Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING
Government Aided Autonomous Institute under Mumbai University
Andheri (W), Mumbai - 400058

Course Contents

Semester V and Semester VI

Working Professional

T. Y. B.Tech. CIVIL ENGINEERING with Minor (XXXX)

Academic Year: 2025-2026
Regulation 23

Bharatiya Vidya Bhavan's
Sardar Patel College of Engineering
Academic Year 2025-26

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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 development.

SEM – V

Regulation 23

Structural Analysis [PC-BTC501]

Course Code	Course Name
PC-BTC501	Structural Analysis

Course pre-requisites	Mechanics of Materials, Mechanics of Materials Lab, Structural Mechanics

Course Objectives

The objectives of this course are

1. To introduce the students to the method of analysis of three hinged arches, cables and suspension bridges.
2. To introduce the students to the concept of Influence line diagrams.
3. To introduce the students to the methods of finding absolute and relative deflections caused by loads, temperature changes and settlement of supports.
4. To introduce the students to the methods of analysis of indeterminate structures.
5. To prepare the base for the students to study other advanced structural engineering courses at a later stage.

Course Outcomes

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

1. Analyse three-hinged arches, cables and suspension bridges.
2. Draw influence line diagrams for determinate beams and pin-jointed frames and determine the maximum effect due to moving loads.
3. Calculate absolute and relative deflections caused by loads, temperature changes, settlement of supports and lack of fit and settlement of supports and to identify and determine the type and degree of indeterminacy in structures.
4. Analyse indeterminate beams using flexibility method and slope-deflection method.

CO-PO-PSO Mapping

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

Course Content

Module No.	Details	Hrs.
1	**Three hinged arches:** Determination of normal thrust, radial shear force and bending moment for three hinged parabolic arch.	06

	Determination of normal thrust, radial shear force and bending moment for segmental arch.	
2	**Cables and suspension bridges:** Simple suspension cable, minimum and maximum tensions in the cable supported at same and at different levels, anchor cable, cable supports, suspension cable with three hinged stiffening girder, shear force and bending moment at any section of the three hinged stiffening girder.	05
3	**Influence lines for statically determinate structures:** Influence lines for reaction, shear force and bending moment at a section in cantilever, simply supported and overhanging beams. Criteria for maximum shear force and bending moment at a section, absolute maximum shear force and bending moment under moving loads (udl and series of point loads) for simply supported beams.	06
4	**Influence lines for statically determinate structures:** Influence lines for axial force in pin jointed frames (trusses).	01
5	**Deflection of statically determinate structures:** Absolute and relative deflections caused by loads, temperature changes and settlement of supports, application to beams, pin jointed frames and rigid jointed frames. Absolute and relative deflections caused by lack of fit in pin jointed frames. **Degree of indeterminacy of structures:** Types of structures occurring in practice and their classification. Stable and unstable structure, degree of static and kinematic indeterminacy of structures.	07 04
6	**Introduction to analysis of indeterminate structures by force method:** Flexibility coefficients and their use in formulation of compatibility equations. Application of the flexibility method to analyse indeterminate beams.	06
7	**Introduction to analysis of indeterminate structures by displacement method:** Slope deflection method- application to indeterminate beams.	04

Recommended Books

1. Reddy C.S.(1999), "Basic Structural Analysis", Tata McGraw hill, ISBN 0070702764, 779 pages.
2. Junnarkar S.B. (2013), "Structural Analysis, Vol. II" Charotar Publishers ISBN: 9380358703, 986 pages.
3. Pandit and Gupta (1999), "Structural Analysis Vol. I", Tata McGraw Hill, ISBN: 0074634933, 679 pages.

4. L. S. Negi, and R. S. Jangid (1997), "Theory and Problems in Structural Analysis "Tata McGraw Hill, ISBN 0074623044, 828 pages.
5. D.S. Prakash Rao (1996), "Structural Analysis: A Unified Approach", Orient Blackswan ISBN: 8173710279, 672 pages.
6. John Benson Wilbur, Senol Utku, Charles H. Norris (1990), "Elementary Structural Analysis", Tata McGraw Hill, ISBN: 9780070659339, 829 pages.
7. Harold I. Laursen (2007), "Structural Analysis", Tata McGraw Hill Higher Education, ISBN: 0070366438, 468 pages.
8. Dr. B.N. Thadani And Dr. J. P. Desai (1964), "Modern Methods in Structural Analysis", Asia Publishing House,
9. C. K. Wang (2010), "Intermediate Structural Analysis", Tata McGraw hill. ISBN: 0070702497
10. Russell C. Hibbeler (2012), "Structural Analysis", Prentice Hall, ISBN: 013257053X, 695 pages.
11. Alexander Chajes (1982), "Structural Analysis", Longman Higher Education, ISBN: 0138534080, 352 pages.
12. Aslam Kassimali (2014), "Structural Analysis", Cengage Learning, ISBN 1133943896, 613 pages.

Hydrology & Water Resources Engineering [PC-BTC502]

Course Code	Course Name
PC-BTC502	Hydrology & Water Resources Engineering

Course pre-requisites	Fluid Mechanics, Hydraulic Engineering

Course Objectives

The objectives of this course are

1. To acquire the knowledge of hydrological parameters for the discharge calculations.
2. To summarize the fundamentals of water resources systems and to compute the various parameters required for the design of hydraulic structures
3. Describe different types of dams, spillways and other irrigation structures.
4. To appraise the various parameters for the design of hydraulic structure, cross drainage work, groundwater and well water system.
5. To discuss different methods of irrigation, water distribution systems and their suitability.

Course Outcomes

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

1. Measure and analyze rainfall, runoff and water losses.
2. Estimate the water requirements of crops.
3. Compute groundwater flow.
4. Design various hydraulic structures and irrigation systems.

CO-PO-PSO Mapping

COs	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
CO 1	3	-	2	2	2	-	-	-	-	-	-	2	3	3
CO 2	3	-	2	2	2	-	-	-	-	-	-	2	3	3
CO 3	3	-	2	2	1	-	-	-	-	-	-	2	3	3
CO 4	3	-	3	3	2	-	-	-	-	-	-	2	3	3

Course Content

Module No.	Details	Hrs.
1	**Introduction:** Hydrologic cycle, water-budget equation, applications in engineering, sources of data, Precipitation – forms of	07

	precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.	
2	**Abstractions from precipitation**: Evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltration indices.	07
3	**Runoff:** Runoff volume, flow duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India.	05
4	**Ground water and well hydrology:** Forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests.	05
5	**Water withdrawals and uses:** Water for energy production, water for agriculture, water for hydroelectric generation; flood control. Analysis of surface water supply, Water requirement of crops- Crops and crop seasons in India, cropping pattern, duty and delta; canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels, alluvial channels, Kennedy's and Lacey's theory of regime channels. Introduction to Canal outlets	07
6	**Hydraulic Structures:** Embankment dams: Classification, design considerations, Estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Arch and buttress dams, economic height of dam, and selection of suitable site.	07
7	**Spillways:** Components of spillways, types of gates for spillway crests; Reservoirs- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, Design of Ogee spillway and	04

	energy dissipater.	

Recommended Books
1. Dr. B.C. Punmia and Dr. Pande B.B. Lal (2009); "Irrigation and Water Power Engineering", Laxmi Publications Pvt. Ltd. New Delhi. ISBN-13 –9788131807637, 964p. 2. Dr. P.N. Modi (2008); "Irrigation Water Resources and Water Power Engineering" Standard Book House. Delhi. ISBN-13 –9788189401290. 1070p. 3. S. K. Garg (2009); "Irrigation Engineering and Hydraulics Structures", Khanna Publishers. Delhi. ISBN-13 –9788174090478. 1594p 4. Challa Satya Murthy (2002); "Water Resources Engineering: Principles and Practice" ISBN-13 –9788122413823. 306p. 5. S. K. Sharma; "Design of Irrigation Structures", S. Chand and Co. ISBN-139788121903295 6. G.L.Asawa (2006); "Irrigation and Water Resources Engineering", New Age International Publishers. ISBN-13 9788122416732. 624p 7. K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill. 8. K Subramanya, Water Resources Engineering through Objective Questions, Tata Mc-Graw Hill. 9. L W Mays, Water Resources Engineering, Wiley. 10. J D Zimmerman, Irrigation, John Wiley & Sons C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford.

Soil Mechanics [PC-BTC503]

Course Code	Course Name
PC-BTC503	Soil Mechanics

Course pre-requisites	Engineering Geology, Mechanics of Materials, Fluid Mechanics, Water Supply Engineering

Course Objectives

All construction that takes place, ultimately transfers the load to the ground, soil mechanics plays a crucial role in all civil engineering projects. The failure to carry out adequate soil study often has had dramatic and expensive consequences on construction projects.

The objectives of this course are

1. Introduce the subject of soil mechanics, rock mechanics and basic definitions of terms related to soil mechanics and the relationship between them.
2. Classify soils, estimate soil permeability, perform seepage analysis, draw flow nets, differentiate between compaction and consolidation of soils and discuss causes of instability of soil slopes.
3. Calculate effective stresses and principal stresses.
   Introduce methods of soil investigation.

Course Outcomes

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

1. Understand the basic principles of soil mechanics and identify and quantify various engineering properties of soil.
2. Analyze soil behaviour under the application of loads
3. Determine shear strength parameters of soil and estimate stability of slopes
4. Understand the importance of a soil investigation programme and recommend suitable site and lab tests needed before commencement of construction

CO-PO-PSO Mapping

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

Course Content

Module No.	*Details*	*Hrs.*
1	**Introduction**: Importance of geotechnical engineering. Basic definitions of various soil parameters and relationships between them. Soil as a three phase system. Determination of various index	08

	properties of soil. Relevance of soil properties to current civil engineering projects. Self-Study: Basic clay mineralogy **Characterization and Classification of soil:** Plasticity and consistency indices. Classification systems based on particle size. Self-Study: Classification based on AASHTO and textural classification	
2	**Soil water:** Capillarity in soils. Quick sand condition. Permeability of soils. Determination of coefficient of permeability in lab and field. Permeability of stratified soils. Introduction to seepage analysis. Effective stress principle. **Self-Study: Flow nets**	05
3	**Compaction of soil:** Determination of optimum moisture content and maximum dry density in lab and field. Self-Study: Suitability of compaction equipment for varioussoil types	03
4	**Stresses in soil:** Importance of estimation of stresses in soils. Boussinesq's and Westergaard's theories for point loads. Variation of vertical stress under point load along the vertical and horizontal planes. Newmark's influence chart. Self-Study: Uniformly loaded circular and rectangular areas	03
5	**Consolidation:** Introduction. Normally consolidated soil, over consolidated soil and under consolidated soil. Preconsolidation pressure and its determination. Estimation of settlements - Terzaghi's 1-D consolidation theory – Coefficient of consolidationand its determination. Self-Study: Difference between compaction and consolidation, Spring analogy	06
6	**Shear Strength:** Mohr-Coulomb theory. Direct shear test. Triaxial compression tests: UU, CU and CD. Pore-pressure measurement. Computation of effective shear strength parameters. Unconfined compression test and vane shear test. Self-Study: Mohr's circle, principal planes	08
7	**Stability of slopes:** Types of slopes. Types of slope failures. Slipcircle method. Determination of centre of most critical slip circle.Taylor's stability charts and their use. Stabilization of soil slopes.Introduction to software. Case studies. Self-Study: Relative merits and de-merits of various methods	05
8	**Soil Exploration:** Methods of boring. Types of soil samplers and sampling procedures, Penetrometer tests. Analysis of borehole logs. Brief introduction to marine geotechnical and geophysical investigations. Site visit recommended to observe field tests. Self-Study: geophysical and advanced soil exploration methods**.**	04

Recommended: NPTEL/Swayam Course on Geotechnical Engineering I
Internal evaluation to include planning site investigation programme for a site (case study)

Reference Books

1. Singh A. *Soil Engineering in Theory and Practice* (Vol.-1). 4th Edition, CBS Publishers and Distributors Pvt. Ltd., India, 2018.
2. Murthy, V. N. S. *Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering*. CRC Press, India, 2002
3. Terzaghi, K. *Soil Mechanics in Engineering Practice*. Wiley, USA, 1943
4. Relevant Indian Standard Specifications & Codes, BIS Publications, New Delhi.

Highway Engineering [PC-BTC504]

Course Code	Course Name
PC-BTC504	Highway Engineering

Course pre-requisites	Concrete Technology, Concrete Technology Lab, Surveying & Geomatics

Course Objectives

The objectives of this course are

1. To Summarize brief History of roads in India, and classification of roads as per different 20 years Road Development Plan,
2. To discuss Highway planning and geometric design of Roads,
3. Design and construction of Flexible as well as Rigid Pavements.

Course Outcomes

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

1. Analyze and design of geometric elements of different road types.
2. Implement the knowledge gained for design & construction of flexible pavements and rigid pavements.
3. Execute construction and maintenance of flexible and rigid pavements.

CO-PO-PSO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	-	3	3	2	-	-	-	-	-	-	2	3	3
CO 2	3	-	3	3	2	-	-	-	-	-	-	2	3	3
CO 3	3	-	2	2	2	-	-	-	-	-	-	2	3	3

Course Content

Module No.	Details	Hrs.
1	**Highway Planning:** Classification of roads, brief history of road developments in India, present status of roads in India. Highway alignment, basic requirement of ideal alignment, factors governing highway alignment Highway location survey, map study, reconnaissance, topographic surveys, highway alignment in hilly area, drawing and report preparation	04

2	**Geometric Design of Highway:** Terrain classification, vehicular characteristics, highway cross section elements, salient dimensions, clearances, width of carriage way, shoulders, medians, width of road way, right of way, camber and its profile. Design speed, sight distance, perception time, break reaction time, analysis of safe sight distance, analysis of overtaking sight distance, intersection sight distance. Horizontal curves: design of super elevation and its provisions, minimum radius of horizontal curves, widening of pavement, transition curves. Gradients: different types, maximum, minimum, ruling and exceptional, grade compensation in curves, vertical curves: design factors, comfort and sight distance. Summit curve, valley curve.	09
3	**Traffic Engineering:** Traffic volume study, spot speed study, traffic sign, traffic signals, intersection at grade, grade separate intersection.	03
4	**Pavement Design:** Types of pavements, different method of pavement design, comparison of flexible and rigid pavements, design wheel load, equivalent single wheel load, equivalent wheel load factor. Flexible pavement design: IRC approach, Burmister's layers theory, Triaxial method. Stress in Rigid Pavements, critical load position, wheel load stress, temperature stress, combine wheel load and temperature stress.	06
5	**Highway Construction:** Construction of different types of roads: water bound macadam (WBM) road, different types of bituminous pavements, cement concrete pavement. Pavement failure: flexible pavement failure, rigid pavement failure, maintenance of different types of pavements. Strengthening of existing pavement: objective of strengthening, design of overlay using Benkelman beam method. Highway drainage, necessity, surface drainage, subsurface drainage.	06

Recommended 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. 835p.
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.
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

Wastewater Engineering and Air Pollution Control [PC-BTC505]

Course Code	Course Name
PC-BTC505	Wastewater Engineering and Air Pollution

Course pre-requisites	Water Supply Engineering, Water Supply Engineering Lab., Fluid Mechanics

Course Objectives

The objectives of this course are

1. Design various units of sewerage system.
2. Design of various wastewater treatment processes
3. Quantify and analyse the sewage generated by various sources
4. Understand the concept of air pollution and how to control it

Course Outcomes

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

1. Analyze the pollution parameters for the wastewater and air with respect to quality
2. Design hydraulic elements of sewerage system
3. Design wastewater treatment plant including preliminary, primary, secondary and tertiary treatment.
4. Apply basic control methods for air pollution

CO-PO-PSO Mapping

COs	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
CO 1	3	3	2	3	2	2	2	3	-	-	-	2	3	3
CO 2	3	3	3	3	2	-	-	2	2	-	-	2	3	3
CO 3	3	3	3	3	2	-	-	2	2	-	-	2	3	3
CO 4	3	3	2	2	2	2	2	2	1	-	-	2	3	3

Course Content

Module No.	Details	Hrs.
1	**Sewage - conveyance and pumping:** Conveyance of Sewage: Sewers- shapes and materials of sewers, sanitary, storm and combined sewers, capacities and designs, appurtenances, maintenance of sewers. Sewage pumping: Consideration of the selection of pump and location of pumping stations.	05

2	**Sewage - characterization and disposal:** Characteristics of sewage: Composition, chemistry of sanitary sewage, B.O.D., C.O.D., aerobic and anaerobic decomposition. Sewage Disposal: discharge of raw and treated sewage on land and water, standards for disposal, raw and treated sewage on land and water, limits of dilution, Standards for disposal and reuse Self-purification of streams: oxygen economy, sewage farming.	03
3	**Sewage treatment:** Basic flow sheets and Unit Operations, Aims, methods of treatments and various flow-sheets for preliminary, primary, secondary and, tertiary treatment, screens, grit chambers, primary and secondary clarifiers, disposal of screenings and grit.	02
4	**Biological treatment methods**: Principles, trickling filter operation, recirculation, activated sludge process and its modifications, hydraulic design of trickling filter and activated sludge process, sludge volume index, operational problems in activated sludge process , trickling filters, stabilization ponds, Aerated lagoons, rotating biological contactors Sludge digestion: Principles of aerobic and anaerobic digestion, quantity and characterization of sludge, thickening, stabilization, dewatering, disposal Rural and Low cost sanitation: Septic tanks and Imhoff tanks – principles, operation and suitability, design values, disposal of treated effluent, New technology including microbial fuel cells Wastewater Reuse Advanced wastewater technology, Potable and non-potable reuse case studies in India and outside India related to wastewater reuse	10
5	**Air Pollution:** Atmosphere as a place of disposal of pollutants, Air Pollution, Definition, Air Pollution and Global Climate, Units of measurements of pollutant, Air quality criteria, emission standards, National ambient air quality standards – Air pollution indices, Air quality management in India. Sources and classification of air pollutants, Man made, Natural sources, Type of air pollutants, Pollution due to automobiles , Analysis of air pollutants , Chemical, Instrumental and biological methods. Air pollution and its effects on human beings, plants and animals, Economic effects of air pollution.	04
6	**Sources, classification, and control of air pollutants:** Man made, Natural sources, Type of air pollutants, Pollution due to automobiles , Analysis of air pollutants , Chemical, Instrumental and biological methods. Air pollution and its effects	04

	on human beings, plants and animals, Economic effects of air pollution, Methods to control stationary and mobile sources of air pollution.	

Recommended Books

1. E.W.Steel (1947); "Water Supply & Sewage", McGraw Hill, New York. ASIN: B001SL037A
2. T.J.McGhee (1991); "Water Supply & Sewage" McGraw Hill, New York. ISBN-13-9780071008235. 602p.
3. Dr. P.N.Modi (2008); "Sewage Treatment & Disposal & waste water engineering" Standard Book House. ISBN 13 9788190089326. 988p.
4. Garg S. K (2008); "Sewage Disposal & Air Pollution Engineering". Khanna Publication. ISBN 13 978-8174092304. 200p
5. Nathanson J.A (2014) "Basic Environmental Technology: Water Supply, Waste Management and Pollution Control". Prentice Hall. ISBN-13: 978-0132840149. 456p.
6. J.W. Clark, W.Veisman, M.J.Hammer (2008); "Water Supply and Pollution Control" Prentice Hall. ISBN-13: 978-0132337175. 864p.
7. Gilbert Masters (2013); "Introduction to Environmental Engineering and Science" Pearson Education. ISBN 13 9781292025759. 700p.
8. Manual on Water Supply and Treatment, (latest Ed.): Ministry of & Housing. New Delhi
9. Relevant Indian Standard Specifications, BIS Publications
10. CPHEEO Manual on Water Supply & Treatment
11. M.N Rao and H.V.N Rao (2017) Air Pollution, Tata McGraw Hill Publication

Highway Engineering Lab. [PC-BTC551]

Course Code	Course Name
PC-BTC551	Highway Engineering Lab.

Course pre-requisites	

Course Objectives

The objectives of this course are

1. To understand the Laboratory procedure for computing various properties pavement layer materials.

Course Outcomes

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

1. Perform standard laboratory tests on aggregates and bitumen safely and effectively, demonstrating proper handling of equipment and adherence to laboratory protocols.
2. Analyse and interpret test results to assess the suitability of materials for pavement construction, in accordance with relevant codes and standards.
3. Work collaboratively in teams to conduct experiments, maintain safety practices, and prepare clear, well-structured technical reports based on laboratory findings.

CO-PO-PSO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	-	2	2	2	-	-	-	-	-	-	2	3	2
CO 2	3	-	2	2	2	-	-	-	-	-	-	2	3	2
CO 3	2	-	-	2	1	2	-	3	3	-	2	2	2	2

List of Experiments

Experiment No.	Name of the Experiment
1	Impact test on aggregates
2	Abrasion test on aggregates
3	Crushing test on aggregates
4	Shape test on aggregates
5	Penetration test on bitumen
6	Ductility test on bitumen
7	Softening point test on bitumen
8	Viscosity test on bitumen

Recpmmended Books
1. Yoder, E. J., John (1975); "Principles of Pavement Design" Wiley & Sons, Inc., New York. ISBN -13: 9780471977803. 711p. 2. Khanna & Justo (1971); "Highway Engineering", New Chand & Brothers, Roorkee.678p. 3. Dr. L. R. Kadiyali and Dr. N. B. Lal (2005); "Principles and Practices of Highway Engineering", Khanna Publication, New Delhi. ISBN-13: 9788174091659. 835p. 4. Guide lines for the Design of Flexible Pavements, IRC:37 -2001, IRC:37-2012

Wastewater Engineering and Air Pollution Control Lab. [PC-BTC552]

Course Code	Course Name
PC-BTC552	Wastewater Engineering and Air Pollution Lab.

Course pre-requisites	Water Supply and Engineering Lab

Course Objectives

The objectives of this course are

1. To find various parameters of wastewater
2. To analyse and interpret the treatment technologies to be use for waste reuse or disposal
3. To find basic parameters related to air pollution

Course Outcomes

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

1. Perform standard tests to determine key physical, chemical, and biological parameters of water, wastewater, and air, using appropriate instruments and methods.
2. Analyse test results to assess environmental quality and compliance with regulatory standards for water and air, demonstrating an understanding of pollution indicators with respect to standards
3. Collaborate effectively in teams to conduct experiments, follow laboratory safety procedures, and prepare clear, well-organised technical reports communicating experimental observations and conclusions.

CO-PO-PSO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	-	2	2	2	-	2	-	-	-	-	2	3	3
CO 2	3	-	2	2	2	-	-	2	-	-	-	2	3	3
CO 3	2	-	-	2	1	2	-	-	3	3	2	2	2	2

List of Experiments

Experiment No.	Name of the Experiment
1	Determination of Turbidity
2	Determination of Hardness
3	Determination of Alkalinity
4	Determination of Acidity
5	Determination of Solids
6	Determination of Chlorides

7	Determination of Sludge Volume Index
8	Determination of Dissolved Oxygen
9	Determination of Biological Oxygen Demand
10	Determination of Chemical Oxygen Demand
11	Determination of PM 10 and PM 2.5 using high volume sampler
12	Determination of SOx and NOx in air

Recommended Books
1. Eaton, A. D., Clesceri, L. S., Greenberg, A. E., Franson, M. A. H., American Public Health Association., American Water Works Association., &Water Environment Federation.(2000). *Standard methods for the examination of water and wastewater.* Washington, DC: American Public Health Association. 2. Relevant Indian standards.

Soil Mechanics Lab. [PC-BTC553]

Course Code	Course Name
PC-BTC553	Soil Mechanics Lab.

Course pre-requisites	Engineering Geology

Course Objectives

The objectives of this course are

1. To introduce students to soil types based on grain size and plasticity characteristics
2. To familiarize students with measurement of various soil properties.

Course Outcomes

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

1. Perform standard laboratory tests to identify and classify soils, and to determine their physical properties.
2. Interpret and analyse test data to evaluate soil behaviour and suitability for geotechnical engineering applications in accordance with relevant codes and procedures.
3. Work collaboratively in teams to conduct experiments safely, handle equipment correctly, and prepare structured technical reports that effectively communicate experimental findings and conclusion

CO-PO-PSO Mapping

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

List of Experiments

Experiment No.	Name of the Experiment
1	Field identification of Fine Grained soils.
2	Field Density using Core Cutter method
3	Relative density of coarse grained soils
4	Specific gravity of Soils.
5	Grain size distribution by Sieve Analysis.
6	Consistency limits by Liquid limit, Plastic limit and Shrinkage limit.
7	Permeability test using Constant-head test method and Falling-head method.
8	Compaction test: Standard Proctor test and Modified Proctor test.

Recommended: NPTEL/Swayam Course on Geotechnical Engineering Lab course.
Lab exam to include hypothetical case studies and use of lab tests

Recommended Books

1. Singh A. Soil Engineering in Theory and Practice (Vol. -1). 4th Edition, CBS Publishers and Distributors Pvt. Ltd., India, 2018.
2. Murthy, V. N. S. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering. CRC Press, India, 2002.
3. Relevant Indian Standard Specifications & Codes, BIS Publications, New Delhi.

SEM – VI

Regulation 23

Construction Engineering & Management [PC-BTC601]

Course Code	Course Name
PC-BTC601	Construction Engineering & Management

Course pre-requisites	Building Materials & construction, Concrete Technology

Course Objectives

The objectives of this course are

1. To understand the process of construction project planning and techniques of project planning.
2. To know the process of construction project Monitoring & Control.
3. To understand basics of construction project quality control and safety management at site.
4. To know the process of cost and resource optimization

Course Outcomes

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

1. Explain the life cycle of construction projects, identify key stakeholders, and understand the roles of various construction equipment and methods used in modern project execution.
2. Apply planning and scheduling techniques such as Gantt charts, CPM, PERT, and resource scheduling to develop, analyse, and manage construction project timelines and resources effectively.
3. Demonstrate understanding of site management practices including manpower planning, material procurement, equipment allocation, cash flow management, and quality control using standard procedures and tools.
4. Work effectively in teams to monitor project progress, address time and cost overruns, ensure safety and environmental compliance, and prepare clear, well-structured technical reports based on project data.

CO-PO-PSO Mapping

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

Course Content

Module No.	Details	Hrs.
1	**Basics of Construction:** Basics of Construction - Construction projects types and features,	05

	life cycle of a construction project, various stakeholders involved in construction project. Construction Equipment basics - Conventional construction methods against Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials.	
2	**Construction Project Planning:** Construction project planning- Stages of project planning: pretender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data	06
3	**Techniques of Planning:** Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on arrow and activity on node representation, computation critical paths, calendaring networks. PERT- Assumptions underlying PERT analysis, determining three time estimates and its analysis, slack computations calculation of probability of completion. Line of balance scheduling.	06
4	**Planning and Organizing at Construction Site:** Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; planning and organizing for construction equipment; Funds: cash flow, sources of funds; Common Good Practices in Construction and attributes of good project manager.	06
5	**Project Monitoring & Control:** Project Monitoring & Control- Supervision, record keeping, periodic progress reports, and periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Histograms and S-Curves. Earned Value management. Common causes of time and cost overruns and corrective measures. Various labour laws. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management.	06
6	**Quality Control and Safety Management at Construction Site:** Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of	05

	inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.	
7	**Resource Scheduling:** Resource Scheduling - resource constraints and conflicts; resource aggregation, allocation, smoothening and levelling. Construction Costs: Make-up of construction costs; Classification of costs, time cost trade-off in construction projects, compression and decompression.	08

Recommended Books

1. Varghese, P.C., "Building Construction", Prentice Hall India, 2007.
2. National Building Code, Bureau of Indian Standards, New Delhi, 2017.
3. Chudley, R., Construction Technology, ELBS Publishers, 2007.
4. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
5. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
6. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
7. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.
8. Barrie D.S. & Paulson B C (2013); "Professional Construction Management" McGraw Hill Education (India) Private Limited. ISBN-13: 978-1259098420. 672p.
9. Chitkara K K (2010); "Construction Project Management" McGraw Hill Education (India) Private Limited. ISBN-13: 978-0070680753. 772p.
10. P K Joy (1991); "Handbook of Construction Management", Macmillan, India. ISBN-13- 9780333926932. 484p
11. King & Hudson (1985); "Construction Hazard and Safety Handbook", Butterworths. ISBN-13: 978-0408013475. 477p.
12. Antill J M & Woodhead R W, (1990); "Critical Path Methods in Construction Practice:" John Wiley & Sons. ISBN-13: 978-0471620570. 448p
13. S. Seetaraman (2000); "Construction Engineering and Management". Umesh pub. ISBN-13 9788188114061. 487p
14. L.S.Shreenath (2001); "CPM and PERT" Affiliated East-West Press (Pvt.) Ltd. ISBN-13: 978-8185336206
15. Dr.B.C.Punmia (2010); "CPM and PERT" Motilal UK Books of India. ISBN-13: 978-8131806982. 250p.

Design of Steel Structures [PC-BTC602]

Course Code	Course Name
PC-BTC602	Design of Steel Structures

Course pre-requisites	Mechanics of Materials, Structural Mechanics, Structural Analysis

Course Objectives

The objectives of this course are

1. To introduce behaviour and design of simple steel structures according to limit state design concept.
2. To have the basic knowledge about the design and failure mode of steel structural members.

Course Outcomes

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

1. Explain the mechanical properties of steel, design philosophies (WSM & LSM), types of loads, and classification of steel sections.
2. Design tension and compression members, and welded and bolted connections, using Limit State Method in accordance with IS 800.
3. Analyse and design structural steel elements such as beams, trusses, and column bases under various loading conditions.
4. Interpret connection design (beam-beam, beam-column) and apply detailing principles in structural drawings using codal provisions.

CO-PO-PSO Mapping

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

Course Content

Module No.	Details	Hrs.
1	**Introduction:** Introduction to types of steel, mechanical properties of steel, advantages of steel as structural material, design philosophies of Working Stress Method (WSM) and Limit State Method (LSM) Limit state method, limit state of strength and serviceability (deflection, vibration, durability, fatigue, fire), characteristics and design loads, Classification of cross section- plastic, compact, semi-compact and slender, limiting width to thickness ratio. Introduction to bolted and welded connections by LSM.	08

2	**Tension Members:** Design of tension members with welded / bolted end connections using single and double angle sections by LSM, design strength due to- yielding of cross section, rupture of critical section and block shear.	05
3	**Compression Members:** Design of compression members with welded / bolted end connections using single and double angle by LSM, design strength, effective length of compression members. Design of columns with single and built-up sections, design of lacing and batten plates with bolted and welded connections using LSM, column buckling curves, effective length, slenderness ratio, limiting values of effective slenderness ratio, buckling class of various cross sections.	08
4	**Truss:** Determinate truss, imposed load on sloping roof, wind load on sloping roof and vertical cladding including effect of permeability and wind drag, analysis of pin jointed trusses under various loading cases, computation of forces in members, design and detailing of connections and supports, wind bracing for roof system, supported on columns.	05
5	**Column Bases:** Design of slab base and gusseted base using bolted and welded connection by LSM, Effective area of a base plate.	04
6	**Beams:** Design of members subjected to bending by LSM, design strength in bending, effective length, laterally supported and unsupported beams. Design of single and built-up rolled steel sections using bolted and welded connections, shear lag effect. Design for shear, web buckling and web crippling.	07
7	**Beam End Connections:** Beam to beam and beam to column connections, design of framed, un-stiffened and stiffened seat connections	05

Recommended Books

1. Dr Ramachandra (2010), "Design Of Steel Structures Vol. II", Scientific Publishers-Jodhpur, ISBN 8172336446
2. N. Subramanian (2008), "Design Of Steel Structures", Oxford, ISBN 0195676815, 864 pages
3. Pasala Dayaratnam (2014), "Design Of Steel Structures", S. Chand Publishing, ISBN 8121923204, 868 pages
4. S. S. Bhavikatti (2009), " Design of Steel Structures by Limit state mrthod as per IS 800:2007", I K International Pvt. Ltd, 414 pages
5. Duggal S K (2010), "Limit State Design of Steel Structures", Tata McGrwaHill
6. Shiyekar M R (2010), "Limit State Design of Steel Structures", PHI Learning
7. SaiRam K S (2010), " Design of Steel Structures", PHI Learning

8. Relevant IS Codes

Foundation Engineering [PC-BTC603]

Course Code	Course Name
PC-BTC603	Foundation Engineering

Course pre-requisites	Soil Mechanics , Soil Mechanics Lab.

Course Objectives

The objectives of this course are to:

1. Describe various earth pressure theories, design and analysis of stability of various types of earth retaining structures
2. Estimate bearing capacity of shallow foundations by various theories.
3. Assess the need for pile foundations and determination of their load carryingcapacity.
4. Explain basic design principles of flexible retaining system, braced cuts, and introduction to reinforced soil.

Course Outcomes

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

1. Apply earth pressure theories such as Rankine and Coulomb to compute lateral earth pressures
2. Evaluate the stability of rigid and flexible retaining structures and interpret construction details including the use of drainage systems
3. Determine the bearing capacity of shallow foundations using analytical methods and IS code provisions, and interpret results from plate load tests.
4. Analyse the behaviour and capacity of axially loaded pile foundations and braced cuts using IS codes for practical foundation design.

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	-	-	-	-	-	-	2	3	2
CO2	3	2	3	3	2	1	1	1	-	-	-	2	3	2
CO3	3	2	3	3	2	1	1	3	-	-	-	2	3	2
CO4	3	2	3	3	2	1	1	3	-	-	-	2	3	2

Course Content

Module No.	Details	Hrs.
1	**Lateral earth pressure theories:** Applications of earth pressure theories. Rankine's earth pressure theory, active earth pressure andpassive earth pressure for horizontal and inclined backfill for cohesionless and cohesive soils. Coulomb's wedge theory. Coulomb's active pressure in cohesionless soils, expression for active pressure, Coulomb's passive earth pressure. Self-Study:	05

	Rebhann's construction for active pressure, Culmann's graphical solutions for active pressure.	
2	**Rigid and flexible retaining structures:** Stability analysis of retaining walls,cantilever retaining walls, construction details, and importance of drainage. Introduction to sheet pile walls, earth pressure diagrams for cantilever sheet pile walls in granular and cohesive soils	04
3	**Bearing capacity of shallow foundations:** Ultimate bearing capacity, gross, net and safe pressures, allowable bearing pressure. Modes of failure. Bearing capacity theory – Terzaghi and Meyerhof. General bearing capacity equation. Corrections for square and circular footings. Ultimate bearing capacity in case of local shear failure. IS 6403 recommendations. Plate load test in detail with reference to IS 1888.	07
4	**Axially loaded pile foundations:** Introduction. Necessity of pile foundations. Classification of piles. Pile capacity based on static analysis. Dynamic methods and their limitations. Pile load test as per IS 2911 specifications, negative skin friction. Pile groups, ultimate capacity of groups, settlement of pile groups in sand and in clays as per IS 2911 and critical depth method.	08
5	**Braced cuts:** Apparent earth pressure diagrams, average earth pressure diagrams in cohesive and cohesionless soils, estimation ofstrut loads in braced cuts **Miscellaneous:** Introduction to caissons, raft foundations and piled-raft foundations. Brief introduction to various ground improvement techniques	04
Recommended: NPTEL/Swayam Course on Geotechnical Engineering II or Foundation Engineering Internal evaluation to include project on foundation design based on investigation data.		

Recommended Books

1. Singh A. Soil Engineering in Theory and Practice (Vol. -1). 4th Edition, CBS Publishers And Distributors Pvt. Ltd., India, 2018.
2. Murthy, V. N. S. Geotechnical Engineering: Principles And Practices Of Soil Mechanics And Foundation Engineering. CRC Press, India, 2002
3. Tomlinson M, and Woodward, J. Pile Design and Construction Practice. 6th Edition, CRC Press, India, 2014
4. Bowles, J. Foundation Analysis and Design. 5th Edition, The McGraw-Hill Companies, Inc. 1995.
5. Relevant Indian Standard Specifications & Codes, BIS Publications, New Delhi.

Design of RCC Elements [PC-BTC604]

Course Code	Course Name
PC-BTC604	Design of RCC Elements

Course pre-requisites	Mechanics of Materials, Structural Mechanics, Structural Analysis

Course Objectives

The objectives of this course are

1. To develop Civil Engineering graduates having clear understanding of concepts of reinforced concrete design using Limit state approach.
2. Application of WSM and LSM to design different RCC members.
3. To familiarize students to use of IS 456 and relevant IS codes, its importance in RCC design.
4. To deal with environmental and economic issues.

Course Outcomes

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

1. Explain the principles of the Working Stress Method (WSM) and Limit State Method (LSM), along with codal provisions and design philosophies as per IS 456.
2. Analyse and design reinforced concrete beams for flexure, shear, and torsion using both WSM and LSM approaches, including singly, doubly reinforced, and T-sections.
3. Design one-way and two-way slabs, short and slender columns, and structural members subjected to combined axial load and bending using LSM as per IS 456.
4. Apply IS code provisions to design isolated and combined footings under axial load and moments, considering serviceability and strength criteria.

CO-PO-PSO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	-	3	3	2	-	-	-	-	-	-	2	3	2
CO 2	3	-	3	3	2	-	-	-	-	-	-	2	3	2
CO 3	3	-	3	3	2	-	-	-	-	-	-	2	3	2
CO 4	3	-	3	3	2	-	-	-	-	-	-	2	3	2

Course Content

Module	Details	Hrs.

No.		
1	**Working state method:** Concept of working stress method, permissible stresses as per IS 456, stress strain curve of concrete and steel, assumptions in working stress method.	02
2	**WSM Design for Flexure:** Concept of balanced, under reinforced and over reinforced sections. Analysis and design of singly reinforced and doubly reinforced rectangular beams for flexure by WSM	03
3	**Limit State Method:** Introduction to limit state method of design as per IS 456 (latest edition): concepts of probability and reliability, characteristic loads, characteristic strength, partial safety factors for loads and materials, introduction to various limit states.	03
4	**Limit State of Collapse – Flexure, Shear and Torsion:** Limit state of collapse in flexure, shear and Limit state of serviceability in deflection and cracking, design of singly reinforced rectangular sections. Design and analysis of doubly reinforced rectangular sections, T sections for flexure, design of members in shear and bond, design of beam subjected to bending and torsion. Requirements governing reinforcement detailing.	06
5	**Design of Slabs:** Design of simply supported one way slab and two way slab	03
6	**Limit State of Collapse - Compression:** Limit state of collapse compression for short and slender column. Column Members subjected to combined axial and uni-axial bending. Development of interactive curves and their use in column design.	05
7	**Design of Foundations:** Isolated square and rectangular footings subjected to axial load and moments. Design of combined rectangular pad footings.	06

Recommended Books
1. P. Dayaratnam,(2011), "Design of Reinforced Concrete Structures", Oxford &Ibh-Pubs Company-New Delhi, ISBN 8120414195 2. Ashok K. Jain(1993), "Reinforced Concrete: Limit State Design" , Nem Chand & Brothers, ISBN 8185240531, 844 pages 3. Dr. S.R. Karve& Dr. V.L. Shah (1994), "Limit State Theory and Design of Reinforced Concrete", Structures Publishers, ASIN B007I29ARC, 1140 pages 4. V. Ramakrishnan & P. D. Arthur (1969), "Ultimate Strength Design for Structural Concrete", Pitman, ISBN 0273403230, 264 pages 5. Dr. H. J .Shah,(2008),"Reinforced Concrete, Volume 2", Charotar Publishing House Pvt. Limited, ISBN 8185594732, 536 pages 6. S N Sinha, (2002),"Reinforced Concrete Design, Second Revised Edition", Tata McGraw-Hill Education, ISBN 0070473323, 708 pages 7. Karve& Shah, (2011), "Illustrated Design of Reinforced concrete Buildings", mihail-koprivchin-3758, 319 pages 8. P.C. Varghese (2009), Limit state design of Reinforced concrete, PHI Learning. 9. B.C. Punmia, Ashokkumar Jain and Arunkumar Jain (2007), Limit State Design of Reinforced Concrete. 10. Wang, C.K., Salmon, C.G., and Pincheira, (2007),"J.A. Reinforced Concrete Design", 7th Ed, John Wiley and Sons, ISBN 0471262862, 948 pages 11. Phil Moss Ferguson, Henry Jacob Cowan, (1981),"Reinforced Concrete Fundamentals, S I Version", John Wiley & Sons Canada, Limited, ISBN 0471051535, 694 pages. 12. B.P. Hughes (1976),"Limit State Theory for Reinforced Concrete Design", Pitman, ISBN 0273010239

Professional Elective – I

Sr. No.	Course Code	Course Name	Specialization
1	PE-BTC621	Analysis of Indeterminate Structures	Structural Engineering
2	PE-BTC622	Structural Dynamics	
3	PE-BTC623	Repair and Rehabilitation of Structures	
4	PE-BTC624	Geographic Information System Science and Application	
5	PE-BTC631	Hydraulic Structures & Irrigation Engineering	Water Resources Engineering
6	PE-BTC632	Introduction to Offshore Engineering	
7	PE-BTC633	Open Channel Flow	
8	PE-BTC634	Ground Water Development and Management	
9	PE-BTC641	Solid and Hazardous Waste Management	Environmental Engineering
10	PE-BTC642	Air and Noise Pollution Control	
11	PE-BTC643	Rural Water Supply and Sanitation	
12	PE-BTC651	Special Construction Materials & Methods	Construction Management
13	PE-BTC652	Appraisal and Implementation of Infrastructure Projects	
14	PE-BTC653	TQM and MIS in Construction	
15	PE-BTC654	Engineering Risk and Uncertainty	
16	PE-BTC661	Pavement Subgrade and Materials	Transportation Engineering
17	PE-BTC662	Low Cost Roads	
18	PE-BTC663	Traffic Engineering and Control	
19	PE-BTC671	Ground Improvement Techniques	Geotechnical Engineering

Analysis of Indeterminate Structures [PE-BTC621]

Course Code	Course Name
PE-BTC621	Analysis of Indeterminate Structures

Course pre-requisites	Mechanics of Materials, Mechanics of Materials Lab, Structural Mechanics, Structural Analysis

Course Objectives

The objectives of this course are

1. To introduce the students to the methods of analysis of indeterminate structures.
2. To introduce the students to the plastic analysis of structures.
3. To prepare the base for the students to study other advanced structural engineering courses at a later stage.

Course Outcomes

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

1. Analyse indeterminate structures using force methods.
2. Analyse indeterminate structures using displacement methods.
3. Evaluate shape factor, plastic moment capacity of the section, determine collapse load for beams using plastic analysis.

CO-PO-PSO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3	-	3	3	2	-	-	-	-	-	-	2	3	-
CO 2	3	-	3	3	2	-	-	-	-	-	-	2	3	-
CO 3	3	-	3	3	2	-	-	-	-	-	-	2	3	-

Course Content

Module No.	Details	Hrs.
1	**Analysis of Indeterminate Structures by Force Method:** Application of flexibility method to simple pin jointed frames (including effect of lack of fit for members) with static indeterminacy up to 3, application to simple rigid jointed frames with static indeterminacy up to 3.	06
2	**Analysis of Indeterminate Structures by Force Method:** Theorem of three moments and its applications to indeterminate beams. Application of flexibility method to two hinged parabolic	04

	arches.	
3	**Analysis of Indeterminate Structures by Force Method:** Analysis of indeterminate structures by the theorem of least work. Application of the theorem to indeterminate beams, simple rigid jointed frames with static indeterminacy up to 3 and pin jointed frames with static indeterminacy up to 3.	05
4	**Slope Deflection Method:** Application of the method to simple rigid jointed frames. Application to simple rigid jointed frames with inclined member but having only one translational degree of freedom in addition to rotational degree of freedom.	06
5	**Moment Distribution Method:** Application of the method to indeterminate beams including the effect of settlement of supports and simple rigid jointed frames without and with sway.	07
6	**Analysis of Indeterminate Structures by Stiffness Method:** Stiffness coefficients for prismatic members and their use for formulation of equilibrium equations, direct stiffness method, Application of the above methods to indeterminate beams including the effect of settlement of supports and simple rigid jointed frames with kinematic indeterminacy up to 3.	08
7	**Introduction to Plastic Analysis of Steel Structures:** Behaviour of ductile material. Idealized stress strain diagram for plastic analysis. Concept of plastic theory of bending, plastic hinge and plastic moment carrying capacity, shape factor, lower bound, upper bound and uniqueness theorems.Determination of collapse load for single and multiple span beams.	06

Recommended Books

1. Reddy C. S. (1999), "Basic Structural Analysis", Tata McGraw hill, ISBN 0070702764, 779 pages.
2. Junnarkar S.B. (2013), "Structural Analysis, Vol. II" Charotar Publishers ISBN 9380358703, 986 pages.
3. Pandit and Gupta (1999), "Structural Analysis Vol. I", Tata McGraw Hill, ISBN 0074634933, 679 pages.
4. L. S. Negi, and R. S. Jangid (1997), "Theory and Problems in Structural Analysis "Tata McGraw - Hill Education, ISBN 0074623044, 828 pages.
5. Baker &Heyman (1980), "Plastic Design of Steel frames", Cambridge University Press, ISBN 0521297788, 238 pages.
6. G. Pandit and S. Gupta (2008), "Matrix Method in Structural Analysis", Tata McGraw hill, ISBN 0070667358, 612 pages.
7. Dr. B.N. Thadani And Dr. J. P.Desai (1964), "Modern Methods in Structural

Analysis", Asia Publishing House.
8. C. K. Wang (2014), "Intermediate Structural Analysis", Tata McGraw Hill ISBN 0070702497, 805 pages.
9. James M. Gere, William Weaver (1990), "Matrix Analysis of Frame Structures", Springer US, ISBN 0442234856, 547 pages.
10. D.S. Prakash Rao (1996),"Structural Analysis: A Unified Approach", Orient Blackswan ISBN 8173710279, 672 pages.
11. Dr. A. S. Meghre, and S. K. Deshmukh (2003), "Matrix Methods of Structural Analysis", Charotar Publishing House, ISBN 8185594088, 552 pages.

Structural Dynamics [PE-BTC622]

Course Code	Course Name
PE-BTC622	Structural Dynamics

Course pre-requisites	Mechanics of Materials

Course Objectives

The objectives of this course are

1. To develop civil engineering graduates having clear understanding of concept of dynamic loads, dynamic analysis of structures.
2. To apply knowledge of structural dynamics to understand the behaviour & to find the response of various structures subjected to dynamic loads.
3. To apply knowledge of Random Vibration analysis to study the behaviour of structures

Course Outcomes

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

1. Distinguish between static and dynamic loads; understand different types of dynamic loads
2. Explain the elements of single degrees of freedom, concept of damping and free and forced vibrations; able to find the frequency and free vibration response of single degree of freedom system for different types of dynamic loads including ground motion in time domain.
3. Determine the frequencies and mode shape for various types of multiple degrees of freedom lumped mass structures and carry out the dynamic (Damped and un-damped) for different types of dynamic loads including ground motion in time domain.
4. Perform the dynamic analysis of systems with distributed mass.
5. Explain the frequency domain analysis

CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	1	2	1
CO2	3	2	2	3	2	-	-	-	-	-	-	1	3	1
CO3	3	2	3	3	2	-	-	-	-	-	-	1	3	2
CO4	3	2	3	3	3	-	-	-	-	-	-	1	3	2
CO5	3	1	2	2	2	-	-	-	-	-	-	1	2	1

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	02

	dynamic loads.	
2	**Single Degree of Freedom (SDOF) Systems:** Un-damped free 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, computation of damping. Forced vibration, response to harmonic forces, periodic loading, dynamic load factors, and 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. Distributed mass system idealized as SDOF system, use of Rayleigh's method, response of SDOF system subjected to ground motion. Use of Fourier Series for periodic forces, introduction to vibration isolation. Concept of Transmissibility.	10
3	**Introduction to Frequency Domain Analysis:** response of structure in frequency domain subjected to general periodic and non-periodic/impulsive forces of short duration, use of complex frequency response function, Fourier Response Integral, Discrete Fourier Transforms, Fast Fourier Transforms.	03
4	**Generalized Single-Degree of Freedom System:** Generalized properties, assemblages of rigid bodies, systems with distributed mass and elasticity, expressions for generalized system properties. Application to single span beams.	07
5	**Free Vibration of Lumped Mass Multi Degree of Freedom (MDOF) System:** Coupled and uncoupled systems, direct determination of frequencies of vibration and mode shapes, orthogonality principle, vibration of MDOF systems with initial conditions, approximate methods of determination of natural frequencies of vibration and mode shapes-vector iteration methods, energy methods and use of Lagrange's method in writing equations of motion.	04
6	**Force Vibration of Lumped Mass Multi Degree of Freedom (MDOF) System:** Decoupling of equations of motion, modal equation of motion, concept of modal mass and modal stiffness, forced vibration of MDOF system, modal analysis, and application to beams and multi storey frames with rigid girders subjected to lateral dynamic loads.	07
7	**Structure with Distributed Mass System:** Use of partial differential equation, free vibration analysis of single span beams with various boundary conditions,	03

	determination of frequencies of vibration and mode shapes, forced vibration of single span beams subjected to the action of specified dynamic loads.	

Recommended Books

1. Dynamics of Structures by Clough &Penzien, McGraw-Hill, Computers & Structures, CBS Publishers, 2015
2. Dynamics of Structures: Theory & Applications to Earthquake Engineering by Anil K Chopra, Prentice Hall of India
3. Structural Dynamics by Mario Paz, Springer India, CBS Publishers, 2004
4. Introduction to Structural Dynamics by John M Biggs, CBS Publishers,2014
5. Basic Structural Dynamics by James C Anderson &FarzadNaeim, John Wiley & Sons
6. Fundamentals of Structural Dynamics by Roy R Craig & Andrew J Kurdia, Wiley
7. Mechanical Vibrations by Den P Hartog, McGraw-Hill
8. Dynamics of Structures by Jagmohan L Humar, 3rd Edition, CRC Press,
9. Wind Effects on Structures by Simiu E &Scanlan R H, Wiley
10. Wing Loading of Structures by John D Holmes, Spon Press
11. Structural Vibration: Analysis & Damping by Beards C F, Arnold
12. Vibrations & Control System by Beards C F, Ellis Horwood
13. Passive Energy Dissipation Systems in Structural Engineering by Soong T T&Dargush GF, Wiley
14. Introduction to Structural Motion Control by Connor J J, Prentice Hall, NJ
15. Active Structural Control by Soong T T, Wiley, NY & Longman Scientific & Technical, England
16. Liquid Sloshing Dynamics by Ibrahim, Cambridge University Press
17. Structural Damping: Applications in Seismic Response Modification by Zach Liang,George C Lee, Gary F Dargush&Jianwei Song, CRC Press
18. MATLAB: An Introduction with Applications by Amos Gilat, Wiley India

Repair and Rehabilitation of Structures [PE-BTC623]

Course Code	Course Name
PE-BTC623	Repair and Rehabilitation of Structures

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 need for maintenance, repair and rehabilitation.
2. To develop clear understanding of concepts, and practical knowledge of modern Civil Engineering techniques.
3. To encourage students and faculty to interact with industry, alumni and other reputed institutes for purpose of better understanding of industry requirements and different materials used.
4. To deal with social, environmental and economic issues when applying various techniques.

Course Outcomes

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

1. Explain the concepts of structural inspection and maintenance, types of deterioration, and their root causes in concrete structures.
2. Identify and classify common structural damages and defects, and interpret their probable causes through condition assessment techniques and visual inspection.
3. Apply appropriate non-destructive testing methods and interpret results for assessing the health of concrete structures.
4. Select and recommend suitable repair materials and strengthening techniques for structural rehabilitation, including specialised repair methods under different exposure conditions.

CO-PO-PSO Mapping

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS
CO1	3	1	-	-	-	2	1	-	-	-	-	1	2	2
CO2	3	2	2	2	2	2	1	-	-	-	-	1	3	2
CO3	3	2	3	3	3	-	1	-	-	-	-	1	3	2
CO4	2	1	3	2	3	1	2	-	-	-	-	1	2	3

Course Content

Module No.	Details	Hrs.
1	**Inspection and Maintenance of Structures:** Definition, Stages and Frequency of Inspection. Definition and Objectives of Maintenance, Broad Categories of Maintenance,	04

	Factors affecting Maintenance.	
2	**Causes of Deterioration of Structures:** Holistic Models of Deterioration, Mechanical, Chemical and Physical causes. Corrosion of Embedded Metals- Carbonation and Chloride Induced Corrosion, Deterioration of Cementitious System- Sulphate Attack, Alkali Aggregate Reaction, Freeze Thaw, Frost Attack, Shrinkage and Creep etc.	06
3	**Effects of Damage:** Spalling, Scaling, Settlement, Cracks. Different Types of cracks in concrete structures. Recognizing Defects and probable causes.	06
4	**Condition Assessment of Structures and Non Destructive Testing:** Exposure Conditions, Visual Inspection. Basic and Advanced Non Destructive and Semi Destructive Tests. Structural Audits-Pro Forma 'B'-MCGM	07
5	**Repair Materials for Concrete:** Parameters for selection of Repair materials. Different Types of Repair Materials-Premixed Cement Concrete, Polymer Modified Mortars and concrete, Epoxy and Epoxy systems etc. Their Composition, Classification, Properties, guidelines and Precautions and fields of application.	05
6	**Structural Strengthening:** Strengthening and retrofitting of columns, beams, walls, footings and slabs, concrete structures by jacketing, external post- tensioning, replacing or adding reinforcement, plate bonding, textile reinforced concrete	07
7	**Specialized Repairs:** Basics of Corrosion, Electro chemical repair using cathodic protection, impressed current cathodic protection (ICCP), re-alkalization and chloride extraction techniques, Specialized repairs for chemical disruption, fire, marine exposure etc.	07

Recommended Books

1. Concrete Repair and Maintenance: Peter H .Emmons and Gajanan M. Sabnis, Galgotia Publication.
2. Repairs and Rehabilitation-Compilation from Indian Concrete Journal-ACC Publication.
3. Guide to Concrete Repair and Protection, HB84-2006, A joint publication of Australia Concrete Repair Association, CSIRO and Standards Australia.
4. CPWD hand book on Repairs and Rehabilitation of RCC buildings published by DG(Works), CPWD, Government of India (NirmanBhawan), http://www.cpwd.gov.in/handbook.pdf.

5. Guide to Concrete Repair, Glenn Smoak, US Department of the Interior Bureau of Reclamation, Technical Service Center, http://books.google.co.in.
6. Management of Deteriorating Concrete Structures: George Somerville, Taylor and Francis Publication
7. Concrete Building Pathology: Susan Macdonald, Blackwell Publishing.
8. Testing of Concrete in Structures: John H. Bungey, Stephen G. Millard & Michael G. Grantham, Taylor & Francis Publication.

Geographic Information System Science and Application [PE-BTC624]

Course Code	Course Name
PE-BTC624	Geographic Information System Science and Application

Course pre-requisites	Basics of Surveying , Surveying and Geomatics

Course Objectives

The objectives of this course are

1. To understand basic GIS theory and principles
2. To be familiar with GIS components
3. To study various methods of spatial data collection and data management
4. To study various database management systems, non-spatial and spatial analysis
5. To use GIS software for basic GIS project

Course Outcomes

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

1. Explain the fundamentals of GIS, including its history, components, coordinate systems, and integration with geodesy, GNSS, and remote sensing.
2. Interpret and apply concepts of maps, map scales, projections, and georeferencing in spatial data input and editing.
3. Construct and manage spatial databases, perform spatial analysis, and apply interpolation techniques using both raster and vector data models.
4. Design map layouts and cartographic visualisations using appropriate GIS tools, and develop a GIS-based project applying end-to-end workflows from data acquisition to spatial analysis and presentation.

CO-PO-PSO Mapping

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

Course Content

Module No.	Details	Hrs.
1	**Introduction to GIS:** History of GIS, Early developments in GIS, Applications of GIS, Introduction to Geodesy & GNSS, remote sensing techniques and their nexus with GIS	04
2	**Maps and map Scales:** Introduction to Maps and map elements and their significance, History of Maps, Map Scales, Types of Maps – uses and presentation, Map and	09

	Globe Georeferencing and Projections; Understanding Earth, Coordinate System, Map Projection, Transformation, Georeferencing Spatial Data Input and Editing; Primary Data, Secondary Data, Data Editing	
3	**Spatial Database Management Systems:** Introduction, Data Storage, Database Structure Models, Database Management system, Entity Relationship Model, Normalization Data Models and Data Structures; Introduction to Data Models and Data Structures, GIS Data Model, Vector Data Structure, Raster Data structure, Geodatabase and metadata Spatial Analysis; Introduction to spatial analysis, Vector Operations and Analysis, Network Analysis, Raster Data Spatial Analysis Interpolation; Introduction to Interpolation, Global Methods of Interpolation, Local Methods of Interpolation	06
4	**Cartographic Principles and Design:** Introduction, Map layout, Data presentation, Toposheet Indexing, Distribution Maps Web GIS; Introduction to Web GIS, OGC Standards and services, Mobile GIS	09
5	**Application of GIS using case study project** Project is intended to provide a deeper understanding of a GIS application through experience. Students will work individually or in groups of 2 on projects. The project should investigate a particular research problem using ArcGIS or QGIS. The project must be an original piece of work developed for this course, marked by a set of milestones from data collection, data management, data preprocessing, spatial analysis and modelling, and result presentation.	14

Recommended Books

1. Paul Bolstad, 2008. GIS Fundamentals, a First Text on Geographic Information Systems. 3rd Edition. Eider Press, ISBN 978-0-9717647-2-9.
2. Longley, P.A., Goodchild, M. F., Maguire, D. J., and Rhind, D. W., Geographic Information Systems and Science, 2nd Edition, John Wiley and Sons, 2005.
3. Burrough, P.A., and McDonnell, R.A., Principles of Geographical Information Systems, 2nd Edition, Oxford University Press, 1998.
4. Demers, M. N., Fundamentals of Geographic Information Systems, John Wiley Sons, 3rd Edition, 2002.
5. Longley, P.A., Goodchild, M. F., Maguire, D. J., and Rhind, D. W., Geographic Information Systems and Science, 2nd Edition, John Wiley and Sons, 2005.
6. Kang-Tsung Chang, "Introduction to Geographic Information Systems", McGraw-Hill Book Company,2006
7. Ormsby, T., E. Napoleon, R. Burke, C. Groessl, and L. Bowden 2010, Getting to Know ArcGIS Desktop: for ArcGIS 10, 2nd Edition, ESRI Press, Redlands, CA, ISBN: 978-1-58948-260-9

Hydraulic Structures & Irrigation Engineering [PE-BTC631]

Course Code	Course Name
PE-BTC631	Hydraulic Structures & Irrigation Engineering

Course pre-requisites	Fluid Mechanics, Hydraulic Engineering, Hydrology & Water Resources Engineering

Course Objectives

The objectives of this course are

1. To understand design principles of hydraulic structures for irrigation purpose.
2. To Know about the basics of design of canals, weir, barrage and appurtenance works
3. To provide knowledge on various hydraulic structures such as energy dissipaters, head and cross regulators, canal falls and structures involved in cross drainage works

Course Outcomes

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

1. Understand the principles of designing gravity and earthen dams, irrigation channels, and various hydraulic structures.
2. Estimate crop water requirements and design lined and unlined irrigation channels considering surface and subsurface flow at hydraulic structures.
3. Analyse and design diversion headworks, cross drainage works, and control structures such as canal falls and regulators using empirical and theoretical methods.
4. Evaluate construction techniques, instrumentation, maintenance practices, and deterioration mechanisms in dams and other hydraulic structures using case studies and field data.

CO-PO-PSO Mapping

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

Course Content

Module No.	Details	Hrs.
1	Design principles for gravity and earthen dams. Key issues in designing irrigation channels and hydraulic structures used in irrigation systems	06
2	Estimation of crop water requirement, Design of lined and unlined channels; Analysis for surface and sub-surface flow at hydraulic structures	06
3	Site selection and investigations for diversion works;	06

	Hydraulics of flow over weirs/under sluices; Components of barrage- waterway, under sluice/weir, glacis, stilling basin and appurtenance works, cutoff, u/s and d/s protection works, Bligh's creep theory, Khosla's Theory	
4	Design of canal falls, regulators	06
5	Cross drainage works: Types of cross drainage works. Design aspects of aqueducts, siphon aqueducts, super-passage, siphon	06
6	Instrumentation and maintenance aspects in earth and gravity dams: Measurements of deformations, pore pressures; Quality control; Foundation preparation and treatment; Quality control of materials and control of moisture, laying and compaction; Tests for quality control; Diversion during construction Deterioration of concrete in dams and remedial measures.	06
7	Discussion on various case studies in Hydraulic structures and Irrigation engineering	06

Recommended Books

1. S. R. Sahasrabudhe (2011); "Irrigation Engineering and Hydraulic Structures" S. K.Kataria& Sons
2. S. K. Sharma; "Design of Irrigation Structures", S. Chand and Co. ISBN-13 – 9788121903295
3. R. S. Varshney and R. C. Gupta (1988); "Theory and Design of Irrigation Structures: Canal and storage works" Nem Chand & Bros. ISBN-13 – 9788185240022
4. G.L.Asawa (2006); "Irrigation and Water Resources Engineering", New Age International Publishers. ISBN-13 9788122416732. 624p
5. M.Michael,(2014); "Irrigation Theory and Practice" 2nd Edition, Vikas Publishing Pvt. Ltd.

Introduction to Offshore Engineering [PE-BTC632]

Course Code	Course Name
PE-BTC632	Introduction to Offshore Engineering

Course pre-requisites	Fluid Mechanics , Hydraulic Engineering, Hydrology & Water Resources Engineering

Course Objectives

The objectives of this course are

1. To understand the complexities in offshore construction and obtaining resources from the ocean.
2. To addresses the general engineering concepts that are fundamental to offshore engineering.
3. To understand types of sites and platform structures, key engineering systems and ocean environmental monitoring

Course Outcomes

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

1. Understand the types of offshore structures and evaluate environmental loads such as wind, wave, and currents affecting their design.
2. Explain offshore construction methods, project management practices, and types of ocean platforms including their deployment strategies.
3. Analyse the structural behaviour of offshore pipelines, buoys, and mooring systems under hydrostatic and hydrodynamic forces.
4. Apply design criteria and probabilistic approaches for offshore components including mooring systems, risers, and deepwater structures, and assess real-world offshore installations through case studies.

CO-PO-PSO Mapping

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

Course Content

Module No.	Details	Hrs.
1	**Introduction:** History and current state of the art of offshore structures, Definition of Offshore Structures, Met ocean Engineering: wind, wave and current loads on offshore structures	06
2	**Environment & Construction:** Offshore environment, Construction and launching, offshore	06

	project management	
3	**Ocean construction:** Types of Platforms: Jackets, TLPs, Semisubmersibles, Jack-ups, Concrete Gravity, deep water construction in ocean, offshore site investigations	06
4	**Offshore Pipelines:** Hydrostatic, hydrodynamic analysis and structural design	06
5	**Buoys and Mooring Systems:** mooring configurations, advantages and disadvantages	06
6	**Design Criteria:** Introduction to probabilistic design, extreme load & strength & fatigue, basics of anchoring and mooring system, riser system, Scaling laws & Model testing, **Challenges in Deepwater Testing:** Deepwater installations, constructions challenges.	06
7	**Case studies in Offshore Engineering:** Indian Ocean, Arabian Sea, Bay of Bengal	06

Recommended Books

1. Subrata K. Chakrabarti (2005): Handbook of offshore engineering Volume–I & II, Elsevier, The Boulevard Langford Lane, Kidlington, Oxford OX5 l GB, UK.
2. Deo M C (2013): Waves and Structures
http://www.civil.iitb.ac.in/~mcdeo/waves.html
3. American Petroleum Institute, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms - Load and Resistance Factor Design, 1st Edition, 1993. (TP690.A642 RP2A-LRFD)
4. American Petroleum Institute, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms - Working Stress Design, 21st ed., 2000. (TP690.A642 RP2A-WSD).

Open Channel Flow [PE-BTC633]

Course Code	Course Name
PE-BTC633	Open Channel Flow

Course pre-requisites	Fluid Mechanics , Hydraulic Engineering, Hydrology & Water Resources Engineering

Course Objectives

The objectives of this course are

1. To introduce Open Channel Flow to students, explaining the types of open channel and their behaviours, the causes and principles of such behaviours, and applications open channels, enabling the students to identify the open channels, and to analyse, design and manage channels.
2. To understand a mathematical study of one dimensional flow in open channels, including uniform, gradually varied flow and sediment transport in channel

Course Outcomes

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

1. Explain and analyse uniform flow in channels
2. Analyse gradually varied and sediment transport in channel flow
3. Differentiate between prismatic and non-prismatic channels and its applications in the field.
4. Interpret spatially varied flow and sediment transport processes, and apply open channel hydraulics principles to real-world problems using case studies

CO-PO-PSO Mapping

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

Course Content

Module No.	Details	Hrs.
1	**Uniform flow:** Uniform flow formulas, Hydraulically most efficient channels, Design of channels	06
2	**Specific Energy and Specific Force:** Specific Energy, force concept, Channel Transition, Classical hydraulic jump, jump types, Energy dissipation, Control of hydraulic jump and its importance, Types of Hydraulic Jump, Energy loss.	06

3	**Gradually Varied Steady Flow:** Gradually varied steady flow and rapidly varied steady flow in open channels, surface profiles in GVF-analysis	06
4	**Computation of Gradually Varied Steady Flow:** Different method of computations, Chow'-s methods, Direct step methods, standard step method, introduction to professional software's.	06
5	**Spatially Varied Flow:** Differential Equation of spatially varied flow (increasing and decreasing), applications	06
6	**Sediment Transport:** Incipient motion, mechanism of sediment transport, sediment load, design of alluvial channels.	06
7	**Case studies:** Applications to various field problem with case studies	06

Recommended Books

1. Open Channel Hydraulics – VenTe Chow, Mc-Graw Hill, 1959.
2. Flow in Open Channel – K. Subramanya, Tata Mc-Graw Hill, 1986.
3. Flow through Open Channel-K.G.Ranga Raju, Tata Mc-Graw Hill, 1993.
4. Open Channel Hydraulics- Richard H. French, Mc-Graw Hill, 1986.
5. Open Channel Flow- F. M. Henderson, Macmillan Publishing Co. Inc., 1966.
6. Codes: 1) I.S. 4997 (1968). "Criteria for design of hydraulic jump type stilling basins with horizontal and sloping apron". Bureau of Indian Standards, New Delhi.
7. Peterka, A.J. (1984). "Hydraulic design of stilling basins and energy"

Ground Water Development and Management [PE-BTC634]

Course Code	Course Name
PE-BTC634	Ground Water Development and Management

Course pre-requisites	Hydrology and Water Resource Engineering

Course Objectives

The objectives of this course are

1. To understand the problems of groundwater in India.
2. To study the elements of groundwater hydrology as well as well hydraulics
3. To summarize the various methods of groundwater exploration
4. To evaluate sources groundwater pollution in detail and devise methods for controlling them

Course Outcomes

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

1. Understand the occurrence, distribution, and significance of groundwater in India, and its role in irrigation and water resource management.
2. Analyse the hydrologic properties of aquifers, apply well hydraulics principles, and evaluate methods of well construction, development, and performance assessment.
3. Apply geologic, geophysical, and remote sensing techniques for subsurface groundwater investigations and site selection for water wells.
4. Assess groundwater conservation strategies, artificial recharge methods, and quality issues, and interpret real-world case studies related to sustainable groundwater management

CO-PO-PSO Mapping

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

Course Content

Module No.	Details	Hrs.
1	**Introduction:** Problems and perspectives regarding groundwater in India; Use of groundwater and its impact on irrigation water management.	02
2	**Hydrologic Properties of Water Bearing Formation:** Occurrence, storage and distribution of groundwater; Use of groundwater zone maps; Groundwater resource assessment and	05

	budget	
3	**Elements of Groundwater Hydrology:** Ground water recharge, ground water balance, aquifer properties Surface investigations of groundwater; Well hydraulics- steady and unsteady flows; Water wells- test holes and well logs; Design, construction and development of shallow and deep wells, design of screen and gravel packs	06
4	**Surface and Subsurface investigations:** (Geologic methods); remote sensing; geophysical explorations; electrical resistivity and seismic refraction), Water Wells: Construction; completion, development, protection and rehabilitation of wells;	06
5	**Ground Water Conservation and Artificial Recharge:** Sustained yield, water balance equation; Ground-water and surface-water interaction, interference of wells; Watershed conservation measures in irrigation commands	06
6	**Groundwater Quality:** Agricultural sources of pollution, causes and monitoring; Technical, socio-economic and organizational aspects of groundwater management	06
7	**Case Studies:** Discussion on case studies and field applications in Ground water development and management	05

Recommended Books

1. Bear, J., "Hydraulics of Groundwater", McGraw Hill.1979
2. Karanth, K. R., "Groundwater Assessment, Development and Management", Tata McGraw Hill.1987
3. Rastogi, A.K., "Numerical Groundwater Hydrology", Penram International.2007
4. Raghunath, H.M., "Groundwater", New Age International.2007
5. Sharma, H.D. and Chawla, A.S., "Manual on Ground Water and Tube Wells", Central Board of Irrigation and Power.1977
6. Sterrett, R.J., "Groundwater and Wells", Smyth Companies. 2008
7. Todd, D. K and Mays, L.W. "Groundwater Hydrology", John Wiley.2005

Solid and Hazardous Waste Management [PE-BTC641]

Course Code	Course Name
PE-BTC641	Solid and Hazardous Waste Management

Course pre-requisites	

Course Objectives

The objectives of this course are

1. Explain the various units in integrated solid waste management
2. Quantify and characterize the solid waste
3. Utilize solid waste as renewable energy
4. Deliberate and propose the kind of collection system to be used
5. Develop flowsheets based on various characterization of waste

Course Outcomes

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

1. Develop flowsheets based on type of solid waste management
2. Evaluate Quantities of waste generated
3. Analyze the type of waste generated and its end use
4. Explain and apply laws related solid waste management

CO-PO-PSO Mapping

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

Course Content

Module No.	Details	Hrs.
1	**Introduction:** History, notifications related to Solid Waste; Hazardous Waste, Plastic Waste, E Waste, Construction and Demolition Waste Definition of solid waste Domestic: garbage, ashes, rubbish, dust, debris. Biodegradable, non-biodegradable and inert (ruminant) waste. Commercial: wastes from offices, shops and markets etc. Hazardous waste: household, industrial. Biomedical waste Segregation at source	04
2	**Sources, Quality and Quantity of Solid Wastes:** Household wastes, Waste from commercial establishments, offices, markets Solid waste from construction activities. Hospital wastes, dead animals. Quantity, composition and properties of solid wastes : Per capita municipal solid waste	08

	(city wise – as per CPHEEO manual). Quantity of industrial solid waste per unit produced. Compositions: physical, chemical and biological constituents. Sampling and characterization of solid wastes.	
3	**Collection, Segregation, Storage and Transportation of Solid Waste:** How to do segregation at source: Household level, society level, community level House to house collection, collection centers: location, sizes, types and maintenance. Transportation methods: manual, mechanical, methods with or without compaction, economy in transportation of waste, optimization of transportation routes, Application of GIS	05
4	**Disposal of Solid Waste :** Segregation, reduction at source, recovery and recycle Disposal methods: pen dumping, sanitary land filling, composting-anaerobic and aerobic, windrow composting, in vessel composting, incineration, sea disposal, vermin-composting Scientific closure of open dumping site with case study Modern trends: Thermal, biological and chemical conversion technologies.; Disposal of other waste: Construction and demolition, E- Waste, biomedical, sanitary waste Case studies (Household level, society level, municipal level) Site visit to SWDF (Ramky Taloja)	12
5	**Management of Specific Types of Waste:** Plastic waste, E Waste, Biomedical waste and construction and demolition waste, Waste as resource Case studies	05
6	**Introduction to Hazardous Waste:** Generation, minimization at source, treatment and disposal.	04
7	**Effect of solid waste on environment:** Effects on air, soil, water surface and ground, health hazards Municipal solid waste in Indian conditions, legal aspects of solid waste disposal. Qualitative exposure to waste to energy	04

Recommended Books
1. Integrated Solid Waste Management: Techobanglous, Thisen and Vigil, McGraw Hill International. 2. Hazardous Waste Management: Lagrega, Buckingham and Evans, McGraw Hill International. 3. Solid Waste Management in Developing Countries: A.D. Bhide, Nagpur publications

Air and Noise Pollution Control [PE-BTC642]

Course Code	Course Name
PE-BTC642	Air and Noise Pollution Control

Course pre-requisites	

Course Objectives

The objectives of this course are

1. Quantify Composition of air and quantification of gases and particulates
2. Understand effects of air and noise pollution
3. Design of control devices such as fabric filters, cyclones, electrostatic precipitators for air pollution
4. Mitigation measures for control of noise pollution

Course Outcomes

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

1. Explain the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management
2. Identify, formulate and solve air and noise pollution problems
3. Design stacks and particulate air pollution control devices to meet applicable laws

CO-PO-PSO Mapping

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

Course Content

Module No.	Details	Hrs.
1	Air Pollution: Definition, Air Pollution and Global Climate, Units of measurements of pollutant, Air quality criteria, emission standards, National ambient air quality standards – Air pollution indices, Air quality management in India	03
2	Sources and Classification of Air Pollutants: Manmade, Natural sources, Type of air pollutants, Pollution due to automobiles , Analysis of air pollutants , Chemical, Instrumental and biological methods. Principle and methods for analysis (online assessment of air pollutants) Air pollution and its effects on human beings, plants and animals, Economic effects of air pollution	03
3	Meteorological Aspects of Air Pollution, Large scale wind circulation geotropic wind, gradient wind, cyclone,	04

	anticyclone, planetary boundary layer. Lapse rate, stability conditions, wind velocity profile, maximum mixing depth, topographic effects.	
4	Plume patterns, plume dispersion, Gaussian model for predicting concentration, downwind from a single source, diffusion coefficients, Methods and instruments for sampling and analysis of air for stack and ambient air monitoring. Assessment models such as AERMOD, CALINE, ISC. Emission factors for different pollutants and its sources for doing Emission modelling; Emission from vehicular sources	05
5	Control Devices Principles, operations and types, simple hoods and ducts. Settling chambers, cyclones, electrostatic precipitators (ESP), Filters, scrubbers, absorption towers and incinerators. Collection efficiencies for laminar and turbulent flows for settling chambers, particle cut size for cyclone, ESP Concept of frictional and overall efficiencies. Design criteria for filters, scrubbers, absorption towers and incinerators, Control of SOx, Nox New techniques to control particulate matters like filters, thermal oxidation; use of catalyst like TiO2to control NOx, CO, VOCs; Design of household air purifiers	14
6	Sources of noise, Units and Measurements of Noise, Characterization of Noise from Construction, Mining, Transportation and Industrial Activities, Airport Noise, General Control Measures, Effects of noise pollution, auditory effects, non-auditory effects. Noise Menace, Prevention and Control of Noise Pollution, Control of noise at source, control of transmission, protection of exposed person, Control of other types of Noise Sound Absorbent Introduction to noise modelling software like SoundPlan, Caustik	09
7	Government of India: air and noise pollution laws. Indian standards- emission and air quality standards, noise standards Indian and International. Continuous Emission Monitoring Requirement Discussion of occupational hazard and Safety	04

Recommended Books

1. C. S. Rao, "Environmental Pollution Control Engineering", Wiley Eastern Limited, 2000.
2. M. N. Rao, H. V. N. Rao, Air pollution, Tata McGraw Hill Pvt Ltd, New Delhi, 1993
3. Dr. Y. Anjaneyulu, "Air Pollution and Control Technologies", Allied publishers Pvt. Ltd., 2002.

Rural Water Supply and Sanitation [PE-BTC643]

Course Code	Course Name
PE-BTC643	Rural Water Supply and Sanitation

Course pre-requisites	Water Supply Engineering , Water Supply Engineering Lab,. Wastewater Engineering and Air Pollution, Wastewater Engineering and Air Pollution Lab.

Course Objectives

The objectives of this course are

1. Comprehend the global picture of water/sanitation/hygiene and health;
2. Know the major technologies and processes of water/sanitation infrastructure in developing countries;
3. Understand the social and cultural factors (e.g., gender issues, children's needs) that must be considered and incorporated into the planning and implementation of water supply and sanitation systems in developing countries;
4. Familiar with the patterns of domestic water use and waste disposal in developing countries, and to describe the modes of transmission of water-related diseases;
5. Understand the principles of operation of a range of appropriate water and sanitation technologies, and to be able to critically evaluate them with respect to multiple criteria;
6. Investigate the concept of community participation and its role in enabling project success and sustainability

Course Outcomes

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

1. Design the rural water supply system based on the characteristics of water and requirement of community
2. Solve basic infrastructure and hygiene problems faced by the community
3. Design rural sanitation system in affordable and hygienic manner

CO-PO-PSO Mapping

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

Course Content

Module No.	Details	Hrs.
1	Introduction to water and sanitation development	01
2	Rural Water Supply: Issues of rural water supply –Various techniques for rural water supply- merits- National rural	10

	drinking water program- rural water quality monitoring and surveillance- operation and maintenance of rural water supplies. Network of water supply Low Cost water Treatment: Introduction – Epidemiological aspects of water quality methods for low cost water treatment – Specific contaminant removal systems; Pot chlorination	
3	Epidemiology : Communicable diseases, Micro-organisms, Methods of communication, Diseases communicated by discharges of intestines, nose and throat, other communicable diseases and their control	03
4	Rural Sanitation: Introduction to rural sanitation- Community and sanitary latrines - Planning of wastewater collection system (network) in rural areas- Treatment and Disposal of wastewater - Compact and simple wastewater treatment units and systems in rural areas stabilization ponds - septic tanks - Imhoff tank- soak pits- low cost excreta disposal systems Effluent disposal. Identify problems pertaining to rural water supply and sanitation. Design water supply and sanitation system for rural community Recycle and reuse using low cost technology like constructed wetlands, anaerobic digester, modification of septic tanks, grey water recycling technologies	13
5	Industrial Hygiene and Sanitation: Hygiene requirements for Schools- Public Buildings-Hospitals- Eating establishments- Swimming pools – Cleanliness and maintenance and comfort- Industrial plant sanitation.	05
6	Solid Waste Management: Disposal of Solid Wastes- Pit Composting- land filling incineration- Biogas plants - Rural health - Other specific issues and problems encountered in rural sanitation. In vessel composting, waste to energy	05
7	Case study – Utility pro poor approach to Bangalore slums Business model for providing affordable sanitation and water; Water and sanitation requirement for religious purposes	05

Recommended Books

1. Water Treatment and Sanitation – Simple Method for Rural Area' by Mann H.T. and Williamson D.
2. Operation and maintenance of rural water supply and sanitation systems by Brikké F
3. 'Water Supply for Rural Areas & Small Communities' by Wanger E.G. and Lanoix J.N.
4. WHO 'Water Supply and Sewerage', by E.W.Steel&T.J.Mcghee, McGraw Hill.
5. 'Manual on Water Supply and Treatment', CPHEEO, Ministry of Urban Development, Govt. of India.
6. 'Manual on Sewerage and Sewage Treatment', CPHEEO, Ministry of Urban

Development, Govt. of India
7. 'Environmental Engineering' by D. Srinivasan, PHI Learning Pvt. Ltd. 2009.
8. Cairncross, Sandy, and Richard Feachem. Environmental Health Engineering in the Tropics:
9. An Introductory Text. Chichester, UK: John Wiley & Sons, 1993, chapter 1 and appendix C. ISBN: 97804719388

Special Construction Materials & Methods [PE-BTC651]

Course Code	Course Name
PE-BTC651	Special Construction Materials & Methods

Course pre-requisites	Building Material and Construction, Building Design with CAD, Material Testing Lab

Course Objectives

The objectives of this course are

1. To describe the unique materials used in constructions
2. To understand the need and basics of constructions chemicals.
3. To summarize the students about various techniques of sub structure and super structure construction

Course Outcomes

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

1. Understand the properties, specifications, and quality control practices of conventional and emerging eco-friendly construction materials used in civil engineering.
2. Identify and evaluate the suitability of construction chemicals, advanced masonry and concrete materials, and sustainable alternatives for various construction applications.
3. Analyse and compare specialised materials and technologies used in thermal insulation, fireproofing, earthquake resistance, 3D printing, and precast/pre-engineered construction systems.
4. Apply advanced construction methods for sub-structure and super-structure works, including tunnelling, deep foundations, offshore structures, and high-rise buildings, with a focus on safety, sustainability, and material efficiency.

CO-PO-PSO Mapping

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

Course Content

Module No.	Details	Hrs.
1	Design, production, application, specification, and quality control of construction materials unique to civil engineering. Eco friendly Construction Materials/ Green Construction materials	06
2	Materials used in construction Especially for masonry work and concrete work, such as Lightweight Autoclaved Aerated Concrete Blocks, Geopolymer bricks, slag sand, Rebar	06

	materials, Predefined Concrete solutions such as Concrete Cover/spacers blocks. Construction Chemicals: in Concrete, water proofing, tiling: Admixtures & Surface Treatments, Grouts and anchors, Industrial Flooring, Concrete repairs and crack filling, Protective Coating, Joint sealants, Water proofing and adhesives, Cement additives	
3	Reflective coating materials, thermal Insulation materials, Fire proof insulation materials, Earthquake resistant Materials and materials used in special requirements of construction, Ferro cement Plumbing material Precast concrete construction methods/Pre Engineered Building: Recycling of Construction and Demolition wastes, Use of plastics in Construction 3D printing	06
4	Basics of construction methods for Bridges; Identification of cutting edge sustainable construction materials, technologies, and project management strategies for use in the construction industry and evaluation of their potential to reduce the negative environmental impacts of construction activity	06
5	Sub Structure Construction- Techniques of Box jacking – Pipe Jacking -underwater construction of diaphragm walls and basement-Tunnelling techniques – Piling techniques - well and caisson – sinking cofferdam - cable anchoring and grouting-driving diaphragm walls, sheet piles - shoring for deep cutting - well points -Dewatering and stand by Plant equipment for underground open excavation	06
6	Super Structure Construction- Launching girders, bridge decks, off shore platforms – special forms for shells - techniques for heavy decks – in-situ pre-stressing in high rise structures, - Erection of articulated structures, braced domes and space decks;	06

Recommended Books

1. Dr. B.C. Punamia(2008); "Building Construction" Laxmi Publications (P) Ltd. ISBN 13: 978-8131804285. 666p.
2. S. S. Bhavekatti (2012); "Building Construction" VikasPulishing House Pvt Ltd. ISBN-13: 978-9325960794. 356p.
3. S. P. Arora and S. P. Bindra (2010); "Textbook of Building Construction", Dhanpat Rai & Sons publication, ISBN-13: 978-8189928803. 688p
4. Sushil Kumar (2010); "Building Construction" Standard Publishes-Distributors. ISBN-13: 978-8180141683. 796p.
5. Construction Technology: Analysis,and Choice, 2ed,Bryan, Wiley India
6. Construction Planning, Equipment and methods – Peurifoy-Tata McGraw Hill

Publication
7. Construction Equipment Planning and Applications – Dr. Mahesh Varma
8. Brochures Published by various agencies associated with construction..
9. Journals such as CE & CR. Construction world, International Construction.
10. Document Reports of actual major works executed.
11. Construction Technology by Roy Chudley and Roger Greeno, Prentice Hall, 2005

Appraisal & Implementation of Infrastructure Projects [PE-BTC652]

Course Code	Course Name
PE-BTC652	Appraisal & Implementation of Infrastructure Projects
Course pre-requisites	Construction Engineering and Management

Course Objectives

The objectives of this course are
1. To discuss about Infrastructure project and their feasibility.
2. To explain appraisal of construction project.
3. To describe the need of financial and environmental appraisal of project.
4. To outline project audit, financing and its implementation.

Course Outcomes

Upon completion of the course, the students will be able to
1. Describe the components, phases, and stakeholder roles in infrastructure projects across urban and rural sectors.
2. Assess project feasibility and compare implementation models such as BOT, BOOT, and BOO through structured project planning and analysis techniques.
3. Conduct technical, managerial, financial, and environmental appraisals of infrastructure projects using standard evaluation tools and sustainability parameters.
4. Examine infrastructure project financing methods, audit mechanisms, and address key challenges in road and bridge development under public-private partnership (PPP) models.

CO-PO-PSO Mapping

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

Course Content

Module No.	*Details*	*Hrs.*
1	Components of Infrastructure, Infrastructure scenario in India, Key issues sector wise, Urban Infrastructure, Rural infrastructure, characteristics of construction project, stakeholders in Infrastructure projects, Phases of infrastructure project	04

2	Project Feasibility Project management cycle, Detailed Project report, project formulation project implementation, Agencies involved in implementation, methods of implementation like Build, operate and transfer (BOT) method and its variants like BOO, BOOT, BOLT etc, SWOT analysis of project.	04
3	Project Appraisal Introduction, Need of appraisal, steps of appraisal Market appraisal, Demand analysis, forecasting demand, sources of information, market survey, uncertainties in demand forecasting Technical appraisal Location, land, buildings, technology and its appropriateness, size of plant, plant and machinery, raw materials, energy requirements, water supply, effluent disposal Management appraisal	08
4	Financial and Environmental Appraisal of project Break-even analysis, financial projections, financial appraisal tools: payback period, accounting rate of return, net present value, internal rate of return, benefit cost ratio, cost of capital, risk analysis, social cost benefit analysis. Guidelines for environmental Appraisal for infrastructure project	08
5	Project Audit Project budget and schedule, causes of project failure, reason for audit, Construction Contract audit and phases of project audit.	08
6	Project financing Norms and policies of financial institutions, Types of financing, sources (local and international),Cash flows by financial institutions, planning commission/Niti Aayog, various issues in financing	05
7	Road and bridge Infrastructure Development Issues and challenges in construction and maintenance of road and bridge Infrastructure, sustainable development of Infrastructure, role of PPP in road and bridge infrastructure development.	05

Text / Reference Books

1.Project Preparation, Appraisal, Budgeting, and Implementation: Prasanna Chandra, Tata McGraw Hill.

TQM and MIS in Construction [PE-BTC653]

Course Code	Course Name
PE-BTC653	TQM and MIS in Construction

Course pre-requisites	Construction and Engineering Managment

Course Objectives

The objectives of this course are

1. To study the concept of quality in construction.
2. To describe the need of MIS in Construction.
3. To explain the need of TQM, ISO and SIX Sigma in Construction.

Course Outcomes

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

1. Define the key concepts of quality in construction and identify factors affecting quality, along with corrective measures to address poor quality in projects.
2. Explain the structure and components of Management Information Systems (MIS) and their role in supporting decision-making in construction management.
3. Apply the principles of Total Quality Management (TQM), ISO standards, and quality manuals to enhance quality control and assurance in construction activities.
4. Utilise modern tools such as ERP, smartphone technologies, GIS, and GPS to improve quality monitoring and documentation in construction projects.

CO-PO-PSO Mapping

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

Course Content

Module No.	Details	Hrs.
1	**Quality in Construction:** Quality – Various definitions and interpretation. Importance of quality on a project in the context of global challenges. Factors affecting quality of construction, reasons for poor quality & measures to overcome.	07
2	**MIS:** Introduction to Management Information systems (MIS) Overview, Definition. MIS and decision support systems, Information resources, Management subsystems of MIS.	07

3	**TQM in Construction:** TQM – Necessity, advantages, Six sigma as a tool in TQM. Defects & it's classification in construction. Measures to prevent and rectify defects.	07
4	**TQM, ISO & Quality Manual:** Difference between, quality control, quality assurance, total quality control and total quality management (TQM). Process based approach for achieving TQM. Study of ISO 9001 principles. ISO implementation procedure in Construction Industry. Quality manual – Importance, contents, documentation. Importance of check-lists in achieving quality. Typical checklist for concreting activity, formwork activity, steel reinforcement activity. Importance of third party certification in Quality Control(ISO, Six Sigma, DUPONT certifications)	07
5	**Management Control:** Management information system structure based on management activity whether for Operational control, management control or strategic planning. Supply chain management as a tool in TQM, Benchmarking in TQM, Kaizen in TQM Categories of cost of Quality.	07
6	**Modern tools in TQM Implementation:** Development of an MIS for a construction organization associated with building works, study and use of various modules of ERP software for construction. Introduction to smart phone technology & incorporating GIS, GPS, Android subsystems for documentation and monitoring of construction projects.	07

Recommended Books

1. Juran's Quality Handbook – Juran Publication
2. Management –Principal, process and practices by Bhat – Oxford University Press.
3. Financial management by Shrivastava- Oxford University Press
4. Management Information Systems – Gordon B. Davis, Margrethe H. Olson – Tata McGraw Hill Publ. Co.
5. Total Project Management – The Indian Context - P.K.Joy Macmillan India Ltd.
6. Total Quality Management-- Dr. Gunmala Suri and Dr. Puja Chhabra Sharma—Biztantra
7. Quality Control and Total Quality Management by P.L.Jain- Tata McGraw Hill Publ. Company
8. Total Quality Management - Dr. S.Rajaram and Dr. M. Sivakumar-- Biztantra
9. Total Engineering Quality Management – Sunil Sharma – Macmillan India Ltd.

10. E- Sources: www.nptel.ac.in , www.mobile.enterpriseappstoday.com

Engineering Risk and Uncertainty [PE-BTC654]

Course Code	Course Name
PE-BTC654	Engineering Risk and Uncertainty

Course pre-requisites	

Course Objectives

The objectives of this 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

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

1. Explain how risk management and analysis is done on modern construction projects.
2. Understand mathematical models based on stochastic and statistical methods for risk management.
3. Develop risk mitigation Plan in construction projects.

CO-PO-PSO Mapping

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	2	2	2	2	2	2	1	2	1	1	2	3
CO2	3	3	2	3	2	–	–	–	–	–	–	2	3
CO3	2	2	3	2	2	2	2	1	2	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, quantifiable and un-quantified risks. Risk analysis and Management for projects (RAMP)	07
2	Performance Measures, Scope of risk control during project life cycle. Risk Registers. Risk Mitigation – by elimination, reducing, transferring, avoiding, absorbing or pooling. Residual risk, mitigation of unqualified risk. Coverage of risk through various policies, role of insurance in risk management.	07
3	Risk analysis in construction projects, Risk Registers, Risk priority number, Risk identification, and analysis& response measures.	07

4	Use of mathematical models based on stochastic and statistical methods, Probabilistic Risk Assessment.	07
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, certainty index method, 3 point estimated method.	07
6	Concept of simulation, Monte Carlo simulation, Use of simulation in risk identification, analysis and mitigation.	07

Recommended Books

1. 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. 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

Pavement Subgrade and Materials [PE-BTC661]

Course Code	Course Name
PE-BTC661	Pavement Subgrade and Materials

Course pre-requisites	Concrete Technology, Surveying & Geomatics, Soil Mechanics

Course Objectives

The objectives of this course are

1. To describe the different layers of flexible and rigid pavement.
2. To explain the function of subgrade, properties of subgrade material and its determination.
3. To discuss the importance of drainage system, its design and ground improvement techniques

Course Outcomes

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

1. Identify the quality of material to be used in subgrades and other pavement layers and demonstrate laboratory and field test.
2. Utilize the knowledge gained for the analysis and design of surface and subsurface drainage system.
3. Appraise different ground improvement technique, use of different stabilizer like, lime, fly ash, fibres in highway subgrade

CO-PO-PSO Mapping

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

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	05
2	Grading requirements for aggregate, selection of bases and subbase material (including stabilized materials), selection of different grade of bitumen, types of bituminous surfaces, skid qualities, bituminous mix design, Marshall stability test, design aspect of paving concrete. Experimental characteristics of road aggregate.	07

3	Soil Survey: Soil Survey Procedure for Highway and Ground Water Investigation. Identification and Significance of soil Characteristics, effect of water in soil Swelling/shrinkage, cohesion, plasticity in soil. Soil Moisture movement ground water, gravitational water, held water, soil suction	05
4	Storm water Drainage: General principles subsoil Drainage. Compaction of soils, field and laboratory method of soil compaction, equipment's used in field compaction. Design of surface and subsurface drainage system, pumping system, water body, holding ponds	07
5	Stress in soil: Theories of elastic and plastic behaviour of soils, Methods of reducing settlement, estimation of rate of settlement due to consolidation in foundation of road embankment	04
6	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.	07
7	Ground Improvement Technique: Different method of soil stabilization, use of geo-textile, geogrid and fibres, lime, fly ash in highway subgrade. Vertical sand drain: design criteria, construction and uses	07

Recommended 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 & Justo, New Chand & Brothers, Roorkee.
4. Principles and Practices of Highway Engineering: Dr. L. R. Kadiyali and Dr. N. B. Lal, Khanna Publication, New Delhi.

Low Cost Roads [PE-BTC662]

Course Code	Course Name
PE-BTC662	Low Cost Roads

Course pre-requisites	Highway Engineering, Soil Mechanics

Course Objectives

The objectives of this course are

1. To acquire the knowledge about the selection of materials for construction and maintenance of Rural Roads.
2. 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

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

1. Describe rural road planning procedures, alignment surveys, and apply PMGSY prioritisation methods for project preparation and development.
2. Apply geometric design standards and evaluate the engineering properties and suitability of pavement materials for different layers of rural roads using standard tests.
3. Design flexible, semi-rigid, and roller-compacted pavements, and select appropriate construction techniques, equipment, and sustainable materials including industrial and agricultural waste.
4. Plan and implement maintenance strategies and quality control measures for rural road networks, addressing pavement distresses and ensuring construction compliance.

CO-PO-PSO Mapping

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

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 subgrade soils.	06
4	**Design and Construction of Rural Roads:** Flexible pavement, semi rigid pavements, roller compacted concrete pavements; equipment's used during construction of roads.	06
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.	06
7	**Quality Control:** Quality control test prior to construction and during construction on different pavement layer materials and pavement layers. frequency of tests.	06

Recommended Books
1. S. K. Khanna, C. E. G. Justo & A. Veeraragavan (2014); "Highway Engineering",Xth Edition New Chand & Brothers, Roorkee. 2. Dr. L. R. Kadiyali and Dr. N. B. Lal (2005); "Principles and Practices of Highway Engineering", Khanna Publication, New Delhi. ISBN-13: 9788174091659. 3. Guide lines for the Design of Rigid Pavements, IRC: 58:2002, IRC: 58:2011. 4. Guide lines for the Design of Flexible Pavements, IRC: SP: 20 2002. 5. Specification for Rural Roads – 2014, Ministry of Rural Development.

Traffic Engineering and Control [PE-BTC663]

Course Code	Course Name
PE-BTC663	Traffic Engineering and Control

Course pre-requisites	Highway Engineering

Course Objectives

The objectives of this course are

1. To discuss different types of traffic surveys with conventional and latest techniques for data collection and summaries the application of statistical techniques for the traffic related problems.
2. To develop skills for planning, design and operations of traffic regulatory and control devices with due application of statistical techniques.

Course Outcomes

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

1. Conduct traffic surveys and studies, and analyse traffic flow parameters such as speed, volume, origin-destination, and trip characteristics to support effective transportation planning.
2. Apply statistical and mathematical methods including probability, hypothesis testing, and transportation assignment models for traffic data analysis and decision-making.
3. Design intersections, traffic signal systems, and rotary layouts considering geometric, functional, and operational aspects for safe and efficient traffic flow.
4. Evaluate transportation plans using economic analysis methods, and recommend appropriate traffic signs, markings, and control strategies for improved roadway performance.

CO-PO-PSO Mapping

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

Course Content

Module No.	Details	Hrs.
1	**Traffic Engineering and Control:** Importance of traffic engineering, power performance of vehicles, running speed, journey speed, spot speed studies, Various traffic surveys and traffic studies: vehicle volume counts classification and occupancy, Origin – Destination surveys, Trip generation and trip distribution.	07
2	**Statistical Methods for Traffic Engineering and Their**	07

	Applications: Probability and its application, std. deviation, Distributions, Sampling theory and Significance testing, Regression and Correlation, Hypothesis.	
3	**Transportation and Assignment Problems:** Balanced and Unbalanced Transportation Problem, N-W Corner Method, Least Cost Method, Vogel's Approximation method.	06
4	**Intersection Design:** At grade and grade separate intersection, rotary inter section its advantages and disadvantages, design rotary inter section, mini round about.	05
5	**Traffic Signals:** Types of traffic signals, advantages, determination of optimal cycle time and signal setting for an intersection with fixed time signals, co-ordination of signals, types, area traffic control, delay at signalized intersection.	06
6	**Economic Evaluation of Transportation Plan:** Cost and benefits of transportation project, different methods available for economic evaluation.	06
7	**Traffic signs and Markings:** General principal of traffic signing, Types of traffic signs, Location and maintenance of signs, Different types of road markings, marking design, marking maintenance.	05

Recommended Books

1. Traffic Engineering and Transport Planning: L.R. Kadiyali, Khanna publishers Delhi
2. Principles of Traffic Engineering: G.J. Pingnataro, McGraw-Hill, 1970.
3. Traffic System Analysis for Engineering and Planners: Wohl and Martin, McGraw Hill, 1983.
4. Principles of Transportation Engineering: Partha Chakroborty and Animesh Das, Prentice hall (India)
5. Traffic Flow Theory and Control: Drew D.R., McGraw – Hill , New York, 1964
6. Highway Capacity Manual, Transportation Research Board, National Research Council, Washington D.C.

Ground Improvement Techniques [PE-BTC671]

Course Code	Course Name
PE-BTC671	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. Explain 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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	3	3	2	1	1	2	1	-	-	1	2	3	3
CO 2	3	3	3	2	3	1	2	1	-	-	1	2	3	3
CO 3	3	3	3	2	1	2	2	1	-	-	1	2	3	3
CO 4	3	3	2	2	1	3	2	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	07
3	Ground improvement by drainage and de-watering, pre-loading, vertical drains and design, vacuum consolidation, stone columns construction methods	07
4	Cement stabilization, cement columns, lime columns, Compaction grouting, and jet grouting	08
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	03

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. Foundation Design Manual. 7th Edition, Dhanpat Rai Publications, India, 2018.
4. Relevant journal and conference papers for case studies.
5. Relevant IS codes

Foundation Engineering Lab. [PC-BTC651]

Course Code	Course Name
PC-BTC651	Foundation Engineering Lab.

Course pre-requisites	Soil Mechanics, Soil Mechanics Lab.

Course Objectives

The objectives of this course are

1. To familiarize students with measurement of various soil properties.

Course Outcomes

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

1. Conduct standard geotechnical laboratory tests to evaluate engineering properties of soils.
2. Interpret test data from lab tests for determining strength and deformation characteristics of soil.
3. Demonstrate proficiency in using geotechnical software for analysing soil behaviour.
4. Prepare structured lab reports by analysing results and collaborating effectively in teams, while adhering to safety and quality practices in the laboratory.

CO-PO-PSO Mapping

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

List of Experiments

Experiment No.	Name of the Experiment
1	Consolidation Test
2	Direct Shear Test
3	Unconfined Compression Test
4	Triaxial Test
5	CBR Test
6	Introduction to Software for Geotechnical Engineering

Recommended Books

1. Singh A. Soil Engineering in Theory and Practice (Vol. -1). 4th Edition, CBS Publishers and Distributors Pvt. Ltd., India, 2018.
2. Murthy, V. N. S. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering. CRC Press, India, 2002.
3. Relevant Indian Standard Specifications & Codes, BIS Publications, New Delhi.

Design and Drawing of Steel Structures [PC-BTC656]

Course Code	Course Name
PC-BTC656	Design and Drawing of Steel Structures

Course pre-requisites	Design of Steel Structures , Engineering Graphics

Course Objectives

The objectives of this course are

1. To develop clear understanding of concepts, and practical knowledge of modern CivilEngineering techniques for design of steel structures and the structural drawings for the same.
2. Use of various relevant IS codes for designing steel structures.

Course Outcomes

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

1. Apply relevant Indian Standards (IS 875 and IS 800) to determine design loads and perform structural analysis for steel members in trusses and multistorey buildings.
2. Design structural components such as truss members, beams, columns, purlins, bases, and various types of connections under tension and compression.
3. Develop structural drawings using appropriate detailing practices for steel elements and connections in accordance with codal provisions.
4. Collaborate effectively in group and individual design tasks, manage project workflow, and document complete design processes through structured reports and drawings.

CO-PO-PSO Mapping

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

List of Experiments

Experiment No.	Name of the Experiment
1	Group project on design and drawing of Roof truss involving: • Understanding and applying the relevant codes for loads and design i.e. IS 875 –Part I, II and III; IS 800-2007 • Obtaining the dead load, live loads and wind loads on truss system • Analysis of member forces • Grouping of members for design • Design of truss members for tension and compression • Design of purlins

	• Design of connections • Preparation of detailed drawings for all the elements designed.
2	Group project on design and drawing of G+2 steel building involving : • Understanding and applying the relevant codes for loads and design i.e. IS 875 –Part I and II ; IS 800-2007 • Obtaining the dead loads and live loads on structural members of framing system • Design of beams for floor system • Design of columns • Design of column bases (Slab base and gusseted base) • Design of beam-beam and beam-column connection • Preparation of detailed drawings for all the elements designed.
3	Individual activities on design and drawing of built –up columns, connections, etc.

Recommended Books
1. S.K. Duggal, Limit State Design of Steel Structures, Tata McGraw Hill Education Private Limited, 2017 2. V.L. Shah and V. Gore, Limit State Design of Steel Structures IS: 800-2007, Structures Publication, 2012 3. Relevant Indian Standard Specifications & Codes, BIS Publications, New Delhi

Community Engagement/Field Project [FP-BTC601]

Course Code	Course Name
FP-BTC601	Community Engagement/Field Project

Course Objectives

1. To enable students to engage with civil engineering problems in real-world and community contexts through structured fieldwork.
2. To promote the application of civil engineering knowledge in areas such as transportation, water supply, waste management, housing, and sustainable construction.
3. To develop research skills through data collection, analysis, and evidence-based problem solving in community-centric projects.
4. To foster teamwork, professional ethics, and effective communication in socially impactful civil engineering interventions.

Course Outcomes

On successful completion of the course, the student will be able to:

1. Identify and assess civil engineering challenges in rural or urban communities through field surveys, site investigations, and stakeholder interaction.
2. Apply civil engineering principles and design standards to propose technically sound and socially relevant solutions in areas such as water management, infrastructure, housing, or sanitation.
3. Utilise research methods to analyse field data and evaluate the feasibility, sustainability, and impact of proposed interventions.
4. Communicate and document findings and solutions through detailed reports, technical drawings, and oral presentations, while demonstrating teamwork and professional responsibility.

CO-PO-PSO Mapping

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

Course Content

Modes of Engagement (any one or a combination):

- Field Project: Hands on project such as Designing low-cost stormwater drainage solutions for semi-urban settlements, Structural assessment of government schools or Anganwadis and proposing retrofit plans., Planning and design of low-traffic access

roads or footpaths using locally available materials.

- Community Project: Hands on project such as Design and implementation of small-scale infrastructure, Water quality and quantity assessment in rural areas and proposing rainwater harvesting schemes, rehabilitation of landslide prone area
- Research based Interventions: Any research based project which directly impacts the community