issues

Course Outcomes

Upon successful completion of the course, students will be able to

1. Apply the principles of the limit state method to design various reinforced concrete elements such as staircases, flat slabs, retaining walls, and water tanks.
2. Develop complete structural design solutions for residential, commercial, or industrial buildings, including foundations and staircases, in compliance with relevant IS codes.
3. Demonstrate an understanding of ductile detailing requirements for earthquake-resistant structures as per IS 13920.
4. Select and implement appropriate methods—both IS coefficient and approximate—for the design of circular and rectangular water tanks, including supporting structures.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	1	-	-	-	-	1	-	2	3	2
CO2	3	3	3	2	2	-	-	-	1	2	1	2	3	3
CO3	2	2	2	1	-	2	2	2	-	1	1	2	2	3
CO4	3	2	3	2	2	-	-	-	-	1	-	2	3	2

Course Content

Module No.	*Details*	*Hrs.*
1	Design of staircases: (limit state method of design) Design of Dog legged, Open well type staircase	06
2	Design of Flat Slabs: (limit state method of design)	06
3	Complete design of residential, commercial or Industrial building including staircase and foundations. (Limit state method of design)	06

4	Complete design of residential, commercial or Industrial building including staircase and foundations. (Limit state method of design). Overview of ductile detailing for Earthquake resistant structures.	06
5	Design of retaining walls: (limit state method of design) Design of Cantilever, Counter fort type retaining wall.	06
6	Design of water tanks: Circular and rectangular, at ground level, underground and overhead water tanks	06
7	Design of water tanks: Circular and rectangular, at ground level, underground and overhead water tanks both by IS coefficient and approximate methods, including supporting structure for overhead water tanks Self Learning: Design of underground water tank	06

Text Books

1. Ashok K. Jain (1993), "Reinforced Concrete: Limit State Design", Nem Chand & Brothers, ISBN 8185240531, 844 pages
2. Dr. H. J. Shah, (2008)," Reinforced Concrete, Volume 2", Charotar Publishing House Pt. Limited, ISBN 8185594732, 424 pages
3. S N Sinha, (2002)," Reinforced Concrete Design, Second Revised Edition", Tata McGraw-Hill Education, ISBN 0070473323, 705 pages
4. Karve& Shah, (2011), "Illustrated Design of Reinforced concrete Buildings", mihail-koprivchin-3758, 502 pages
5. Relevant I.S. codes and design aids
6. P.C. Vargese (2007) Advance reinforced concrete design, PHI Learning.
7. B.C. Punmia, Ashokumar Jain and Arunkumar Jain (2009), Limit State Design of Reinforce Concrete.

Reference Books

1. B.P. Hughes (1976)," Limit State Theory for Reinforced Concrete Design", Pitman, ISBN 0273010239.
2. Phil Moss Ferguson, J.E. Breen & J.O. Jirsa (1988), "Reinforced Concrete Fundamentals", John Wiley and Sons (WIE), ISBN 0471803782, 592 pages.

Engineering Economics Estimation & Costing PC-BTC702

Course Code	Course Name
PC-BTC702	Engineering Economics, Estimation & Costing
Course pre-requisites	Building Materials and Construction, Building Design with CAD, Construction Engineering and Management

Course Objectives

The objectives of this course are

1. To introduce the fundamental principles of economics, accounting, and financial decision-making in the context of construction projects.
2. To develop the ability to prepare specifications, estimates, and quantity take-offs using standard methods, IS codes, and digital tools.
3. To familiarise students with rate analysis, material and market surveys, and productivity norms relevant to construction materials and equipment.
4. To impart knowledge of the tendering process, contract types, and legal frameworks applicable to construction, including relevant acts and dispute resolution mechanisms.

Course Outcomes

Upon successful completion of the course, students will be able to

1. Explain fundamental concepts of economics, accounting, and financial management relevant to construction, and apply them in economic decision-making using tools such as cash flow diagrams, break even and sensitivity analysis.
2. Prepare detailed specifications, estimates, and quantity take-offs using standard methods and IS codes, including bar bending schedules and estimation techniques for buildings and roadwork projects.
3. Conduct rate analysis and material surveys, interpret productivity norms, and utilise thumb rules and software tools—including an introduction to BIM—for quantity surveying and estimation tasks
4. Describe and interpret procedures involved in tendering and contract management, including contract types, arbitration, and legal aspects relevant to construction such as labour laws and dispute resolution

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	–	1	–	–	1	–	2	3	2
CO2	3	2	3	2	2	–	–	–	1	2	–	2	3	2
CO3	3	2	3	2	3	–	–	–	1	2	–	2	3	2
CO4	2	1	2	–	1	2	2	2	2	2	2	2	2	2

Course Content

Module	*Details*	*Hrs.*
1	Basic principles and of economics, accounting, finance and economy, basic terminology related to economics and accounting, introduction to micro andeconomic decision making, cash flow diagrams, time value of money, equipment cost, equipment life, depreciation, sinking fund, economic management of equipment, present value, future worth, decision making based on economics, private vs. public projects. Benefit to cost ratio, breakeven analysis, sensitivity analysis.	12

2.	Specifications-Types, requirements and importance, drafting of general and detailed specifications.	04
3.	Approximate estimates, Detailed estimates, Measurement of various items, use of relevant IS codes, taking out quantities, long wall-short wall method, centre line method, bar bending schedule, use of computers in quantity surveying, introduction to BIM.	12
4.	Estimation of earthwork for roadwork project, mass haul diagram.	04
5.	Material survey, thumb rules for computation of material, market survey of basic materi als, rate analysis using relevant IS codes, purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity	04
6	Importance of inviting tenders, preparation of tender documents, tendering process, contract types, relative merits, prequalification, general and special conditions, termination of contracts, extra work and changes, penalty and liquidated charges, settlement of disputes.	04
7.	Introduction to Acts pertaining to-Minimum wages, Workman's compensation (WC), Arbitration and conciliation act.	02

Term Work

Term work shall comprise of assignments related to:

1. Deriving an approximate estimate for a multi-storeyed building by approximate methods.
2. Detailed estimate for a multi-storeyed structure with the required material survey
3. Earthwork estimate for road work project with mass haul diagram
4. Preparation of bar bending schedule.
5. Drafting specifications
6. Rate analysis
7. Calculation of present value, future worth, cash flow diagrams
8. Calculation of depreciation and book value of construction equipment
9. Problems related to economic decision making
10. Breakeven analysis and sensitivity analysis

Textbooks and reference books

1. Chakraborti, M. (2006). Estimating, Costing, Specification and Valuation in Civil Engg.
2. Dutta, B. N. (2020). Estimating and Costing in Civil Engineering: Theory and Practice: Including Specifications and Valuation. UBS.
3. Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia
4. Jha, K. N. (2011). Construction project management: Theory and practice. Pearson
5. Acts Related to Minimum Wages, Workmen’s Compensation, Contracts, and Arbitration
6. Typical PWD Rate Analysis documents.
7. Relevant Indian Standard Specifications.
8. FIDIC Contract Conditions

PE III- Advanced Structural Analysis PE-BTC721

Course Code	Course Name
PE-BTC721	Advanced Structural Analysis

Course pre-requisites	Structural Mechanics, Structural Engineering

Course Objectives

The main objectives of the course are;

1. To impart clear understanding of concepts & practical knowledge of advanced and conventional methods of analysis required to design various types of civil engineering structures.
2. To apply stiffness matrix method to analyse various real-life structures required t

Course Outcomes

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

1. Formulate and assemble stiffness matrices for various structural members (truss, frame, grid, space frame) and analyse indeterminate structures using the matrix stiffness method.
2. Apply the flexibility method and its conventional forms (Elastic Centre, Column Analogy) to determine internal forces and displacements in indeterminate structures under various effects such as support settlements and temperature variations.
3. Construct and interpret Influence Line Diagrams (ILDs) for statically indeterminate structures using Muller Breslau's principle and apply these diagrams to evaluate structural response under moving loads.
4. Use approximate methods for analysing building frames under gravity and lateral loads and perform basic plastic analysis of steel structures.

CO-PO-PSO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	2	2	–	–	–	–	1	–	2	3	2
CO2	3	2	2	2	2	–	–	–	–	1	–	2	3	2
CO3	3	2	2	2	2	–	–	–	–	2	–	2	3	2
CO4	3	2	3	2	2	–	–	–	–	1	–	2	3	2

Course Content

Module No.	*Details*	*Hrs.*
	Introduction to Stiffness Method in Matrix Form: Basic concepts of stiffness coefficients, member stiffness matrix	

1	for member of plane truss, member of rigid jointed plane frame, member of plane grid and member of space frame. Properties of stiffness matrix, co-ordinate transformation matrix, stiffness matrix in local and global co-ordinate axes system, assemblage of structural stiffness matrix and application of boundary conditions.	06
2	Stiffness Matrix Method cont. Joint loads, Equivalent joint loads, method of solution for displacements and computation of internal forces in members. Application of stiffness method to beams, pin jointed trusses, rigid jointed plane frames and simple plane grid structures.	05
3	Conventional Form of Stiffness Method, Modified Moment Distribution Method: Symmetric structure, Symmetric and anti-symmetric loads, Modification of stiffness and carryover factors for symmetric and anti-symmetric loads both for sway and non-sway cases for frames with different support conditions. Application to frames (without inclined members) with and without side sways.	07
4	Flexibility Method: Review of concepts of flexibility coefficients, Selection of primary structure, concept of structure flexibility matrix, compatibility equations, solution for redundant forces, computation of internal forces, and joint displacements. Application to pin jointed trusses and rigid jointed plane frames for different loading including the effect of settlement of support, temperature changes and elastic supports. Conventional Form of Flexibility Method: Elastic Center Method and its application to rectangular box, rigid jointed portal frames and fixed arches. Column Analogy Method and its application to analysis of non-prismatic beams, simple rectangular frames, determination of stiffness coefficients and carry over factors for non-prismatic beam members. Self-Learning: Application of Elastic Center Method to fixed arches.	04 07

5	Influence Line Diagrams for Indeterminate Structures: Muller Breslau's Principle for drawing influence line diagrams for statically indeterminate structures. Influence Lines Diagrams for propped cantilevers, fixed beams and continuous beams. Self-Learning: ILD for indeterminate beams.	06
6	Approximate Methods for Analysis of Building Frames: Approximate methods for gravity loads: Substitute frame and equivalent frames. Approximate methods for lateral loads: Portal and cantilever method.	04
7	Plastic Analysis of Steel Structures: Application to single bay single story rectangular frames.	04

Term Work
At least 20 (twenty) solved problems based on the above syllabus shall be submitted as term work. Exposure to computer aided analysis using available software.

Text Books
1. Basic Structural Analysis: Reddy C.S., Tata McGraw hill 2. Intermediate Structural Analysis: Wang C.K., Tata McGraw hill

Reference Books

1. Matrix Method in Structural Analysis: Livesley R. K., Pergamon Press, London.
2. Analysis of Framed Structures: Gere and Weaver, East-West Press.
3. Elementary Structural Analysis: Wilber, McGraw Hill, New York.
4. Analytical Method in Structural Analysis: S.A. Raz, New Age Int Publishers
5. Modern Methods in Structural Analysis: Dr. B.N. Thadani and Dr. J. P. Desai, Weinall Book Corporation.
6. Plastic Methods of Structural Analysis: B.G. Neal, Chapman & Hall, London.
7. Structural Analysis Vol.I and Vol. II: Pandit and Gupta, Tata McGraw hill.
8. Matrix Method in Structural Analysis: Pandit and Gupta, Tata McGraw hill.
9. Matrix Methods of Structural Analysis: Dr. A. S. Meghre, S. K. Deshmukh, Charotar Publishing House.
10. Structural Analysis: In Theory & Practice: Alan Williams, Butterworth-Heinemann, 2009
11. Fundamentals of Structural Analysis: Kenneth M Leet, Chia-Ming Uang & Anne M Gilbert, Tata McGraw hill.
12. Matrix Structural Analysis: Ronald L Sack, Waveland Press, 1994
13. Plastic Theory of Structures: Michael R Horne, Elsevier, 2014

PE-III Finite Element Analysis PE-BTC721

Course Code	Course Name
PE-BTC722	Finite Element Analysis

Course pre-requisites	Advanced Solid Mechanics

Course Objectives

The objectives of this course are

1. To understand mathematical modelling and numerical formulation of engineering problems.
2. To learn about concepts of elements and their properties.
3. To understand finite element methods and its application for solution of structural mechanics problems.

Course Outcomes

Upon successful completion of the course, students will be able

1. Explain the principles of numerical and approximate methods such as Galerkin's, Rayleigh-Ritz, and weighted residual methods for solving engineering problems.
2. Develop finite element models using one-, two-, and three-dimensional elements, and formulate interpolation and shape functions for different types of elements.
3. Apply the finite element method to analyse structural elements such as springs, trusses, beams, and two-dimensional stress systems using linear and isoparametric elements.
4. Analyse basic non-linear and dynamic problems using FEM, including geometric and material non-linearity, and perform vibration analysis through mass and damping matrix formulation.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	–	–	–	–	1	–	2	3	2
CO2	3	2	3	2	3	–	–	–	–	1	–	2	3	2
CO3	3	2	3	2	3	–	–	–	–	1	–	2	3	2
CO4	3	2	2	2	3	–	–	–	–	1	–	2	3	2

Course Content

Module No.	*Details*	*Hrs.*
1	**Introduction** Mathematical Modeling of Engineering Problems, Types of governing equations, Solution methodologies, numerical modeling, approximate method of analysis – method of point collocation, method of collocation by sub region, method of least squares, Galerkin's method, Rayleigh-Ritz method	05
2	**Finite Element Method:** General Steps in FEM, Direct approach, variational approach, energy approach and weighted residual approach.	06

3	**Finite Elements and Interpolation Functions:** Interpolation functions, one two and three dimensional elements – linear, quadratic, Cubic and Lagrangian Interpolation function, Isoparametric elements, Serendipity elements Shape Functions, Sub-Parametric and super parametric elements,Infinite elements	06
4	**One Dimensional Finite Elements:** Linear spring, Truss element, Space truss, Beam Element. Application to analysis of beams, trusses, plane frames and grids Multilinear springs, compression and tension only springs.	04
5	**Two Dimensional Finite Elements:** Two dimensional stress analysis, CST element for plane stress and plane strain, triangular elements for axi-symmetric analysis, rectangular elements, isoparametric formulation	05
6	**Introduction to Non-Linear Analysis:** Geometric Non-Linearity-Geometric Stiffness of an Axial Element. Stability of Bar- Spring System. General Formulation of Geometrically Non Linear Problem. Geometric Stiffness of Beam-Column and Triangular Elements. Non-Linear Material Behavior. Non- Linear Spring- Elasto Plastic Analysis by FEM- Elasto Plastic Analysis of a truss- Two Dimensional Element Formulations- General Formulation of a physically Non-Linear Problem	05
7	**Introduction to Dynamic Analysis by FEM:** Formulation of Inertial Properties- Lumped Mass vs Consistent Mass Matrices –Condensation and Assembly of Mass Matrices- Formulation of Damping Properties- Free Vibration, Steady – State and Transient Response Analysis for Simple Problems.	05

Text Books

1. Desai Y.M, Eldho T.I, Shah A.H (2011) ,"Finite Element Method With Applications in Engineering ", Pearson Education India , ISBN 8131724646 , 492 pages
2. Krishnamoorthy C.S, (1994), "Finite Element Analysis", Tata McGraw Hill, ISBN 0074622102, 710pages
3. William B. Bickford, (1990),"First Course in The Finite Element Method", ISBN 0256079730, 649 pages
4. Rajshekaran S. (2008), "Finite Element Analysis", Wheeler publishing, ISBN 8121923149, 630 pages

Reference Books

1. O. C. Zienkiewicz,K. Morgan (2000), “Finite Elements and Approximation”, Dover publications, ISBN 0486453014, 352 Pages
2. J.N. Reddy, (2008), “Non linear Finite Element Analysis”, Oxford University Press, ISBN 0195692039,
3. Cook R.D., Malkus D.S. and Plesha,(2001), “Concepts and Applications of Finite Element Analysis”, John Wiley & Sons (Asia) PvtLtd.ISBN0471356050, 736 pages.
4. Weaver W and Johnston P.R., “Finite Element for Structural Analysis”, Prentice Hall

PEIII Advanced Design of Steel Structures PE-BTC723

Course Code	Course Name
PE-BTC725	Advanced Design of Steel Structures

Course pre-requisites	Design of steel structures

Course Objectives

The objectives of this course are

1. To develop clear understanding of concepts, and practical knowledge of modern Civil Engineering techniques for design of steel structures.
2. Use of various relevant IS codes for designing steel structures.
3. To encourage students and faculty to interact with industry, alumni and other reputed institutes for purpose of better understanding of industry requirements
4. To deal with social, environmental and economic issues

Course Outcomes

Upon successful completion of the course, students should be able to

1. Design steel members under tension, compression and bending using IS codes.
2. Design and detail welded and bolted connections in structural steel.
3. Analyse and design industrial steel structures and high-rise systems.
4. Analyse and design gantry girders, lattice towers, and chimneys.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	2	–	–	–	–	1	–	2	3	2
CO2	3	2	3	1	2	–	–	–	–	2	–	2	3	2
CO3	3	2	3	2	3	–	–	–	–	1	–	2	3	2
CO4	3	2	3	2	3	–	–	–	–	1	–	2	3	2

Course Content

Module No.	*Details*	*Hrs.*
1	Review of basic design of structural steel elements – tension members, compression members, flexural members	06
2	Design of connections Review of basic connection design, Design of moment resistant bolted and welded beam end connections.	06

3	Round Tubular Structural Members Properties of steel tubes, design of tension and compression members, design of welded connections, design of flexural members, analysis and design of tubular trusses	04
4	Gantry Girder: Loads acting on gantry girder. Analysis and design of gantry girder.	06
5	Introduction to structural steel systems for high rise buildings and industrial structures, types of lateral load resisting systems and their applicability	06
6	Lattice Tower: Different configurations of lattice towers, loads acting on lattice towers, analysis and design of lattice tower including welded or bolted connections for members.	06
7	Steel Chimney: Forces acting on chimney, design of self-supporting welded chimney and its components including design of base.	06

Text Books

1. Design of steel structures: Subramanian, Oxford Press.
2. Design of steel structures: Negi L.S., Tata McGraw Hill
3. Design of steel structures: Kazimi S.M. A. & Jindal R.S., Prentice Hall of India.
4. Design of steel structures: Krishnamachar B.S, &Ajitha Sinha D.
5. Design of steel structures: Arya and Ajmani, New Chand & Bros.
6. Design of steel structures, Vol I & II: Ramchandran, Standard Book House, New Delhi.
7. Design of steel structures: Dayaratnam, Wheeler Publication, New Delhi
8. Comprehensive design of steel structures: Punamia, A.K. Jain &Arun Kumar Jain, LaxmiPublicalions Pvt. Ltd.
9. Design of steel structures: I C Sayal&Salinder Singh, Standard Publishers & Distributors.

Reference Books

1. Steel structures, Controlling behaviour through design: R. Englekirk, Wiley
2. Design of steel structures: Breslar, Lin and Scalzi, John Willey, New York.
3. Design of steel structures: Mac. Ginely T.
4. Structural steel work: Reynolds TJ., Kent L.E. &Lazenby, D.W., English University Press.

4	Gantry Girder: Loads acting on gantry girder. Analysis and design of gantry girder.	06
5	Introduction to structural steel systems for high rise buildings and industrial structures, types of lateral load resisting systems and their applicability	06
6	Lattice Tower: Different configurations of lattice towers, loads acting on lattice towers, analysis and design of lattice tower including welded or bolted connections for members.	06
7	Steel Chimney: Forces acting on chimney, design of self-supporting welded chimney and its components including design of base.	06

Text Books

1. Design of steel structures: Subramanian, Oxford Press.
2. Design of steel structures: Negi L.S., Tata McGraw Hill
3. Design of steel structures: Kazimi S.M. A. & Jindal R.S., Prentice Hall of India.
4. Design of steel structures: Krishnamachar B.S, &Ajitha Sinha D.
5. Design of steel structures: Arya and Ajmani, New Chand & Bros.
6. Design of steel structures, Vol I & II: Ramchandran, Standard Book House, New Delhi.
7. Design of steel structures: Dayaratnam, Wheeler Publication, New Delhi
8. Comprehensive design of steel structures: Punamia, A.K. Jain &Arun Kumar Jain LaxmiPublicalions Pvt. Ltd.
9. Design of steel structures: I C Sayal&Salinder Singh, Standard Publishers & Distributors.

Reference Books

1. Steel structures, Controlling behaviour through design: R. Englekirk, Wiley
2. Design of steel structures: Breslar, Lin and Scalzi, John Willey, New York.
3. Design of steel structures: Mac. Ginely T.
4. Structural steel work: Reynolds TJ., Kent L.E. &Lazenby, D.W., English University Press.

PEIII Surface Hydrology PE-BTC731

Course Code	Course Name
PE-BTC731	Surface Hydrology

Course pre-requisites	Hydraulic Engineering, Water Resource and Irrigation Engineering

Course Objectives

The objectives of this course are

1. To discuss scope of hydrology and hydrologic parameters and introduce the basic components of the hydrological cycle and discuss the water balance model.
2. Give an account of the different components evapotranspiration, precipitation, interception, run off, stream flow.
3. to summarize hydrographs along with estimation and design flood control methods.
4. to describe reservoir and channel routing techniques and its applications.

Course Outcomes

Upon successful completion of the course, students will be able to

1. Explain the components of the hydrological cycle and assess water losses such as evaporation, infiltration, and interception using standard methods.
2. Apply techniques for measurement and analysis of precipitation, streamflow, and runoff, including rainfall-runoff relationships and stream gauging.
3. Analys**e** hydrographs, including unit and synthetic hydrographs, for hydrological modelling and flood prediction.
4. Evaluate flood estimation and routing methods, and apply hydrological forecasting techniques to support flood control and risk assessment.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	2	3	2	–	1	–	2	3	3
CO2	3	2	3	2	2	1	2	1	–	1	–	2	3	3
CO3	3	2	3	2	2	1	2	2	–	1	–	2	3	3
CO4	3	2	2	2	2	2	3	2	–	1	–	2	3	3

Course Content

Module No.	*Details*	*Hrs.*
1	**Introduction**: Hydrological cycle, scope of hydrology, water budget equation, sources of data, Introduction to climate change.	06
2	**Precipitation and Water Losses**: Measurement, rainfall records, missing data, mass curve analysis, station year method, depth - area - duration relationship, intensity - duration - frequency relationship. Water losses: Evaporation, evapotranspiration, interception, initial loss, infiltration. Determination of water losses.	06

3	**Streamflow's and Runoff:** Stream gauging techniques, latest methods of measuring depths, current meter-types-calibration, mid-section and mean section methods, rating curves. **Runoff:** Factors affecting runoff, rainfall-runoff relationship, runoff estimation.	06
4	**Hydrograph analysis:** Characteristics, base flow separation, unit hydrograph, S-hydrograph, complex hydrograph, synthetic hydrograph, dimensionless unit hydrograph, instantaneous unit hydrograph.	06
5	**Floods and Flood routing:**	06
	Estimation, envelope curves, flood frequency studies, probability and stochastic methods, estimation of design flood, flood plains, flood hazards,flood control methods, limitations, risk-reliability and safety factor.Reservoir routing, channel routing.	
6	**Hydrological forecasting**: Introduction, General operation of flood forecasting, forecasting by unit hydrograph method.	06
7	**Case studies:** applications of basic principles to hydrology and flood control	06

Reference Books

1. Engineering Hydrology: K. Subramanya, Tata McGraw Hill Publishing Co. Ltd.. New Delhi.
2. Hydrology: H. M. Raghunath, New Age International Publishers, New Delhi
3. Elementary Hydrology: V. P. Singh, Prentice Hall
4. Engineering Hydrology: Principles and practice: V. M. Ponce, Prentice Hall
5. Hydrology and Water Resources Engineering: K. C. Patra, Narosa Publishing House, New Delhi.
6. A Text Book of Hydrology: Dr. P. JayaramiReddi, Laxmi Publications Pvt. Ltd. New Delhi.

PEIII Water and Air Quality Modeling PE-BTC741

Course Code	Course Name
PE-BTC741	Water and Air Quality modeling

Course pre-requisites	EEI, EEII, EVS

Course Objectives

The objectives of this course are

1. Develop models based on the mass-balance approach
2. Predict the impact of the of external waste loading on different environmental matrices
3. Predict and generate future conditions under various loading scenarios or management/intervention action alternatives.

Course Outcomes

Upon successful completion of the course, students will be able

1. Describe the scope, objectives, and approaches of environmental modelling and outline the model -building process for environmental systems.
2. Apply fundamental principles of mass transport and transformation processes to simulate environ mental systems using basic reactor models and material balance equations.
3. Develop and analyse water and air quality models using appropriate analytical methods and interp ret results for different environmental scenarios.
4. Demonstrate the use of modelling software such as WASP, QUAL2E, MODFLOW, AERMOD, a nd CMAQ through practical case studies and research applications.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	2	3	3	–	1	–	2	3	3
CO2	3	2	2	2	2	2	3	2	–	1	–	2	3	3
CO3	3	2	3	2	3	2	3	2	–	1	–	2	3	3
CO4	3	2	3	2	3	2	3	2	–	2	–	2	3	3

Course Content

Module No.	*Details*	*Hrs.*
1	**Introduction** Environmental modeling: scope and problem definition, goals and objectives, definition; modeling approaches– deterministic, stochastic and the physical approach; applications of environmental models; the model building process	05

2	**Elementary concepts, laws, theories and processes** The building blocks: extensive and intensive properties, properties relevant to of environmental systems, the material balance approach; the transport processes–advection, diffusion, dispersion, gravitational settling, transport in porous media; the transformation processes–the non-reactive processes, the reactive processes; simulation of transport and transformation processes– introduction, the completely stirred tank reactor, plug flow reactor, mixed flow reactor models; the general material balance models.	10
3	**Water Quality Modeling** Water quality modeling: surface water quality modeling – lakes and impoundments, rivers and streams, estuaries; ground water pollution modeling.	06
4	**Air Quality Modeling**	04
	Air quality modeling: the box model, the Gaussian plume model point sources, line sources, area sources; special topics; Gaussian puff model.	
5	Software's in water quality modeling Understanding WASP, QUAL2E, Modflow	06
6	Software's in air quality modeling Understanding AERMOD, CMAQ, CLINE, HEM	06
7	Case studies Understanding application of models on ground by various research papers	05

Reference Books

References

1. Chapra S.C. (1997) Surface Water-Quality Modelling, McGraw-Hill International Edition.
2. Nirmalkhandan N. (2001) Modeling Tools for Environmental Engineers and Scientists, CRC Press, Boca Raton, Florida.
3. Schnelle K.B. and Dey P.R. (1999) Atmospheric Dispersion Modelling Compliance Guide, McGraw-Hill. 4. Thomann R.V. and Mueller J.A. (1987) Principles of Surface Water Quality Modelling and Control, Harper & Row, New York.
5. Turner D.B. (1994) Workbook of Atmospheric Dispersion Estimates 2nd ed., Ann Arbor, MI, Lewis Publishers.
6. Benarie M.M. (1980) Urban Air Pollution Modelling, Cambridge, MA: The MIT Press.
7. Dunnivant F.M. and Anders E. (2006) A Basic Introduction to Pollutant Fate and Transport, John Wiley & Sons, Inc., New Jersey.
8. Ramaswami A., Milford J.B. and Small M.J. (2005) Integrated Environmental Modelling, John Wiley and Sons, Inc., New Jersey.
9. Schnoor J.L. (1996) Environmental Modeling, John Wiley & Sons, Inc., New York.
10. Zannetti P. (1990) Air Pollution Modelling, Theories, Computational Methods and available Software, Van Nostrand Reinhold, New York.

PEIII Valuation and Value Engineering PE-BTC751

Course Code	Course Name
PE-BTC751	Valuation and Value Engineering

Course pre-requisites	Construction Engineering and Management

Course Objectives

The objectives of this course are

1. To describe purpose of valuation and different methods of valuation.
2. To describe concept and importance of Value analysis and management.
3. To summarize life cycle costing for the construction project.

Course Outcomes

Upon successful completion of the course, students will be able

1. Differentiate between price, cost and value, and explain the purpose, types, and methods of valuati on for various properties and assets including land, buildings, and special structures.
2. Apply suitable valuation techniques such as rental basis, land and building method, profit method, and development method for assessing property value.
3. Demonstrate knowledge of value analysis and value engineering principles to identify unnecessary costs and develop efficient alternatives using tools such as FAST diagrams and job plans.
4. Evaluate construction projects using life cycle costing, present worth analysis, and rate of return m ethods, and prepare standard valuation reports based on industry practices.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	2	2	2	–	1	–	2	2	3
CO2	3	2	2	2	2	2	2	2	–	1	–	2	2	3
CO3	3	2	2	2	3	2	2	2	–	2	–	2	2	3
CO4	3	2	2	2	3	2	2	2	–	2	–	2	2	3

Course Content

Module No.	*Details*	*Hrs.*
1	Valuation: Purpose of valuation. Meaning of price, cost and value. Factors affecting 'value'. Types of value: only Fair Market Value, Book Value, Salvage/ Scrap Value, Distressed Value and Sentimental Value. Concept of free hold and lease hold property. Estimation versus valuation. Estimation versus valuation, Methods of depreciation & obsolescence, Sinking Fund, Years Purchase.	6
2	Different methods for valuation of assets such as land and building, horticulture, historical places. Methods of Valuation of Building: Rental Basis, Land & Building basis, Direct Comparison Method, Profit based method, Belting of Land, Development method.	6
3	Value: Meaning of value, value analysis, value engineering and value management, basic and secondary functions, factor contributing to value such as aesthetic, ergonomic, technical, economic value. Identifying reasons for unnecessary costs, FAST diagram and its importance.	6

4	Value Analysis: value analysis team; principles of value analysis, elements of a job plan such as orientation, Information, presentation. Implementation, follow up action, benefits of value analysis, various applications; assessing effectiveness of value analysis. Value management for building and other construction works.	6
5	Life cycle costing – Forecasting of Capital as well as operating & maintenance costs, time value, present worth analysis, DCF methods, ROR analysis.	5
6	Valuation Report: Valuation Report, contents, standard formats, Case study of any one Report	2
7	Case study in Value Engineering in building construction sector and Infrastructure sector.	5

Text Books

1. Value Engineering: Analysis And Methodology By Del Younke
2. Industrial Engg. & Mgt., O.P.Khanna, Dhanpat Rai Publ.
3. Industrial Organization & Engg. Economics, T.R.Banga, S.C.Sharma, Khanna Publ.
4. Estimating and Costing in Civil Engineering: Theory and Practice B.N Dutta Published S. Dutta & Company, Lucknow.
5. Estimating, Costing Specifications & valuation in Civil EngineeringBy: M.Chakraborty
6. Estimating and Costing By: Rangwala Published By: Charotar Publishing House,
7. Practical Information for Quantity Surveyors, Property valuers, Architects Engineers and Builders, P.T.Joglekar, Pune Vidyarthi Griha Prakashan, 2008 reprint.
8. Value Management of Construction Projects by John Kelly,Steven Male and Drummond Graham

PEVI Contracts Management PE-BTC752

Course Code	Course Name
PE-BTC752	Contracts Management

Course pre-requisites	Construction Engineering and Management

Course Objectives

The objectives of this course are

1. To describe the Overview of Contract Management
2. To understand Performance parameters; Delays, penalties in contract
3. To summarize the students about Contract Administration and Legal Aspects in Contract Management.

Course Outcomes

Upon successful completion of the course, students will be able

1. Explain the fundamentals and importance of contract management, including types of contracts
2. Identify and interpret key contract clauses, roles and responsibilities of contracting parties, and the procedures related to notices, contract duration, and pricing.
3. Analyse contract performance parameters, delays, claims, and dispute resolution methods in accordance with legal frameworks such as the Indian Contract Act and Arbitration Act.
4. Demonstrate understanding of contract administration practices in various scenarios, including international and consultancy contracts, and assess procedures for risk management, contract closure , and post-implementation review.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	2	2	2	–	2	2	2	1	2
CO2	3	2	1	2	1	2	2	2	–	2	2	2	1	2
CO3	3	2	2	2	2	3	3	3	–	2	2	2	1	3
CO4	3	2	2	2	2	2	2	2	–	2	2	2	1	3

Course Content

Module No.	*Details*	*Hrs.*
1	Introduction, Importance of Contracts, Overview of Contract Management, Overview of Activities in Contract Management; Planning and People- Resource Management; Types of Contracts. EPC, BOT, BOOT, BOLT,HAM,DBFOT & PPP	06
2	Parties to a Contract; Common contract clauses, Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price.	06

3	Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations. Defect liability period. Construction Claims: Extra items and causes of claims. Types of construction claims, documentation. Settlement of claims, extension of time. Notices under contracts; Conventional and Alternative Dispute Resolution methods. Various Acts governing Contracts, Indian Contract Act (1872), Indian Arbitration and Conciliation Act 1996	06
4	Contract Administration, Payments; Contract Management in Various Situations- Contract Management in NCB Works, Contract Management in ICB Works Contracts, Contract of Supply of Goods- Design, Supply and Installation Contracts, FIDIC Conditions.	06
5	Contract Management in Consultancy,; Managing Risks and Change; Contract Closure, Post-Implementation Review; Change of Scope of Contract	06
6	Legal Aspects in Contract Management- Contract Management Legal View, Dispute Resolution, Arbitration, Integrity in Contract Management; Managing Performance- Introduction, Monitoring and Measurement Injunctions and Bailment.	06

Text Books

1. Civil Engineering Contracts and Estimates - B. S. Patil – Universities Press- 2006 Edition, reprinted in 2009.
2. The Indian Contract Act (9 of 1872), 1872- Bare Act- 2006 edition, Professional Book Publishers.
3. The Arbitration and Conciliation Act,(1996), 1996 (26 of 1996)- 2006 Edition, Professional Book Publisher.
4. Law of contract Part I and Part II, Dr. R.K. Bangia- 2005 Edition, Allahabad Law Agency.
5. Arbitration, Conciliation and Alternative Dispute Resolution Systems- Dr. S.R. Myneni- 2004 Edition, reprinted in 2005- Asia Law House Publishers.
6. The Workmen's Compensation Act, 1923 (8 of 1923) Bare Act- 2005- Professional Book Publishers.
7. Standard General Conditions for Domestic Contracts- 2001 Edition- Published by Ministry Of Statistics and Program Implementation, Government of India.
8. FIDIC Document (1999).
9. Dispute Resolution Board foundation manual-www.drbf.org.
10. Law for Engineers, Vandana Bhatt (2018), Procare India.

PEIII Pavement Design and Construction PE-BTC761

Course Code	Course Name
PE-BTC761	Pavement Design and Construction
Course Prerequisites	Highway Engineering

Course Objectives

The objectives of this course are

1. To acquire the knowledge about distribution of stress within the pavement
2. To discuss the methods available for design of pavements and utilize the knowledge for implementation.
3. To summarize the importance of strengthening existing pavements and implementation of knowledge for its application.

Course Outcomes

Upon successful completion of the course, students will be able

1. Explain the structural components, design factors, and stress analysis methods for flexible and rigid pavements, including empirical and layered theory approaches.
2. Design flexible and rigid pavements using relevant IRC codes, evaluate failure criteria such as fatigue and rutting, and utilise software tools like IITPAVE for analysis.
3. Describe materials, mix design, and construction techniques for various pavement types including conventional, roller-compacted, and cell-filled concrete pavements.
4. Assess pavement condition through distress evaluation and quality control testing, and design appropriate maintenance, overlay, and drainage solutions based on IRC standards.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	2	2	2	–	1	–	2	3	3
CO2	3	2	3	2	3	2	2	2	–	1	–	2	3	3
CO3	3	2	2	2	2	2	2	1	–	1	–	2	3	2
CO4	3	2	2	2	3	2	2	1	–	1	–	2	3	3

Course Content

Module No.	*Details*	*Hrs.*
1	Pavement structure and functional attributes, factor affecting pavement design, types of wheel loads for highways, Classification of Pavement Design Methods. Stresses in flexible pavements, 1-layer, 2-layer, 3-layers theories, EWLF, ESWL, Stresses in Rigid pavement: wheel load and temperature stresses, combined stresses.	06

2	**Flexible Pavement Design:** i. Testing of subgrade soils. ii. Empirical methods using no soil strength criteria, GI method, iii. Empirical method based on soil strength criteria: CBR method as specified by IRC: 37: 2001 & IRC: 37: 2012, Fatigue and rutting as a failure criterion, Analysis of flexible Pavement using IITPAVE software.	08
3	**Rigid Pavement Design:** Comparison of Flexible and rigid pavements, Design of Rigid Pavement using IRC: 58:2002, IRC: 58:2011, axle load survey.	4
4	**Road Construction:** Construction of different layers of Flexible Pavements, size and gradation of aggregate, material selection, Economics in construction. Mix design, concrete strength, size of aggregates, and gradation, and workability, preparation of base form work, mixing, transporting, placing, compaction, finishing and curing, classification of joints. Construction of Roller Compacted concrete pavements, Cell filled Concrete Flexible Pavements.	8
5	**Distress Evaluation maintenance and strengthening:** Flexible and rigid pavement distresses, condition and evaluation surveys, present serviceability index, roughness measurement, Benkaleman beam deflections & design of overlays using IRC: 81:1997,	8
6	**Highway Drainage:** Surface & Subsurface Drainage, Surface Drainage for Hilly Roads, Design of surface and subsurface drainage system.	4
7	**Quality Control:** Quality control test prior to construction and during construction on different pavement layer materials and pavement layers. frequency of tests.	4

Text Books

1. Yoder, E. J., John (1975); "Principles of Pavement Design" Wiley & Sons, Inc., New York. ISBN -13: 9780471977803.
2. S. K. Khanna, C. E. G. Justo & A. Veeraragavan (2014); "Highway Engineering", Xth Edition New Chand & Brothers, Roorkee.
3. Dr. L. R. Kadiyali and Dr. N. B. Lal (2005); "Principles and Practices of Highway Engineering", Khanna Publication, New Delhi. ISBN-13: 9788174091659.
4. Guide lines for the Design of Flexible Pavements, IRC:37 -2001, IRC:37-2012,
5. Guide lines for the Design of Rigid Pavements, IRC: 58:2002, IRC: 58:2011.
6. Guide lines for Strengthening of Flexible Road Pavements using Benkelman Beam Deflection Technique. IRC: 81:1997.
7. Concrete Roads: HMSO, Road Research Laboratory, London.
8. Specification for Rural Roads – 2014, Ministry of Rural Development

PEIII Advanced Foundation Engineering PEBTC771

Course Code	Course Name
PE-BTC771	Advanced Foundation Engineering

Course pre-requisites	Soil Mechanics, Foundation Engineering

Course Objectives

In this course, students are taught about the higher level applications of the topics learnt during previous semesters in Soil Mechanics and Foundation Engineering. They will be exposed to the field applications in the form of completion and submission of mini projects.

The objectives of this course are

1. Highlight the importance of site exploration and characterization, purpose, scope and methods.
2. Apply the consolidation theory, use appropriate laboratory tests and field curves, introduce concept of quasi-consolidation
3. Predict the stress-strain behaviour of soil and estimate stresses in soil using various theories
4. Analyze and estimate bearing capacity and settlement of shallow foundations and estimate pile capacity by various methods
5. Explain methods and importance of ground improvement

Course Outcomes

Upon successful completion of the course, the learners should be able to

1. Explain the significance and importance of geotechnical investigations and insist on proper implementation of the same in construction projects.
2. Plan and handle simple site projects based on the field data provided to them.
3. Apply the basics explained in earlier semester to complex and practical problems in design and construction of foundations.
4. Recommend the use of suitable ground improvement techniques where required.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	2	–	–	–	1	–	2	3	2
CO2	3	2	2	2	3	–	–	–	–	1	–	2	3	2
CO3	3	2	3	2	3	–	–	–	–	1	–	2	3	3
CO4	3	2	2	2	2	2	2	1	–	1	–	2	2	3

Course Content

Module No.	*Details*	*Hrs.*

1	**Site Exploration and Characterization** Purpose and scope, influence of soil conditions and type of foundation on exploratory programme, project assessment, phasing of site exploration, excavation and boring methods of exploration, types of samplers and their design features, subsurface soundings – static and dynamic methods, planning of subsurface investigations, as per IS 1892, type and sequence of operations, bore logs, core logs and importance of logging, lateral extent and depth of exploration, interpretation of field and laboratory data	06
2	**Consolidation** Terzaghi's theory of one-d consolidation – derivation of equation (solution in detail need not be covered), estimation of C_c and C_v from laboratory tests, Estimation of P_c by various methods, field consolidation curves, Quasi- preconsolidation and secondary consolidation, practical applications.	08
3	**Stress and Strain Behaviour of Soils** Triaxial test - drained and undrained behaviour of sands and clays, failure criteria in soils - only Mohr - Coulomb's criteria, ideal, plastic and real soil behaviour, shear strength of sands and clays.	04
4	**Estimation of Stresses** Boussinesq's theory, vertical stress due to concentrated load, horizontal and shear stress due to concentrated load, Isobar diagram, vertical stress distribution on horizontal plane, influence diagram, vertical stress distribution on vertical plane, vertical stress due to line load, vertical stress under strip load, maximum shear stress at points under strip loads, vertical stresses under a circular area, vertical stress under a corner of a rectangular area, Newmark's influence charts, Westergaard's theory.	06
5	**Bearing Capacity and Settlement Analysis of Shallow Foundations** Modes of failure, failure criteria, – Terzaghi solutions, Vesic's solutions, IS Code recommendations, assumptions in estimates of ultimate loads, effect of shape, embedment of footing, eccentricity in loading, compressibility (including critical rigidity index), water table. Choice of factor of safety, settlement of foundations on sand – Schmertmann method, Plate load test, evaluation of bearing capacity using standard penetration test, Housel Method	08

6	**Pile Foundations** Use of load tests, Introduction to IS 2911 for estimation of single pile capacity by static and dynamic methods, Group capacity in sand and clay deposits, Separation of skin friction and end-bearing capacity. Settlement of single and group of piles.	05
7	**Ground Improvement** Improvement of deep cohesionless soils and cohesive soils	05
	(including stone columns / band drains), instrumentation – mainly pore pressure gauges and settlement gauges and their applications.	

Reference Books

1. Murthy, V. N. S. Textbook of Soil Mechanics and Foundation Engineering: Geotechnical Engineering Series. CBS Publishers and Distributors (P) Ltd., 2018.
2. Terzaghi, K., Peck, R. B., and Mesri, G. Soil Mechanics in Engineering Practice. 3rd Edition, Wiley-India, India, 2009.
3. Fang, H. Foundation Engineering Handbook. 2nd Edition, CBS Publishers and Distributors (P) Ltd., 2004.
4. Nayak, N. V. Foundation Design Manual. 7th Edition, Dhanpat Rai Publications, India, 2018.
5. Das, B. Principles of Foundation Engineering. 8th Edition, Cengage India Private Ltd., 2017
6. Relevant journal and conference papers for case studies.
7. Relevant IS codes

PEIII Rock Mechanics PE-BTC772

Course Code	Course Name
PE-BTC772	Rock Mechanics

Course pre-requisites	Engineering Geology, Soil Mechanics

Course Objectives

The objectives of this course are

1. Introduce the subject of rock mechanics, explain some theoretical and practical aspects
2. Classify rocks and estimate stresses in rock
3. Discuss problems that arise in rock engineering

Course Outcomes

Upon successful completion of the course, the learners should be able to

1. Identify and quantify various engineering properties of rock.
2. Analyze their behavior under the application of loads
3. Provide solutions to problems arising during construction in or over rock
4. Apply their understanding of rock mechanics to help in the design of several structures such as tunnels, underground structures and foundations resting on rock.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	–	–	–	–	1	–	2	3	2
CO2	3	2	2	2	2	–	–	–	–	1	–	2	3	2
CO3	3	2	3	2	2	2	1	–	–	1	–	2	3	3
CO4	3	2	3	2	2	1	2	–	–	1	–	2	3	3

Course Content

Module No.	*Details*	*Hrs.*
1	Introduction to rock mechanics. Importance of rock mechanics to engineering problems. Rock types and rock structures	04
2	Geological and geophysical investigations, Stereographic plots of joints.	04

3	Classification of rocks – lithological, engineering. Classification of fissures, joints and faults, Engineering properties of rocks. Lab and site measurements	06
4	Definition of stress in rock, simple methods of determining in-situ stresses, induced stresses after excavation	06
5	Ground Response Curves (GRC) and Support Response Curves (SRC). Evaluation of in-situ rock stresses by borehole deformation and flat jack methods. Tunneling by Drill & blast methods Tunnel	10
	boring machine (TBM), NATM.	
6	Problems and remedies in rock engineering such as squeezing and rock-burst, Swelling and water pressure	06
7	Applications of rock mechanics – Tunnels, foundations, underground civic facilities, defense shelters, waste storage	06

Reference Books

1. Jaeger, J.C., Cook, N.G.W, Zimmerman, and R.W. Fundamentals of Rock Mechanics. 4th Edition, Wiley-Blackwell, 2007.
2. Jumikis, A. R. Rock Mechanics. Trans Tech Publications, USA, 1983.
3. Look, B. Handbook of Geotechnical Investigation and Design Tables. 2nd Edition, Routledge, UK, 2014
4. Relevant journal and conference papers for case studies.
5. Relevant IS codes

PEIV Prestressed Concrete PE-BTC724

Course Code	Course Name
PE-BTC 724	Prestressed Concrete

Course pre-requisites	Mechanics of Materials, Structural Mechanics, Structural Analysis, Design of RCC Elements

Course Objectives

The objectives of this course are

1. To understand prestress force and its effect in structural members, prestressing systems and industrial applications.
2. To understand the materials which can be used for prestressed structure.
3. To understand the concept of deflections due to prestressing force along with other forces
4. To understand the concept of composite structures and concordance of cables.
5. To understand the design concept using prestressing force and familiarize with IS-1343.

Course Outcomes

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

1. Explain the fundamental principles of prestressed concrete, including materials, methods, systems of prestressing, and the behaviour of prestressed elements under loading.
2. Analyse prestressed concrete sections for flexure and shear using both working stress and limit state methods, including evaluation of losses, kern points, cable profiles, and deflections.
3. Design pre-tensioned and post-tensioned structural elements such as beams, slabs, and bridge girders in accordance with IS 1343–2012 and IRC loading criteria.
4. Evaluate complex behaviours in prestressed structures such as end zone stresses, creep, relaxation, and apply concepts of composite action and continuity in continuous prestressed members.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	–	–	–	–	1	–	2	3	2
CO2	3	2	3	2	2	–	–	–	–	1	–	2	3	2
CO3	3	2	3	2	3	–	–	–	–	1	–	2	3	2
CO4	3	2	2	2	2	–	–	–	–	1	–	2	3	2

Course Content

Module No.	*Details*	*Hrs.*
1	Introduction to basic concepts and general principles of pre-stressed concrete, materials used in prestressed concrete and methods and techniques of prestressing, prestressing systems.	02

2	Analysis of prestressed concrete sections for flexure considering loading stages, computational of sectional properties, critical sections under working loads for pretensioned and post tensioned members, load balancing method of analysis of prestressed concrete beams, losses in prestress, application to simply supported beams and slabs, concept of debonding of cables in pre tensioned units.	09
3	Design philosophy of prestressed concrete sections, permissible stresses in concrete and steel, design approaches using working stress method as per IS 1343 – 2012, limit state of collapse – flexure and shear as applied to prestressed concrete beams, kern points, choice and efficiency of sections, cable profile and layouts, cable zone, deflection of prestressed concrete sections.	09
4	End zone stresses in prestresses concrete members, pretension transfer bond, transmission length, end block of post tensioned members.	06
5	Design of simply supported pre-tensioned and post tensioned slabs and beams. Design of bridge girders subjected to IRC loadings.	06
6	Analysis and design of composite prestressed concrete structures, concept and behaviour of long term creep and relaxation of prestressed members.	05
7	Introduction to application of prestressing to continuous beams, linear transformation and concordance of cables, deck continuity.	05

Text Books:

1. T. Y. Lin, “Design of Prestressed Concrete Structures”, John Wiley Publishers
2. N. Krishna Raju, “Prestressed Concrete”, Tata McGraw Hill
3. Y. Guyon, “Prestressed Concrete”, Contractors Record Ltd.
4. R. H. Evans & E. W. Bennette, “Prestressed Concrete”, McGraw Hill Book Co

PEIV Earthquake Engineering PE-BTC725

Course Code	Course Name
PE-BTC725	Earthquake Engineering

Course pre-requisites	Engg. Mathematics II, Structural Dynamics

Course Objectives

The objectives of this course are

1. To develop civil engineering graduates having clear understanding of concept of dynamic loads, dynamic analysis, Seismic analysis of structures.
2. To apply the knowledge of structural dynamic to evaluate the seismic response of structures subjected to different ground motion. To apply response spectrum concept to characterize the ground motion.
3. To apply provisions of IS 1893-2016& IS 13920-2016 to design seismic resistant structures.
4. To inculcate ethics to deal with social, environmental & economic issues.

Course Outcomes

Upon successful completion of the course, students will be able to

1. Describe earthquake phenomenon, their causes and effects on structures
2. Apply knowledge of structural dynamics in evaluation of structural response to earthquake ground motion
3. Characterize the ground motion in the form of response spectra and construct response spectra and evaluate the structural response to earthquake ground motion using response spectra
4. Perform Seismic analysis of structure, incorporating the provision of IS -1893-2016; and IS 13920- 2016

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	2	2	2	–	1	–	2	3	3
CO2	3	2	3	2	3	2	2	2	–	1	–	2	3	3
CO3	3	2	3	2	3	2	2	2	–	1	–	2	3	3
CO4	3	2	3	2	3	2	2	2	–	1	–	2	3	3

Course Content

Module No.	*Details*	*Hrs.*

1	**Introduction:** Introduction to structural dynamics, definition of basic problem in dynamics, static v/s dynamic loads, different types of dynamic loads	02
2	**Single degree of Freedom (SDOF) systems:** Undamped vibration of SDOF system, natural frequency and period of vibration, damping in structures, viscous damping and Coulomb damping, effect of damping on frequency of vibration and amplitude of vibration, logarithmic decrement. Forced vibration, response to harmonic forces, periodic loading, dynamic load factors, response of structure subjected to general dynamic load, Duhamel's integral, numerical evaluation of dynamic response of SDOF systems subjected to different types of dynamic loads. Use of Fourier Series for periodic forces, introduction to vibration isolation.	08
3	**MDOF systems:** Direct determination of frequencies and mode shapes, orthogonality principle, approximate methods for determination of frequencies and mode shapes. Forced vibration of MDOF system, modal analysis, applications to beams and multistoried frames with rigid girders subject to lateral dynamic loads including ground motion.	06
4	**Seismological background:** Seismicity of a region, earthquake faults and waves, structure of earth, plate tectonics, elastic-rebound theory of earthquake, intensity and magnitude of earthquake, measurement of ground motion, seismogram, earthquake frequency, local site effects, seismotectonic and Seismicity of India. Effect of near-field and far-field earthquake ground motions.	04
5	**Characterization of ground motion:** Earthquake response spectra, factors influencing response spectra, design response spectra for elastic systems, peak ground acceleration, response spectrum shapes, deformation, pseudo-velocity, pseudo-acceleration response spectra, peak structural response from the response spectrum, response spectrum characteristics, construction site specific response spectra.	05
6	**Deterministic earthquake response:** Types of earthquake excitation, lumped SDOF elastic systems.	04

	translational excitation, lumped MDOF elastic systems, translational excitation, time history analysis, multistoried buildings with symmetric plans, multi storied buildings with un symmetric plans, torsional response of symmetric plan building, distributed - parameter elastic systems, translational excitation, combining maximum modal responses using mean square response of a single mode, SRSS and CQC combination of modal responses.	
7	**I. S. code method of seismic analysis:** Equivalent static method and its limitation, response spectrum method, IS 1893-2016 provisions for seismic analysis of buildings and water towers, seismic evaluation and retrofitting, types of structural systems used in building to resist earthquake loads. Review of damages during past earthquakes and remedial measures, seismic design considerations, allowable ductility demand, ductility capacity, reinforcement detailing for members and joints as per IS 13920-2016.	06 03

Term Work
Term work shall comprise of At least 20 (twenty) solved problems based on the above syllabus shall be submitted as term work. Exposure to computer aided analysis using available software be considered.

Text Books
1. Dynamics of Structures by Anil K Chopra, Prentice Hall of India 2. Structural Dynamics of Earthquake Engineering: Theory & Application using MATHEMATICA & MATLAB by S Rajasekaran, Woodhead Publishing Ltd. 3. Earthquake Resistance Design & Risk Reduction by David Dowrick, Wiley India 4. Seismic Analysis of Structures by T K Dutta, John Wiley & Sons (Asia) Pvt.Ltd 5. I.S. Codes No. 1893, 4326, 13920 (All latest codes)

Reference Books

1. Fundamentals of Earthquake Engineering by N M Newmark's & E Rosenblueth, Prentice Hall
2. Earthquake Spectra & Design by N M Newmark's & W J Hall, Earthquake Engineering Research Institute, Berkeley, California
3. Dynamics of Structures by Clough & Penzien, McGraw-Hill, Computers & Structures
4. Fundamentals of Earthquake Engineering by Amr S Elnashai & Luigi Di Sarno, Wiley India
5. Fundamentals of Earthquake Resistant Construction by Ellis L Krinitzsky, James P Gould & Peter H Edinger, Wiley India
6. Design of Earthquake Resistant Structures by E Rosenblueth, Pentech Press, London
7. Design of Seismic Isolated Structures: From Theory to Practice by Farzad Naeim & James M Kelly, John Wiley & Son
8. Mechanics of Rubber Bearings for Seismic and Vibration Isolation by James M Kelly & Dimitrios A Konstantinidis, Wiley
9. Seismic Engineering by Jacques Betbeder-Matibet, Wiley
10. Seismic Design of Reinforced Concrete & Masonry Buildings by T. Paulay & M J N Priestley, Wiley India
11. Plate Tectonics: An Insider's History of The Modern Theory of The Earth by Naomi Oreskes, Westview Press
12. Elementary Seismology by C R Richter, W.H. Freeman & Company, San Francisco
13. "Proceedings on World Conference on Earthquake Engineering" 1956-2000.

PEIV Hydraulic Modelling PE BTC732

Course Code	Course Name
PE-BTC732	Hydraulic Modelling

Course pre-requisites	Hydrology, Water Resource Engineering, Fluid Mechanics

Course Objectives

The main objective of this course is to introduce various concepts which will help in designing hydraulic models.

Course Outcomes

At the end of the course students will be able to

1 Explain the principles of dimensional analysis and similarity mechanics relevant to hydraulic modelling.

2 Classify and distinguish between physical, numerical, and data-driven hydraulic models for different engineering applications.

3 Design and analyse gravity-dominated, gravity-friction, and friction-dominated hydraulic models using appropriate model laws and scaling principles.

4 Demonstrate the use of open-source hydraulic modelling software and interpret real-world case studies to evaluate the effectiveness of hydraulic model applications.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	–	–	–	–	1	–	1	3	2
CO2	3	2	2	2	2	–	–	–	–	1	–	1	3	2
CO3	3	2	2	2	3	–	–	–	–	1	–	1	3	2
CO4	3	2	2	2	3	–	–	–	–	1	–	1	3	2

Course Content

Module No.	*Details*	*Hrs.*
1	**Dimensional analysis:** Similarity mechanics, model laws, distinction between numerical and hydraulic models, classification of hydraulic modelling, materials used in the model, scale effect, design, construction, operation and interpretation of the results.	06
2	**Hydraulic Modelling:** Types of modeling: Physical, numerical, data driven models.	06
3	Gravity dominated models	06
4	Gravity friction models	06
5	Friction dominated models	06
6	Study of open source hydraulic modeling software's	06
7	Applications to various case studies in Hydraulic modelling	06

Reference Books

P. Novak, V. Guinot, A. Jeffrey and D. E. Reeve (2010): Hydraulic Modelling – an Introduction, Principles, methods andapplications, Spon Press (Taylor and Francis) 270 Madison Avenue , New York, NY 10016, USA

PEIV Sustainable Engineering & Technology PE-BTC742

Course Code	Course Name
PE-BTC742	Sustainable Engineering & Technology

Course pre-requisites	Probability and Statistics, Environmental Science (mandatory course)

Course Objectives

1. **To introduce** the fundamental principles of sustainability and their relevance in engineering and technological systems.
2. **To familiarise** students with the concepts and methodologies of **Life Cycle Assessment (LCA)**, including inventory and impact analysis, in accordance with ISO standards.
3. **To develop** an understanding of environmental risk, waste management, and sustainable design strategies within the broader context of ecological and economic systems.
4. **To equip** students with the ability to apply tools and techniques to assess, compare, and interpret sustainability performance across products, processes, and systems.
5. **To encourage** systems thinking and critical analysis by engaging students in real-world case studies related to environmental, architectural, water, transportation, and urban sustainability challenges.

Course Outcomes

Upon successful completion of the course, students will be able

1. **Understand** fundamental concepts related to the interaction between industrial and ecological systems and recognise sustainability challenges through systems-based approaches.
2. **Develop** a broader perspective for sustainable engineering practices by applying engineering knowledge and principles.
3. **Comprehend** life cycle assessment (LCA), inventory (LCI), and impact assessment (LCIA), including socio-economic aspects.
4. **Apply** LCA methodology to analyse and solve real-world sustainability problems.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	3	3	3	–	1	–	3	2	3
CO2	2	2	2	2	2	3	3	3	–	1	–	3	2	3
CO3	2	2	2	2	2	3	3	3	–	1	–	3	2	3
CO4	2	2	2	2	2	3	3	3	–	1	–	3	2	3

Course Content

Module No.	*Details*	*Hrs.*
1	Introduction Sustainability concepts and Life Cycle Analysis (LCA), material flow and waste management, importance of sustainability for engineers.	06

2	Risk And Life Cycle Framework Definition- risk, risk assessment, examples and characteristic of environmental problem	08
3	Life Cycle Assessment Detailed methodology and ISO framework - detailed example on LCA comparisons, LCA benefits and drawbacks, historical Development and LCA steps from ISO framework, life cycle inventory and impact assessments unit processes and system boundary data quality, procedure for life cycle impact assessment, LCIA in practice with examples, interpretation of LCIA results, factors for good LCA study - ISO terminologies, LCA steps recap, chemical release and fate and transport, and green sustainable materials LCA - Data Collection And Methodology Environmental data collection issues, statistical analysis of environmental data, common analytical instruments, overview of LCA methodology - goal definition, life cycle inventory, life cycle impact assessment, life cycle interpretation, LCA software tools	16
4	Design For Sustainability Environmental design for sustainability: economic, environmental indicators, social performance indicators, sustainable engineering design principles and environmental cost analysis.	06
5	Case Studies Architectural, environmental, transportation, water resources, and other areas	06

Text Books

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
3. Environment Impact Assessment Guidelines, Notification of Government of India, 2006

Reference Books

1. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
2. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
3. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
4. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998

PEIV Industrial Wastewater Treatment PE-BTC743

Course Code	Course Name
PE-BTC743	Industrial Wastewater Treatment

Course pre-requisites	EE1, EEII

Course Objectives

The objectives of this course are

1. Analyse and understand the difference between Industrial and municipal waste and wastewater
2. Predict DO levels using Streter Phelps modeling
3. Understand advanced treatment techniques for industrial waste effluents
4. Develop treatment schemes for industries such as pulp and paper, textile, tannery, dairy, electroplating, cane sugar and distilleries
5. Emphasize on inplant control and good housekeeping

Course Outcomes

Upon successful completion of the course, students will be able

1. Explain the nature and characteristics of industrial liquid waste and assess its environmental impacts on natural water bodies, sewers, and land.
2. Analyse the effect of industrial waste on aquatic ecosystems using models such as the Streeter-Phelps equation and interpret oxygen sag and eutrophication phenomena.
3. Describe and compare various modern and conventional industrial wastewater treatment methods , including MBBR, MBR, RO, and natural wetland systems.
4. Evaluate industrial waste management strategies for selected industries and propose suitable treatment, reuse, and resource recovery options.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	3	3	3	–	1	–	3	2	3
CO2	2	2	2	2	2	3	3	3	–	1	–	3	2	3
CO3	2	2	2	2	2	3	3	3	–	1	–	3	2	3
CO4	2	2	2	2	2	3	3	3	–	1	–	3	2	3

Course Content

Module No.	*Details*	*Hrs.*

1	General: liquid wastes from industries – their volumes and characteristics, Effect of disposal into natural water courses, Municipal sewers and on land, River standards and effluent standards; Standards prescribed by MoEF (Stream water – I to IV) Lessons from history: a study of a few accidents/violations such as Minamata bay Japan screening of documentaries to ease the students into the course	06
2	Stream sanitation: Effects of industrial wastes on self-purification of streams and fish life, Aquatic bio system; Statement and significance of the parameters of Streeter and Phelp's equation and BOD equations, deoxygenation and reaeration , Oxygen sag, Case study of Eutrophication	06
3	Sampling and analysis of industrial wastes, Storage of Samples; Treatability study	
4	General treatment of industrial wastes: neutralization, equalization, segregation, MBBR, MBR, SBR, Natural Wetland system, RO, RO-MEE, Newer treatment flowsheets	02
5	Modification of conventional aerobic and anaerobic biological treatment methods. Dewatering and disposal of sludges – floatation, vacuum filtration, centrifugation, filter press, Inplant control measures for volume and strength reduction Selection of technology based on area, effluent characteristics, investment cost, maintenance issues, concept of zero liquid discharge	06
	Detailed consideration of wastes produced from following industries: Processes followed Volume of wastewater generated by specific industry and effects of raw and treated effluent on streams, sewers and land by wastewater of specific industry. Treatment methods and schemes for specific industry , reuse-recovery 1) Textiles: cotton and synthetic 2) Pulp &paper:- Sulphate process 3) Electroplating 4) Dairy 5) Sugar- sugarcane 6) Distilleries 7) Tanneries 8) Mining 9) Pharmaceutical	16
7	Provision of various acts pertaining to industrial wastes / effluents, introduction to environmental impact assessment and environmental and water audit.	06
Textbooks		

1. Waste Water Treatment: Rao &Datta, Oxford & IBH Publishing Co.
2. Industrial Water Pollution Control: W W Eckenfelder Jr, Mc Graw Hill
3. Industrial Water Pollution Management: E F Gurnham, John Wiley
4. Biological Waste Treatment: Eckenfelder & Connor Pergamon Press
5. Theories and Practices of Industrial Waste Treatment: AdisonWesley
6. Pollution Control in Process Industries: S P Mahajan , Tata mcgraw Hill
7. Industrial Waste: W Rudolfs ,(Ed), L E C Publishers Inc
8. The Treatment of Industrial Wastes: E D BesselievreMcgraw Hill
9. Industrial Waste Disposal: R D Ross , (Ed), Reinhld Bok Corporation
10. Standard Methods of examination of water and wastewater, APHA, 2010

PEIV Engineering Risk and Uncertainty PE-BTC752

Course Code	Course Name
PE-BTC752	Engineering Risk and Uncertainty

Course pre-requisites	

Course Objectives

The main objectives of the course are
1.To describe the concept of risk and uncertainty.
2. To understand basics of Risk management.
3. To summarize the students about various techniques of mathematical models based on stochastic and statistical methods for risk management.

Course Outcomes

At the end of the course the students will be able to

1. Understand and explain the fundamental concepts of risk and uncertainty in civil and construction engineering projects.
2. Apply appropriate risk mitigation strategies and assess risk control measures across the project lifecycle.
3. Identify, analyse and prioritise risks using tools such as RAMP, risk registers, FEMA, and risk priority numbers.
4. Use stochastic models and decision analysis methods (e.g., decision trees, sensitivity analysis, Monte Carlo simulation) for risk evaluation.

CO-PO-PSO Mapping

CO \ PO/PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	-	-	-	2	2	1	-	1	1	1	2	3
CO2	3	3	3	1	2	2	3	1	1	1	2	2	3	3
CO3	3	3	3	2	2	1	2	1	1	1	2	2	3	3

Course Content

Module No.	*Details*	*Hrs.*
1	Basic concept of Risk & Uncertainty, Risk in Civil engineering and mainly in construction,Difference between Risk and Uncertainty, Types of risks in constructions. Importance of Risk, Steps in Risk Management.Integrated risk management.	6
2	Performance Measures, Scope of risk control during project life cycle. Risk Mitigation – by elimination, reducing, transferring, avoiding, absorbing or pooling. Residual risk, Coverage of risk through various policies, role of insurance in risk management.	6
3	Risk analysis and Management for projects (RAMP) Risk analysis in construction projects, Risk Registers, Risk priority number, Risk identification, and analysis& response measures. Failure effect mode analysis (FEMA)	6
4	Use of mathematical models based on stochastic and statistical methods, Probability Risk Assesment.	5

5	Decision making under Risk & Uncertainty, Sensitivity analysis, Break even analysis, Scenario analysis and Decision tree analysis. Risk profile method, Certainly equivalent method; risk adjusted discount rate method, certainity index method,three point estimated method.	7
6	Concept of simulation, Monte Carlo simulation, Use of simulation in risk ide ntification, analysis and mitigation.	6
7	Introduction to PPP projects and Hybrid Annuity model, Typical risks in road construction projects, Risks in PPP contract. Mitigation of Risks in roads and PPP contract.	6

Text Books

1. Project Risk Analysis And Management Guide By John Bartlett APM Publishing Limited, 2004 2nd Edition
2. Industrial Engineering And Management Of Manufacturing Systems.- Dr. Surendra Kumar Satya Prakashan
3. RAMP Handbook By Institution Of Civil Engineers And The Faculty And Institute Of Actuaries Thomas Telford Publishing, London.
4. Construction Engineering And Management – Seetharaman.
5. Projects Planning Analysis Selection Implementation And Review – Prasanna Chandra.
6. Construction Project Management, K. K. Chitkara, Tata Mcgraw Hill Publ.
7. Construction Management Practice, Dr.V.K.Raina, Shroff Publ.
8. Projects, Prasanna Chandra, Tata Mcgraw Hill Publ
9. 9.Reliability Principles and practices-Calabro-McGraw Hill Book Company, 1963
10. Shrivastava, Shenoy & Sharma, Quantitative Techniques for Managerial Decisions, Wiley, 1989.
11. Applied Statistics for Civil and Environmental Engineers by Kottegoda.- Stratford Books

PE IV Infrastructure Planning and Management [PE-BTC753]

Course Code	Course Name
PE-BTC753	Infrastructure Planning and Management

Course pre-requisites	

Course Objectives

The objectives of this course are

1. To describe the role of Infrastructure in the development of nation.
2. To understand basics of infrastructure planning and management.
3. To summarize the students about emerging trends in infrastructure.

Course Outcomes

Upon successful completion of the course, students will be able

1. Understand the role and classification of infrastructure, and assess the demand–supply scenario with reference to Indian conditions.
2. Apply appropriate techniques and models to forecast and quantify infrastructure requirements using socio-economic, land use, and econometric indicators.
3. Evaluate infrastructure planning strategies and prioritise development regions through integration at local, regional, and national levels.
4. Analyse infrastructure management systems and assess current practices, including Public-Private Partnership (PPP), stakeholder concerns, and risk management.

CO-PO-PSO Mapping

CO \ PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	–	–	2	3	1	–	1	1	1	2	3
CO2	3	3	2	2	2	2	3	1	1	1	2	2	3	3
CO3	3	3	3	2	2	2	3	1	1	1	2	2	3	3
CO4	3	3	3	2	2	2	3	1	1	2	3	3	3	3

Course Content

Module No.	*Details*	*Hrs.*
1	Introduction: Definition of basic terminologies, role of infrastructure in economic development, types of infrastructure, measurement of infrastructure capacity, bases for quantification of demand and supply of various types of infrastructure, Indian scenario in respect of adequacy and quality.	06
2	Infrastructure Planning: Goals and objectives of infrastructure planning; Identification and quantification of the casual factors influencing the demand for infrastructure; review and application of techniques to estimate supply and demand for infrastructure	06

3	Infrastructure Planning: use of econometric, social and land use indicators and models to forecast the demand and level of service of infrastructure and its impact on land use; critical review of the relevant forecasting techniques	06
4	Infrastructure Planning: infrastructure planning to identify and prioritize preferred areas for development; Integration of strategic planning for infrastructure at urban, regional and national levels; case studies in infrastructure planning.	06
5	Infrastructure Management: Concepts, Common aspects of urban and rural infrastructure management systems; pavement and bridge management systems	06
6	Integrated infrastructure management, Case studies; Emerging trends in infrastructure, Overview of Public-Private Participation in infrastructure projects, Understanding stakeholders' concerns, regulatory framework, risk management in infrastructure projects,	06
7	Public policy for infrastructure: Sectoral Overview Highways, railways, waterways, airports, urban and rural infrastructure: roads, housing, water supply, sanitation – case study Example.	06

Text Books
1. Project Preparation, Appraisal, Budgeting, and Implementation: Prasanna Chandra, Tata McGraw Hill. 2. Project Management: K Nagrajan, New Age International Publishers.7th Edition, 2015. 3. Construction Engineering and Management of Projects (for Infrastructure and Civil works),S. C.Sharma, Khanna Publishers.2nd Edition 2011.

PEIV Risk and Value Management [PE BTC754]

Course Code	Course Name
PE-BTC754	Risk and Value Management
Course Pre Requisites	Construction Engineering and Management

Course Objectives

The main objectives of the course are

1. To understand the process of risk management in construction.
2. To identify the tools and techniques for risk assessment.
3. To know different methods of valuation
4. To understand the process of value management in construction along with different techniques for the evaluation of engineering alternatives

Course Outcomes

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

1. **Understand** the concepts of risk and uncertainty in construction projects and explain the complete risk management cycle including identification, assessment, response, and monitoring.
2. **Apply** tools and techniques such as FMEA, FMECA, decision tree analysis, and Monte Carlo simulation for analysing and mitigating risks in engineering projects.
3. **Demonstrate** an understanding of property valuation methods, including rent calculation, depreciation, and land/building valuation, and prepare standardised valuation reports.
4. **Evaluate** engineering projects using value engineering principles and economic appraisal techniques like NPV, IRR, BCR, and life cycle costing, with consideration of the time value of money.

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO
CO1	3	2	1	1	–	2	2	1	–	1	2	2	2
CO2	3	3	2	2	2	2	3	1	1	1	2	2	3
CO3	3	2	2	1	2	2	–	1	1	2	3	2	2
CO4	3	3	3	2	2	2	2	1	–	2	2	3	3

Course Content

Module No.	*Details*	*Hrs.*
1	Concept of Risk & Uncertainty, Types of risks in construction projects. Process of risk management- identification of risk, assessment, risk response, risk monitoring and control, Risk Mitigation – by elimination, reducing, transferring, avoiding, absorbing or pooling, risk management feedback and lessons learnt.	6
2	Scope of risk control during project life cycle. Residual risk, contingency risk, Role of insurance in risk management, Integrated risk management. Risk Registers Risk Registers, Risk priority number,	6

3	Decision making under Risk & Uncertainty, Risk identification tools and techniques, qualitative risk assessment and quantitative risk assessment, Sensitivity analysis, Break even analysis, Scenario analysis and Decision tree analysis, Use of simulation in risk identification, analysis and mitigation. Failure Mode and Effect Analysis (FMEA), Failure Mode Effect and Criticality Analysis (FMECA)	6
4	Introduction to PPP projects and Hybrid Annuity model, Typical risks in road construction projects, Risks in PPP contract. Mitigation of Risks in roads and PPP contract.	4
5	Valuation- Purpose of valuation, factors affecting value of an asset, types of value, concept of freehold and leasehold property, estimation versus valuation, different methods to calculate depreciation, rent fixation of a building, methods of valuation of land and building. Valuation Report, contents, standard formats, Case study of any one valuation Report.	8
6	Value Engineering- Meaning of value, difference between valuation and value engineering, factor contributing to value such as aesthetic, ergonomic, technical, and economic. Reasons for unnecessary costs, basic and secondary functions, FAST diagram, Element of value engineering Job Plan.	6
7	Time value of money, different techniques for adjusting time value of money, life cycle costing, different techniques of economic appraisal of projects such as payback period, Rate of return method, NPV, BCR, IRR. Evaluation of Engineering alternatives with Present worth method, Future worth method, equivalent annual worth comparison method and DCF method	6
Recommended Books		

1. Project Management, R Panneerselvam, & P. Senthilkumar, PHI Learning Pvt. Ltd. 2013, third edition.
2. Engineering Economics and Costing-by Sasmita Mishra, PHI Learning Pvt. Ltd. 2013, second edition.
3. Managing Risk In construction Projects-By N. J. Smith, T Merna, P Jobling, Blackwell publishing 2006, Second Edition.
4. Value & Risk Management A guide To Best Practice- M. F. Dallas, Blackwell publishing 2006, Second Edition.
5. Sustainable Value Management for Construction Projects- A. E. Oke, C.O. Aigbavboa Springer 2017.
6. Project Risk Analysis And Management Guide By John Bartlett APM Publishing Limited, 2004 2nd Edition
7. RAMP Handbook By Institution Of Civil Engineers And The Faculty And Institute Of Actuaries Thomas Telford Publishing, London.
8. Contemporary Project Management, Timothy J. Kloppenborg | Vittal S. Anantatmula | Kathryn Wells, Cengage Publishers, 2019.
9. An Introduction to Management Science: Quantitative Approaches to Decision Making,
10. Projects Planning Analysis Selection Implementation And Review – Prasanna Chandra.
11. Construction Project Management, K. K. Chitkara, Tata Mcgraw Hill Publ.
12. Projects, Prasanna Chandra, Tata Mcgraw Hill Publ
13. Reliability Principles and practices-Calabro-McGraw Hill Book Company, 1963

PEIVGround Improvement Techniques [PE-BTC773]

Course Code	Course Name
PE-BTC773	Ground Improvement Techniques

Course pre-requisites	Soil Mechanics

Course Objectives

The objectives of this course are

1. To understand the necessity and importance of ground improvement techniques.
2. To learn the principles behind mechanical stabilization, physical and chemical ground improvement methods, their suitability and limitations

Course Outcomes

Upon successful completion of the course, students will be able to

1. Demonstrate an understanding of mechanical and chemical methods available for improvement of granular and clayey soils
2. Understand the application of slope reinforcement techniques such as use of geosynthetics, and methods of stabilizing rock mass
3. Evaluate the suitability of the ground improvement technique applicable to a particular site and effectively use it to engineer an economical solution.
4. Analyse real-world ground improvement projects through case studies and evaluate the effectiveness of applied methods.

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	–	–	–	–	1	–	2	3	2
CO2	3	2	3	2	3	–	–	–	–	1	–	2	3	2
CO3	3	2	3	2	3	–	–	–	–	1	–	2	3	2
CO4	3	2	2	2	3	–	–	–	–	1	–	2	3	2

Course Content

Module No.	Details	Hrs.
1	Need for engineered ground improvement, different types of difficult soils, classification of ground modification techniques, objectives of soil improvement	03
2	Densification methods for granular soils, vibratory methods, dynamic compaction	06
3	Ground improvement by drainage and de-watering, pre-loading, vertical drains and design, vacuum consolidation, stone columns construction methods	09
4	Cement stabilization, cement columns, lime columns, Compaction grouting, and jet grouting	06
5	Reinforced soil slopes, reinforced earth walls, use of geosynthetics for reinforcement, drainage and seepage control using geosynthetics	09
6	Soil nailing, ground anchors, rock bolting, shotcreting	05
7	Case studies in ground improvement	04

Recommended Books
1. Hausmann, M. R. Engineering Principles of Ground Modifications. McGraw-Hill, USA, 1990. 2. Purushothama Raj, P. Ground Improvement Techniques. Laxmi Publications, India, 1999. 3. Nayak, N. V. Foudnation Design Manual. 7th Edition, Dhanpat Rai Publications, India, 2018. 4. Relevant journal and conference papers for case studies. 5. Relevant IS codes

OEII Economic policies of India OE-BTC711

Course Code	Course Name
OE-BTC711	Economic policies of India

Course pre-requisites	

Course Objectives

The objectives of this course are

1. To make Engineering students aware about the economic policy of India to become a good project manager.

Course Outcomes

Upon successful completion of the course, students will be able

2. **Understand** the structure of India's economic planning and key institutions such as RBI, NITI A ayog, and the Ministry of Finance.
3. **Identify and explain** major economic policies of India (industrial, trade, fiscal, agricultu ral, monetary) and their relevance to infrastructure development.
4. **Evaluate** the role of government policies in promoting economic growth, income redistri bution, and technological advancement in the construction sector.
5. **Analyse** how macroeconomic and stabilisation policies (e.g. inflation control, money sup ply, interest rates) impact civil engineering projects and financial planning.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	–	1	1	3	2	2	–	1	–	3	–	3
CO2	2	2	–	1	1	3	2	2	–	1	–	3	–	3
CO3	2	2	–	1	1	3	2	2	–	1	–	3	–	3
CO4	2	2	–	1	1	3	2	2	–	1	–	3	–	3

Course Content

Module No.	*Details*	*Hrs.*
1	Introduction: Brief introduction about RBI, NITI Aayog, Economic planning, Ministry of Finance, Indian federal system.	03
2	Economic policies of India: Industrial Policy, Trade Policy, Monetary Policy, Fiscal Policy, Indian Agricultural Policy, National Agricultural Policy, Industrial Policies, International Trade Policy, Exchange Rate Management Policy, and EXIM Policy.	06
3	Policies designed to create economic growth: Policies related to development economics, Government policies on water conservation and water resources planning and management, Disaster management.	06
4	Policies dealing with the redistribution of income, property and/or wealth.	05

5	Regulatory policy, anti-trust policy, industrial policy and technology-based economic development policy.	06
6	Macroeconomic stabilization policy: Stabilization policy,money supply, inflation, Monitory policies, Money in circulation, interest rates.	06
7	Case studies: Economic policies of India and Construction sector.	04

Text Books
1. https://www.rbi.org.in/ 2. http://www.niti.gov.in/ 3. https://dea.gov.in/

OEII Entrepreneurship, Innovation and Design thinking OE-BTC712

Course Code	Course Name
OE-BTC712	Entrepreneurship, Innovation and Design thinking

Course pre-requisites	

Course Objectives

Enable graduates to:
1. Innovate based on needs.
2. Write and execute a business plan.
3. Pitch for a start up.

Course Outcomes

At the end of the course the student will be able to:
1. Identify and evaluate basic societal needs and the significance of community involvement, partnerships, and policy frameworks in driving innovation..
2. Interpret innovation and design strategies based on diverse social, economic, and cultural contexts.
3. Apply human-centred design and innovation principles, from need identification to prototyping
   and deployment of impactful solutions.
4. Develop a business model, formulate a business plan, and create an effective pitch for launching an entrepreneurial venture.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	2	2	2	2	2	2	2	3	1	3
CO2	2	2	2	2	3	2	2	2	2	2	2	3	2	3
CO3	2	2	3	2	3	2	2	2	2	2	2	3	2	3
CO4	2	2	3	2	3	2	2	2	2	3	3	3	2	3

Course Content

Module No.	*Details*	*No of lectures*
SECTION 1. - Innovation		
1	Understanding Innovation Curve Identifying opportunities for innovation	04
2	Understanding concepts – Prototyping, Minimum Viable Product (MVP), validating with early adopters Bring forth ideas to life using prototypes to test with real users and identify promising solutions to implement	06
SECTION 2. - Design Thinking		

3	Introduction to human-centered Design - Create innovative solutions to real-world challenges, Appreciating User Needs & Social Context Conduct user interviews and synthesize learning to uncover insights	04
4	Design thinking models;Integration of design and technology for impact perspective; Understanding minimum value proposition Case Studies Sanitation, Education, Health, Food, Insurance and finance technology	08
SECTION 3. - Entrepreneurship		
5	Immersive Learning Exercises for an entrepreneurial venture Concepts of ideation and experimentation, problem validation and	06
	hypothesis testing, prototype creation and viability	
6	Quick Introduction to key concepts – Cost, Revenues, Profit, cash flow, funding/investments, Business Model types – B2C, B2B, B2B2BC, and importance of knowing what business you are in.	03
7	Writing a business plan; Making pitch to investors And Launching a start up	06

Quick Mandatory Reads

The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Eric Reis, 2011Crown Business Publishing.

Zero to One: Notes on Startups, or How to Build the Future, Peter Theil with Blake Masters, 2014, Crown Business Publishing.

The McKinsey Way Hardcover – 1999, Ethan Raisel, Mc Graw Hill Publication.

References

1. Innovation and Entrepreneurship by Peter F. Drucker (Special Indian Edition). Routledge.
2. Entrepreneurship Development by S.S. Khanka. S. Chand Publishers.
3. Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School, 2013, Wiley Publications.
4. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, 2009.

OEII Disaster Management and Preparedness OE-BTC713

Course Code	Course Name
OE-BTC713	Disaster Management And Preparedness

Course pre-requisites	Environmental Science (mandatory course), Surveying and Geomatics

Course Objectives

The objectives of this course are to:

1. Introduce students to the fundamental concepts of disasters, hazards, vulnerabilities, and risks.
2. Help students understand the causes and impacts of various natural and human-made disasters.
3. Familiarise students with disaster management cycles, frameworks, and institutional mechanisms.
4. Develop the ability to assess risk and vulnerability using geospatial and analytical tools.
5. Encourage sustainable and responsible decision-making in disaster preparedness, mitigation, and recover

Course Outcomes

Upon successful completion of the course, students will be able

1. Identify different types of natural and manmade disasters and understand key terms like hazard, vulnerability, and risk.
2. Explain how development activities and environmental changes can increase disaster risks.
3. Apply disaster management principles and recognise the roles of individuals, communities, and governments in disaster response and recovery.
4. Use tools like GIS and risk assessment techniques to evaluate hazards and plan for disaster preparedness.

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	–	–	–	2	3	3	–	–	–	2	2	2
CO2	2	2	–	–	–	3	3	3	–	–	–	2	2	2
CO3	3	3	2	2	1	2	3	2	–	1	–	3	3	3
CO4	3	3	2	2	2	3	3	3	1	2	1	3	3	3

Course Content

Module No.	*Details*	*Hrs.*

1	**Introduction** Concepts and definitions: disaster, hazard, vulnerability, risk, severity, frequency and details, capacity, impact, prevention, mitigation **Disasters –** Disasters classification; natural disasters (floods, drought, avalanches, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, flash floods, cloud burst, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); Disasters in global context, hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility, recent case studies	09
2	**Disaster Impacts –** Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.	06
3	**Disaster Risk Reduction (DRR) –** Disaster management cycle – its phases; prevention – significance of preventive action and measures, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.	11
4	**Disasters, Environment and Development –** Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.) – case studies, sustainable and environmental friendly recovery; reconstruction and development methods.	09
5	**Hazard, Vulnerability Risk Assessment (HVRA)** Definitions; risk, hazard, vulnerability, severity, exposure, Rating scale or classification of levels of exposure, vulnerability, threat, hazard, Hazard probability, Risk calculation, Hazard mapping, Risk mapping - use of geoinformatics for HVRA	07

Text Books

1. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
2. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation

Reference Books

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.

OEII Engineering System and Development OEBTC714

Course Code	Course Name
OE-BTC714	Engineering System and Development

Course pre-requisites	

Course Objectives

Objectives of the course are :

1. Introduce students to the social role and ethical responsibility of engineers in promoting equity, efficiency, and sustainability.
2. Enable students to understand interdisciplinary approaches to solving societal problems through engineering.
3. Familiarise students with development indicators and socio-economic paradigms.
4. Provide insights into rural and urban systems and the role of engineers in improving infrastructure and services.
5. Equip students to analyse and solve real-life problems through field-based project work.

Course Outcomes

At the end of the course the student will be able to:

1. Explain the role and responsibilities of engineers in society and their impact on equitable and sustainable development.
2. Interpret various development indicators like HDI and apply the values of equity, efficiency, and sustainability to engineering practice.
3. Compare rural and urban systems and evaluate the impact of engineering interventions on these sectors.
4. Apply interdisciplinary knowledge to analyse and develop solutions for real-world problems through case study/project work.

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	3	3	2	1	2	2	3	2	3
CO2	3	2	2	1	2	3	3	3	2	2	2	2	3	3
CO3	3	2	2	2	3	3	3	3	2	2	2	3	3	3
CO4	2	3	3	3	3	3	2	2	2	2	2	3	3	3

Course Content

Module No.	*Details*	*Hrs.*
1	Module 1. Engineer and Society: Basics of Engineering Profession, engineering services, understanding the values of equity, efficiency and sustainability.	5
2	Module 2. The Engineer as a change agent: Interdisciplinary, the need for design and synthesis	6

3	Module 3. Development Indices: Human Development Index (HDI) and Organization for Economic Co-operation and Development (OECD) indices, The data needed to compute these, Core values of equity, efficiency and sustainability, Paradigms of development.	7
4	Module 4: Role of Engineer as a change agent: Understanding Rural and Urban divide and its economy, Wholesale vs. Retail markets, the role of knowledge, practices, science and technology.	6
5	Module 5: A Sectoral Engineering System. Example: Drinking water, Irrigation, Electricity, Diesel pumps, non-conventional energy, solar system, community services, water pipe networking, education, health services, road networking, road development, drainage system, energy audit, telecommunication, small scale	6
	industries, agricultural sector, effect of seasonal variation on development, understanding service and manufacturing sector, understanding local and global scenario, any other as per engineering sector (Civil, Mechanical, Electrical, Computer, Agricultural, Health etc.)	
6	Module 6: Project through case studies (Rural/Urban): Framing the project, Understanding the demand, needs analysis, Studying the options available, measurement of social and economic parameters as inputs, The activities and the analysis, picking case-study, analyzing, solving and reporting solutions to the stakeholders.	6

Text Books

References:

https://unfoundation.org

http://www.undp.org

http://hdr.undp.org

http://www.oecd.org

http://unnatbharatabhiyan.gov.in

http://www.ctara.iitb.ac.in

https://sustainabledevelopment.un.org

Project Stage II [PR-BTC701]

Course Code	Course Name
PR-BTC701	Project Stage-II
Course Pre-Requisites	Course pre-requisites: Recommended – all courses till semester VI

Course Objectives

Objectives of the course is:

- Apply knowledge of engineering principles to address real-world societal challenges.
- Conduct ethical and thorough literature surveys for identifying and addressing engineering problems.
- Develop empathy-driven problem formulation, analysis, and effective project execution

Course Outcomes

At the end of the course the student will be able to:

1. Use knowledge from previous courses to review literature and find solutions to engineering problem s.
2. Apply their understanding to design, formulate, or fabricate a project as part of a team.
3. Analyse resources and choose the most suitable ones for effective project execution.
4. Work ethically in a team and effectively present the project using professional communication skills.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	–	–	–	2	2	2	3	3	3
CO2	3	2	2	2	2	–	–	–	2	2	2	3	3	3
CO3	3	2	2	2	2	–	–	–	2	2	2	3	3	3
CO4	3	2	2	2	2	–	–	–	3	3	3	3	3	3

Course Content

Module No.	*Description*	*Hrs.*
1	Student shall study the topic of project work in terms of data collection, analysis, and inferencing. The student shall prepare an interim report and shall present a seminar on the work done at the end of semester. There would be one or more evaluation throughout the semester by committee of Faculty members	2+8(Self study)

VA Environmental Impact Assessment and Management

[VA-BTC772]

Course Code	Course Name
VAC-BTC772	Environmental Impact Assessment and Management

Course pre-requisites	EVS

Course Objectives
The objectives of this course are 1. Enable graduates to identify attributes for EIA 2. Enable graduates to prepare EIA reports 3. Enable graduates to formulate Environmental Management Plans
Course Outcomes
Upon successful completion of the course, students will be able 1. Identify environmental attributes for the EIA study 2. Identify methodology and prepare EIA reports 3. Specify methods for prediction of the impacts 4. Formulate environmental management plans
Course Content

Module No.	*Details*	*Hrs.*
1	Introduction: The Need for EIA, Indian Policies Requiring EIA, The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.	04
2	Identifying The Key Issues: Key Elements of an Initial Project Description and Scoping, Project Location(s), Land Use Impacts, Consideration of Alternatives, Process selection: Construction Phase, Input Requirements, Wastes and Emissions, Air Emissions, Liquid Effluents, Solid Wastes, Risks to Environment and Human, Health, Socio-Economic Impacts, Ecological Impacts, Global	04

	Environmental Issues.	
3	EIA Methodologies: Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods, Environmental index using factor analysis, Cost/benefit analysis, Predictive or Simulation methods. Rapid assessment of Pollution sources method, predictive models for impact assessment, Applications for RS and GIS.	04
4	Reviewing The EIA Report: Scope, Baseline Conditions, Site and Process alternatives, Public hearing. Construction Stage Impacts, Project Resource Requirements and Related Impacts, Prediction of Environmental Media Quality, Socio-economic Impacts, Ecological Impacts, Occupational Health Impact, Major Hazard/ Risk Assessment, Impact on Transport System, Integrated Impact Assessment.	04
5	Review of EMP And Monitoring: Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, Stipulating the Conditions, what should be monitored? Monitoring Methods, who should monitor? Pre-Appraisal and Appraisal.	04
6	Case Studies: Preparation of EIA for developmental projects-Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Nuclear fuel complex, Highway project, Sewage treatment plant, Municipal Solid waste processing plant, Tannery industry.	08
7	ISO 14001	02

Term Work

Term work shall comprise of

Report on assignments including problems based on the above syllabus shall be submitted as term work. One assignment on each module is to be submitted.

Audit will be granted on submitting the assignments and case studies

Text Books

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill Pub. Co., 1997

2. David P. Lawrence, Environmental Impact Assessment: Practical Solutions to Recurrent Problems, John Wiley & Sons, 2003
3. Hosetti, B. B., Kumar A, Eds, Environmental Impact Assessment & Management, Daya Publishing House, 1998
4. UNESCO, Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development, UNESCO/UNEP, Paris, 1987
5. Anjaneyulu.Y., and Manickam. V., Environmental Impact Assessment Methodologies, B.S. Publications, Hyderabad, 2007
6. Wathern.P., Environmental Impact Assessment- Theory and Practice, Routledge Publishers, London, 2004

VA Conventional and Non-conventional materials in Highway subgrade [VABTC773]

Course Code	Course Name
VAC-BTC773	Conventional and non conventional materials in Highway subgrade

Course pre-requisites	Highway Engineering

Course Objectives

1. To Explain the Laboratory & Field Procedure for Testing of Subgrade,
2. To discuss use conventional & Nonconventional Materials in Subgrade.

Course Outcomes

Upon successful completion of this course, students will be able to :

1. Learn how to conduct static and cyclic triaxial test & how to use these data in pavement design. How to conduct static & cyclic plate bearing test, CBR test in field & lab.
2. Learn about different ground improvement technique, use of different stabilizers like, lime, fly ash, fibres in highway subgrade

Course Content

Module No.	***Details***	***Hrs.***
1	Subgrade: Functions, importance of subgrade soil properties on pavement performance, subgrade soil classification for highway engineering purpose soils as per PRA system, revised PRA system, Burmister system, Compaction System.	10
2	Test on subgrade soils: Static and cyclic triaxial test on subgrade soils, resilient deformation, Resilient strain, resilient modulus. CBR test, effect of lateral confinement on CBR and E – value of Subgrade soil. Static and cyclic plate load test, estimation of modulus of subgrade reaction, correction for plate size, correction for worst moisture content	06
3	Ground Improvement Technique: Different method of soil stabilization, use of geo- textile, geogrid and fibres, lime, fly ash in 3 highway subgrade. Vertical sand drain: design criteria, construction 08 and uses.	08

Text Books
1. Principles of Pavement Design, Second edition, 1975: Yoder, E. J., John Wiley & Sons, Inc., New York. 2. Concrete Roads: HMSO, Road Research Laboratory, London. 3. Highway Engineering: Khanna and Justo, New Chand and Brothers, Roorkee. Principles and Practices of Highway Engineering: Dr. L.R Khadiyali and Dr.N.B.York Lal Khanna Publication, New Delhi

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute under Mumbai University) Andheri (W), Mumbai – 400058

SEM – VIII
Regulation 22

Course Contents for Regulation 22 for Sem-VIII

OE III Human Resources Development and Organizational Behavior

OE-BTC812

Course Code	Course Name
OE-BTC812	Human Resources Development and Organizational behavior

Course pre-requisites	NA

Course Objectives

The objectives of the course are:

1. Introduce the fundamentals of Human Resource Development and its role in organisation al effectiveness.
2. Equip students with knowledge of HRD interventions such as mentoring, counselling, an d competency mapping.
3. Provide an understanding of career development strategies and learning organisations.
4. Highlight the ethical dimensions of HRD and its future role in innovation and talent man agement.
5. Explore foundational concepts in organisational behaviour and group dynamics, includin

Course Outcomes

Upon completion of the course, the students will be able to:

1. Explain the HRD process, challenges, and methods of implementation in organisational s ettings.
2. Describe HRD interventions like mentoring, counselling, stress management, and compet ency mapping.
3. Apply concepts of career planning and development to individual and organisational cont exts.
4. Analyse individual and group behaviour in organisations, including leadership, motivation, and organisational change.

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	–	1	–	2	2	2	–	2	1	2	–	–
CO2	2	2	–	–	–	2	2	2	–	2	1	2	–	–
CO3	2	2	1	1	–	2	1	2	1	2	2	2	–	–
CO4	3	3	2	2	–	2	2	2	2	3	3	2	–	–

Course Content

Module No.	*Details*	*Hrs.*

1	**Introduction to Human Resource Development:** Emergent of HRD, Critical roles, challenges, HRD Process Model: identification of needs and Design and development of HRD programs, Process Model: Methods of Implantation, Evaluation of programs.	06
2	**HRD interventions: Mentoring for employee development:** Role of mentoring in development, Employee counseling for HRD: Overview of counseling programs, employee assistance program, stress management, employee wellness and health promotion, Competency framework of HRD: steps in competency mapping.	06
3	**Career Planning, management, and development:** Career development stages and activities, role of individual and organization in career planning, Organizational Learning, and learning organizations.	06
4	**The future of HRD and Ethics:** Research, practice and education of HRD for innovation and talent development and management, Role of HRD in developing ethical attitude and behavior and development, Ethical problems with HRD roles.	06
5	**Organizational Behavior:** Introduction, What is organizational Behavior? Diversity in Organizations, Attitudes and Job Satisfaction, Emotions and Moods, Personality and Values, Perception and Individual Decision Making, Motivation Concepts.	06
6	**Foundations of Group Behavior:** Understanding Team work, Communication, Leadership, Power and Politics, Conflict and Negotiation, Foundations of Organization Structure, Organizational Culture, Human Resource Policies and Practices, Organizational Change and Stress Management.	06
7	Case Studies: Based on survey done with various industries.	06

Text Books

1. Werner and DeSimone (2006). Human Resource Development. Thomson Press, Network.
2. David Mankin (2009). Human Resource Development, Oxford University Press: Delhi.
3. Rosemary Harison (2000). Employee Development. University Press: Hyderabad.
4. John P. Wilson (2005). Human Resource Development. Kogan Page.
5. Stephen P. Robbins and Timothy A. Judge (2013) Organizational behavior, Copyright © 2013, Pearson Education, Inc., publishing as Prentice Hall.

OEIII Disaster Management and Preparedness OE-BTC814

Course Code	Course Name
OE-BTC814	Disaster Management And Preparedness

Course pre-requisites	Environmental Science (mandatory course), Surveying and Geomatics

Course Outcomes

Upon successful completion of the course, students will be able to:

1. Identify and classify various types of disasters/hazards and understand related key concepts such as risk and vulnerability.
2. Analyse the relationship between disasters and development, and understand their impacts on society and environment.
3. Apply disaster management strategies including risk reduction, preparedness, and response, with awareness of ethical and societal responsibilities.
4. Use spatial tools and geoinformatics techniques to assess hazard risk, vulnerability, and exposure.

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	–	–	–	2	3	3	–	1	–	2	2	2
CO2	2	2	1	–	–	3	3	3	–	1	–	2	2	2
CO3	2	2	2	2	–	3	3	3	1	2	1	3	2	3
CO4	2	2	2	2	3	2	2	2	–	1	–	2	3	3

Course Content

Module No.	*Details*	*Hrs.*
1	**Introduction** Concepts and definitions: disaster, hazard, vulnerability, risk, severity, frequency and details, capacity, impact, prevention, mitigation **Disasters –** Disasters classification; natural disasters (floods, drought, avalanches, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, flash floods, cloud burst, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); Disasters in global context, hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility, recent case studies	08

2	**Disaster Impacts –** Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.	05
3	**Disaster Risk Reduction (DRR) –** Disaster management cycle – its phases; prevention – significance of preventive action and measures, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority	10
4	**Disasters, Environment and Development –** Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.) – case studies, sustainable and environmental friendly recovery; reconstruction and development methods.	08
5	**Hazard, Vulnerability Risk Assessment (HVRA)** Definitions; risk, hazard, vulnerability, severity, exposure, Rating scale or classification of levels of exposure, vulnerability, threat, hazard, Hazard probability, Risk calculation, Hazard mapping, Risk mapping - use of geoinformatics for HVRA	05

Text Books
1. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication. 2. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
Reference Books
1. http://ndma.gov.in/ (Home page of National Disaster Management Authority) 2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs). 3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.

OEIII Environmental Impact Assessment OE-BTC815

Course Code	Course Name
OE-BTC815	Environmental Impact Assessment

Course pre-requisites	Environment related course in respective branch

Course Objectives

The objectives of this course are

1. Enable graduates to identify attributes for EIA
2. Enable graduates to conduct EIA study
3. Enable graduates to formulate Environmental Management Plans.

Course Outcomes

Upon successful completion of the course, students will be able

1. Identify environmental attributes for the EIA study
2. Understand methodology and conduct EIA study
3. Specify and Use methods for prediction of the impacts
4. Formulate environmental management plans.

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	–	–	–	2	3	3	–	–	–	2	2	2
CO2	3	3	2	2	1	2	3	2	–	1	–	3	3	3
CO3	3	3	3	2	2	2	2	2	–	1	–	3	3	2
CO4	2	2	2	2	2	3	3	3	1	2	1	3	3	3

Course Content

Module No.	*Details*	*Hrs.*
1	Introduction: The Need for EIA, EIA notification and its emergence ; EIA notification 2006 and its subsequent amendments The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements. , Consent to establish and operate	6

2	Identifying The Key Issues: Key Elements of an Initial Project Description and Scoping, Project Location(s), Land Use Impacts, Consideration of Alternatives, Process selection: Construction Phase, Input Requirements, Wastes and Emissions, Air Emissions, Liquid Effluents, Solid Wastes, Risks to Environment and Human, Health, Socio-Economic Issues and Management, Ecological Impacts including biodiversity, Global Environmental Issues.	6
3	EIA Methodologies: EIA methodology (as per EIA 2006 notification_ impact identification, impact measurement, impact interpretation & Evaluation, impact communication, development of Leopold Matrix, predictive models for impact assessment, Applications for RS and GIS. Role of consultants, NABET, QCI	8
4	Reviewing Contents of EIA Report: Scope, Baseline Conditions, Site and Process alternatives, Public hearing. Construction Stage Impacts, Project Resource Requirements and Related Impacts, Prediction of Environmental Media Quality, Socio-economic Impacts, Ecological Impacts, Occupational Health Impact, Major Hazard/ Risk Assessment, Impact on Transport System, Integrated	6
6	Case Studies: Preparation of EIA for developmental projects-Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant,.	5
7	Case Studies :Nuclear fuel complex, Highway project, Sewage treatment plant, Municipal Solid waste processing plant, Tannery industry, Construction Projects	5

Text Books

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill Pub. Co., 1997
2. David P. Lawrence, Environmental Impact Assessment: Practical Solutions to Recurrent Problems, John Wiley & Sons, 2003
3. Hosetti, B. B., Kumar A, Eds, Environmental Impact Assessment & Management, Daya Publishing House, 1998
4. UNESCO, Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development, UNESCO/UNEP, Paris, 1987
5. Anjaneyulu.Y., and Manickam. V., Environmental Impact Assessment Methodologies, B.S. Publications, Hyderabad, 2007
6. Wathern.P., Environmental Impact Assessment- Theory and Practice, Routledge Publishers, London, 2004
7. EIA notification (2006)
8. EIA manuals of different sectors (available online)

Internship [IN-BTC801]

Course Code	Course Name
IN-BTC801	Internship

Course Objectives
The objectives of the internship course are to: 1. Provide students with hands-on experience in an industrial or professional environment. 2. Bridge the gap between academic knowledge and real-world engineering practice. 3. Enable students to observe and participate in professional work culture, ethics, safety, and communication. 4. Promote understanding of roles, responsibilities, and interdisciplinary collaboration in engineering projects.
Course Outcomes
Upon successful completion of the course, students will be able 1. **Apply classroom knowledge** to solve basic engineering problems in a real work setting. 2. **Understand the structure and functioning** of engineering organisations and follow professional ethics. 3. **Prepare technical reports** and effectively **present** the work completed during the internship. 4. **Work collaboratively in teams** and manage tasks, time, with ethics and responsibilities efficiently.

CO-PO_PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	–	–	1	2	–	2	3	2
CO2	2	2	2	–	–	3	2	3	2	2	2	2	2	3
CO3	1	–	–	–	2	–	–	1	1	3	1	2	1	1
CO4	1	1	2	–	–	–	–	2	3	2	2	2	2	2

VA Low Cost Roads (Rural Roads) VABTC873

Course Code	Course Name
VA-BTC873	Low Cost Roads (Rural Roads)

Course pre-requisites	

Course Objectives
1. To acquire the knowledge about the selection of materials for construction and maintenance of Rural Roads. 2. To discuss the Geometric standard of rural roads and utilize the knowledge for implementation. 3. To identify and Implement the suitable technique for construction of rural roads
Course Outcomes
1.To produce the knowledge for deciding the geometric standards for rural roads. 2. To acquire the knowledge about the selection of materials for construction and maintenance of Rural Roads. 3. To identify and Implement the suitable technique for construction of rural roads.

Course Content

Module No.	*Details*	*Hrs.*
1	Rural Road Planning: classification of low cost roads, reason of low connectivity, Road alignments survey, factor affecting alignments, collection of data, preparation of project reports and drawing, PMGSY Approach for priority of construction and upgradation of roads	06
2	Geometric Design standards: Classification of rural roads, design speed, cross sectional elements, sight distance, horizontal and vertical curve, super elevation, extra widening, gradients	06
3	Pavement Materials subgrade soil classification for highway engineering purpose soils as per PRA system, revised PRA system, Grading requirements for aggregate, Grading of aggregate for WBM type bases and subbase construction, material selection for Bituminous Course of Rural Roads. Suitability of aggregate and binding material for construction of rural roads. CBR test, triaxial test on subgrade soils, plate bearing test, modulus of subgrade reaction, E – Value of subgrase soils	05
4	Design and construction of Rural Roads: Flexible pavement, semi rigid pavements, roller compacted concrete pavements; equipment's used	06

	during construction of roads	
5	Use of waste materials: Different methods of stabilization, use of fly ash in embankment and subgrade, construction of lime – fly ash – soil, construction of Lime – Fly ash bound macadam, lime fly ash concrete, roller compacted concrete pavement, dry lean concrete for base course. Use of other waste materials like rise husk ash, recycled concrete, iron and steel slag, natural and synthetic fibers, geotextile and geogrids	06
6	Maintenance of Rural roads: Distresses in flexible, rigid and semi-rigid pavements, routine maintenance, periodic maintenance, maintenance of earth road, gravel roads, WBM type roads, Bituminous macadam types roads etc.	04
7	Quality Control: Quality control test prior to construction and during construction on different pavement layer materials and pavement layers. frequency of tests,	04

Text Books

1. Yoder, E.J., John (1975); "Principle of pavement Design" Wiley & sons, Inc., New York.
2. S.K. Khanna, C.E.G. Justo & A. Veeraragavan (2014); "Highway Engineering",10th Edition new Chand & Brothers, Roorkee.
3. Guide lines for the design of flexiable pavement, IRC: 37-2012.
4. Guide lines for strengthening of flexible road pavements using Benkelman beam Deflection Technique. IRC: 81:1997.
5. Concrete Roads: HMSO, Road Research Laboratory, London.

Specification of Rural Roads – 2014, Ministry of Rural Development