Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441 108
NAAC A+ Accredited
Approved by AICTE, New Delhi, Govt. of Maharashtra
(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

Department of Civil Engineering

DEPARTMENT OF CIVIL ENGINEERING

Structure & Curriculum

From

Academic Year 2023-24

Vision of Institute

"To emerge as a learning Center of Excellence in the National Ethos in domains of Science, Technology and Management"

Mission of Institute

[M1] To strive for rearing standard and stature of the students by practicing high standards of Professional ethics, transparency and accountability

[M2] To provide facilities and services to meet the challenges of Industry and Society

[M3] To facilitate socially responsive research, innovation and entrepreneurship

[M4] To ascertain holistic development of student and staff members by inculcating knowledge and profession as work practices

Vision of the Department

To enhance and empower the capability of youth in education, research and entrepreneurship, capable of offering the innovative solution to the challenges faced in the Civil Engineering domain

Mission of the Department

- To develop capable civil engineering graduates by imparting quality education and training.
- To nurture youth to face challenges and offer solutions in the research domain of civil engineering.
- To promote overall development of the students by enhancing their skills to become self-sufficient by offering industrial exposure.
- To develop leadership skills and engage in the process of lifelong learning.
- To create infrastructure and human services in a sustainable way, to achieve social and environmental needs.

Program Education Objectives (PEO)

- The graduates will be able to apply principles of advanced Mathematics and Engineering sciences to analyze and solve civil engineering problems.
- Create sustainable environment to plan infrastructure for social needs.
- Design and execute civil engineering projects.
- Develop as a leader and to inculcate team spirit to execute ethically the projects.
- Adopt emerging technologies for lifelong learning.

Program Outcomes (PO)

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

SCHEME OF INSTRUCTION & SYLLABI

Programme: Civil Engineering

Scheme of Instructions: Third Year B. TECH in Civil Engineering

Semester – V

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs./Wk	Credits	EXAM SCHEME				
									CT1	CT2	TA/CA	ESE	TOTAL
1	PCC	BCE3501	Reinforced Cement Concrete Structures	3	-	-	3	3	15	15	10	60	100
2	PCC	BCE3502	Advanced Structural Analysis	3	1	-	4	4	15	15	10	60	100
3	PCC	BCE3503	Advanced Surveying	3	-	-	3	3	15	15	10	60	100
4	PEC	BCE3504-07	Program Elective-I	3	-	-	3	3	15	15	10	60	100
5	PEC	BCE3508-11	Program Elective-II	3	-	-	3	3	15	15	10	60	100
6	OEC	BCEXX01-14	Open Elective-I	3	-	-	3	3	15	15	10	60	100
7	PCC	BCE3516	Reinforced Cement Concrete Structures Lab	-	-	2	2	1	-	-	25	25	50
8	PCC	BCE3517	Advanced Structural Analysis Lab	-	-	2	2	1	-	-	25	25	50
9	PCC	BCE3518	Advanced Surveying Lab	-	-	2	2	1	-	-	25	25	50
10	PROJ	BCE3519	Micro Project	-	-	2	2	1			25	25	50
11	MCC	BAU3505	Heritage	2	-	-	2	Audit	-	-	-	-	-
			Total	**20**	**1**	**8**	**29**	**23**	**90**	**90**	**160**	**460**	**800**

L- Lecture T-Tutorial P-Practical

CT1- Class Test 1 TA/CA- Teacher Assessment/Continuous Assessment

CT2- Class Test 2 ESE- End Semester Examination (For Laboratory End Semester performance)

Course Category	HSMC (Hum., Soc. Sc, Mgmt.)	BSC (Basic Sc.)	ESC (Engg. Sc.)	PCC (Programme Core courses)	PEC (Programme Elective courses)	OEC (Open Elective courses from other discipline)	Project / Seminar / Industrial Training	MCC (Mandatory Courses)
Credits	--	--	-	13	06	03	01	Yes
Cumulative Sum	06	27	18	41	06	03	02	--

PROGRESSIVE TOTAL CREDITS :80+23 =103

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Principal
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College Of Engineering &
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SCHEME OF INSTRUCTION & SYLLABI

Programme: Civil Engineering

Scheme of Instructions: Third Year B. TECH in Civil Engineering

Semester – VI

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs./Wk	Credits	EXAM SCHEME				
									CT1	CT2	TA/CA	ESE	TOTAL
1	PCC	BCE3601	Advanced Fluid Mechanics	3	-	-	3	3	15	15	10	60	100
2	PCC	BCE3602	Design of Steel Structures	3	-	-	3	3	15	15	10	60	100
3	PCC	BCE3603	Geotechnical Engineering	3	-	-	3	3	15	15	10	60	100
4	PEC	BCE3604-07	Program Elective-III	3	-	-	3	3	15	15	10	60	100
5	PEC	BCE3608-11	Program Elective-IV	3	-	-	3	3	15	15	10	60	100
6	OEC	BCEXX01-14	Open Elective -II	3	-	-	3	3	15	15	10	60	100
7	PCC	BCE3616	Geotechnical Engineering Lab	-	-	2	2	1	-	-	25	25	50
8	PCC	BCE3617	Steel Structures Lab	-	-	2	2	1	-	-	25	25	50
9	PCC	BCE3618	Advanced Fluid Mechanics Lab	-	-	2	2	1	-	-	25	25	50
10	PROJ	BCE3619	Mini Project#	-	-	2	2	1+1#	-	-	25	25	50
11	MCC	BAU3606	Social Awareness	2	-	-	2	Audit	-	-	-	-	-
			Total	**20**	**-**	**8**	**28**	**23**	**90**	**90**	**160**	**460**	**800**

 # Every Student will undergo Industrial Training/Internship of Two weeks in summer vacation after B. TECH VI Sem. Examinations, upon successful completion of industrial training/internship 01 credit will be awarded after submission of the report in prescribed format.

L- Lecture T-Tutorial P-Practical

CT1- Class Test 1 TA/CA- Teacher Assessment/Continuous Assessment

CT2- Class Test 2 ESE- End Semester Examination (For Laboratory End Semester performance)

Course Category	HSMC (Hum., Soc. Sc, Mgmt.)	BSC (Basic Sc.)	ESC (Engg. Sc.)	PCC (Programme Core courses)	PEC (Programme Elective courses)	OEC (Open Elective courses from other discipline)	Project / Seminar / Industrial Training	MCC (Mandatory Courses)
Credits	--	--	--	12	06	03	02	Yes
Cumulative Sum	06	27	18	53	12	06	04	--

PROGRESSIVE TOTAL CREDITS: 103+ 23 = 126

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Program: Civil Engineering

List of Electives offered by Civil Engineering Department

Program Elective- I	Program Elective- II	Program Elective- III	Program Elective- IV
Semester V Environmental Engineering	**Semester V** Hydrology & Water Resources Engineering	**Semester VI** Hydraulics	**Semester VI** Construction Engineering & Management
BCE3504-Rural Water Supply and Sanitation	**BCE3508**-Water Resources Engineering	**BCE3604**-Design of hydraulic structures	**BCE3608**-Building Construction Practice
BCE3505-Environmental Laws and Policy	**BCE3509**-Water Quality Engineering	**BCE3605**-Hydraulic modelling	**BCE3609**- Advanced Building Construction Methods
BCE3506-Solid and Hazardous Waste Management	**BCE3510**-Surface Hydrology	**BCE3606**-Urban Hydrology and Hydraulics	**BCE3610**-Structural Audit & Retrofitting of Structures
BCE3507-Air and Noise Pollution Control	**BCE3511**-Flood Control & Drainage Engineering	**BCE3607**-River Engineering	**BCE3611**-Construction Equipment & Automation

Program Elective- V	Program Elective- VI	Program Elective- VII	Open Elective- I	Open Elective- II
Semester VII Transportation Engineering	**Semester VII** Structural Engineering	**Semester VII** Geotechnical Engineering	**Semester V**	**Semester VI**
BCE4703-Pavement Design	**BCE4707**-High Rise Structures	**BCE4715**-Foundation Engineering	**BCEXX07**-Introduction to art and Aesthetics	**BCEXX08**-Metro Systems & Engineering
BCE4704-Urban Transportation Planning	**BCE4708**- Industrial Structures	**BCE4716**-Geotechnical Design		
BCE4705-Airport Planning and Design	**BCE4709**-Prestressed Concrete	**BCE4717**-Structural Geology		
BCE4706-High Speed Rail Engineering	**BCE4710**-Earthquake Engineering	**BCE4718**-Rock Mechanics		

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Program: B.Tech. Civil Engineering

Semester-VI	BCE3601: Advanced Fluid Mechanics

Teaching Scheme		**Examination Scheme**	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial		**CT-II**	15 Marks
Total Credits	**3**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks

Pre-Requisites: Fluid Mechanics, Engineering mechanics

Course Contents

Unit I	Flow Through Pipes: Frictional resistance to flow of fluid, loss of energy in pipe, Darcy-Weis-bach & Hazen William's equation for frictional head loss, Hydro-dynamically smooth and rough surfaces, Hydraulic gradient and energy gradient lines: Pipes in series and parallel, equivalent pipe.
Unit II	Flow Through Pipes: Syphon, Branched pipes, Three reservoir, pipe networks, Hardy – Cross method. Introduction, fundamental quantity, derived quantity, dimensions, dimensional homogeneity, methods of dimensional analysis, repeated variable, Buckingham pi method, Transient behavior of Fluid - Water hammer phenomenon
Unit III	Uniform flow in Open Channel: Types of channels and their geometrical properties, Types of flow in open channel. Chezy's and Manning's equations for computations of normal depth of flow, hydraulically most efficient rectangular, triangular, trapezoidal, circular sections.
Unit IV	Critical Flow and Rapidly Varied Flow: Specific energy and specific energy diagram, alternate depths, Computations of critical depth, section factor for critical flow, Conditions of critical flow, Definition, application of hydraulic jump, Classifications of jump, energy loss, Belanger momentum equation. Transient behavior of Fluid - surge
Unit V	(A) Turbines: Definition, Classification of Turbines; component parts and working principles. (B) Reciprocating Pumps: Components parts, working principle, Work done of single & double acting pumps (C) Centrifugal Pump: Component parts; Working principle; Static and manometric Heads; losses & efficiencies; Vertical Turbine Pump

Text Books

T.1	"Hydraulics and Fluid mechanics ", authored by Modi & Seth,Standard Book House, Delhi,2017.
T.2	"Fluid Mechanics And Fluid Power Engineering " authored by Kumar D.S., S.K.Kataria And Sons, 1998.
T.3	"Flow in open channels", authored by Subramanya K, Tata McGraw Hill Publication,, 2009.
T.4	"Fluid Mechanics: Including Hydraulic Machines" authored by Jain,A.K. ,INT Khanna Publishers,2009.

Reference Books	
R.1	"Open channel hydraulics", authored by VenTeChow , International Student Edition. McGraw Hill, 2009.
R.2	"Engineering Fluid Mechanics" authored by Garde, Mirajgaonkar, Scitech Publication, 2010.
R.3	"Flow through open channels", authored by K.G.RangaRaju,Tata McGraw Hill Publications, 1998.
R.4	"Fluid Mechanics, Hydraulics And Hydraulic Machines" authored by Arora K.R.,NT Standard Publishers Distributors, 2005.
Useful Links	
1	https://nptel.ac.in/courses/105/101/105101082/
2	https://nptel.ac.in/courses/112/105/112105206/

	Course Outcomes	CL	Class Sessions
BCE3601.1	**Determine** the losses in pipe network using Darcy-Weisbach and Hazen William's equation.	3	8
BCE3601.2	**Analyze** the pipe network system and its components including water hammer pressure.	4	10
BCE3601.3	**Understand** the concepts of uniform and critical flow through open channels including efficient channel sections.	2	9
BCE3601.4	**Analyze** energy concepts in the open channel flow and undertake Rapidly Varied flow.	4	8
BCE3601.5	**Apply** the concept of hydraulic machines in performance of Power plant.	3	10

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Semester-VI	BCE3602: Design of Steel Structures.

Teaching Scheme		**Examination Scheme**	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial		**CT-II**	15 Marks
Total Credits	**3**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks
Pre-Requisites: Mechanics of Solid		**Total Marks**	**100 Marks**

Course Contents

Unit I	Steel as a Structural Material: Physical and mechanical properties of Structural Steel, Merits and Demerits of Steel as a Structural Material, Grades of Structural Steel, Shape factor of various Structural Steel Sections, IS 800:2007, Introduction to Limit State Method.
Unit II	Structural Fasteners: Behavior of bolted and welded connections, failure of bolted and welded joints. Strength of bolt and strength of weld. Efficiency of joints. Design of simple bolt and welded connections.
Unit III	Tension Member: Types of Tension Member, Stresses, Design of Tension Member Compression Member: Effective length, Slenderness ratio, Design of Compression Member. Design of connection: Beam to beam, beam to column.
Unit IV	Design of simple and built-up beams: Laterally restrained and un-restrained, (symmetrical as well as unsymmetrical section). Design of welded plate girder and Curtailment of plates.
Unit V	Column: Design of Axially loaded columns, Design of Laced and Battened Columns (Design of Built-up Columns) with Bolted and Welded End Connection. Column Bases: Types of Column Bases, Slab Base, Gusset Base, Design of Slab Base and Gusseted Base.

Text Books

T.1	"Fundamentals of Structural Steel Design", authored by M. L. Gambhir, McGraw Hill Education, 2013
T.2	"Design of Steel Structures", authored by N. Subramanian, OXFORD University Press, First Edition, 2008
T.3	"Limit State Design of Steel Structures", authored by S. K. Duggal, McGraw Hill Education Private Limited, 2011
T.4	"Design of steel structure" authored by L.S. Negi, Tata Mc Graw hills Publisher Co. Ltd, New Delhi, 1986.

Reference Books

R.1	"Stability Analysis and Design of Steel Structure",authored By M. L. Gambhir, McGraw Hill Education, 2004.
R.2	"Design of steel structure "authored by S. S. Bhavikatti, dreamtech, distributed by Willey, 2009.

R.3	"Design of steel structure" authored by A. S. Arya and J.L. Ajmani, Nem chand bros, Roorkee, 2011.
R.4	"Design of steel structure" authored by P Dayaratnam , S. Chand of Co. Delhi 2003 edition,2012.
Useful Links	
1	https://nptel.ac.in/courses/105/105/105105162/
2	https://nptel.ac.in/courses/105/104/105104030/

	Course Outcomes	CL	Class Sessions
BCE3602.1	**Use** the knowledge of IS code of practice (IS 800) for the design of steel structural elements.	3	10
BCE3602.2	**Design** structural fasteners (Bolted and welded connections) used in steel construction.	6	9
BCE3602.3	**Design** the Tension and Compression members.	6	8
BCE3602.4	**Design** simple & built-up beams and built-up columns.	6	8
BCE3602.5	**Design** Axially loaded columns	6	10

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Semester-VI | BCE3603: Geotechnical Engineering

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial		**CT-II**	15 Marks
Total Credits	**3**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks
Pre-Requisites: Concrete Technology		**Total Marks**	**100 Marks**

Course Contents

Unit I	Introduction: Formation of soil, residual & transported soil, major deposits found in India, soils generally used in practice such as sand, gravel, organic soil, clay, Betonies, black cotton soil etc. Introduction to clay mineralogy. Phases of soil: Various soil weight & volume inter-relationship. Density index, methods of determining in situ density.
Unit II	Index Properties & Their Determination, Water content, specific gravity, sieve analysis, particle size distribution curve, sedimentation analysis, Differential and free swell value, Consistency of soil, Atterberge's limits. Classification of Soil: Particle size classification, Textual classification, Unified & I.S. classification system, field identification of Expansive soil, Swelling pressure.
Unit III	Permeability: Darcy's law & its validity, Discharge & seepage velocity, factors affecting permeability, Determination of coefficients of permeability by Laboratory and field methods, permeability of stratified soil. Seepage: Seepage pressure, quick sand condition, characteristics & uses of flow nets, Preliminary problems of discharge estimation in homogeneous soils, Effective, Neutral and total stresses in soil mass.
Unit IV	Stress Distribution: Stress distribution in soil Mass, Boussinesque equation, point load and uniformly distributed load over rectangular & circular areas, Use of Newmarks charts. Shear Strength: Introduction, Mohr Coulomb's theory, Drainage condition, Measurement of shear strength by direct shear test, triaxial test, unconfined compression test, vane shear test, and sensitivity.
Unit V	Consolidation: Compression of laterally confined soil, Terzaghis 1-D consolidation theory (formation of Differential equation), Determination of coefficient of consolidation, Degree of consolidation. Determination of preconsolidation pressure, Settlement, Rate of settlement. Compaction: Mechanism of compaction, factors affecting compaction, standard & modified proctor Tests, field compaction equipment, quality control, Advance compaction Techniques, Nuclear density meter.

Text Books

T.1	Soil Mechanics & Foundation Engg. – K.R. Arora, Standard. Publisher, 2020 edition

T.2	Soil Mechanics & Foundations – B.C.Punmia, Laxmi Publication, 16th edition 2017
T.3	Basic & Applied Soil Mechanics – Gopal Ranjan & Rao, Newage International Publication, 3rd edition 2016
T.4	Geotechnical Engg. – T.N.Ramamurthy & T.G. Sitharam, S. Chand Publishing, 2005 edition
Reference Books	
R.1	Soil Mechanics & Foundation Engg – P.N. Modi, Standard Book House, 5th edition 2019
R.2	Soil Mechanics & Foundation Engg – V.N.S. Murthy, CBS Publisher, 2018 edition
R.3	Geotechnical Engg. – P.Purushothama Raj, McGraw-Hill Education, 1995 edition
R.4	Soil Mechanics & Foundation Engg – P.Purushothama Raj, Pearson Education India, 1st edition 2007
Useful Links	
1	https://nptel.ac.in/courses/105/101/105101201/
2	https://nptel.ac.in/courses/105/105/105105168/
3	https://nptel.ac.in/courses/105/106/105106142/

	Course Outcomes	CL	Class Sessions
BCE3603.1	**Understand** the knowledge about origin and classification of soils	2	8
BCE3603.2	**Distinguish** index and engineering properties of the soil and develop a proficiency in handling experimental data	4	8
BCE3603.3	**Estimate** the influence of water flow on the engineering behavior of soils	4	10
BCE3603.4	**Evaluate** the concept of effective stress and its influence on soil behavior	5	9
BCE3603.5	**Analyze** and compute principles of permeability, compaction, consolidation and shear strength parameters of soil	4	10

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Semester-VI	BCE3604: Design of Hydraulic Structure **(PE-III)**

Teaching Scheme		**Examination Scheme**	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial		**CT-II**	15 Marks
Total Credits	**3**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks
Pre-Requisites: Hydrology and Water Resources Engineering		**Total Marks**	**100 Marks**

Course Contents

Unit I	General: Irrigation, necessity, importance, benefits of irrigation, types.Water requirement for crops : Crop seasons and major crops of India, crop rotation, soils and their irrigation requirement, field capacity, wilting point, available moisture in soils for crops / plants, depth & frequency of irrigation, GCA, CCA, kor period, kor water depth, duty – delta relation, base period.
Unit II	Reservoir Planning : Selection of site for reservoirs, engineering surveys, geological and Hydrological investigations, fixing of LWL, FTL/FRL, HFL, TBL, dead storage, live storage, different storage zones in reservoirs, reservoir sedimentation and its removal. Statistical Methods: Statistics in hydrological analysis, probability and probability distribution. Floods: Causes and effects, Factors affecting peak flows and its estimation, frequency analysis
Unit III	Water Logging: Causes, effect, Preventive measure of water logging.Canal Irrigation : types of canal system, stable canal, unstable canal, grading, lined, canal network Canals In Alluvial Soils : Kennedy's silt theory–Design procedure, silt supporting capacity, drawbacks, Lacey's silt theory–definition of initial final and permanent regime channels, Lacey's Regime equations, channel design procedure, limitations.Lined Canals: design procedure, types of lining, relative merits and demerits of canal lining, economics of canal lining.
Unit IV	Dams: General Classification of dams as per use, hydraulic design and materials; Factors governing selection of dams. Instrumentation in damGravity Dam: Forces acting on gravity dam; stability requirements; Theoretical & practical profile of gravity dam; Low & High dam; Galleries.Earthen Dams: Types of earthen dam; Description of component parts of earthen dams-foundation, cut off trench, rock toe, hearting, central impervious core, pitching and chipping, turfing; seepage through body of earthen dam and drainage arrangements; Failure of earthen dams; Plotting of phreatic line for earthen dams with horizontal filters; Stability of foundation against shear. (OMC and ODD tests for hearting and casing zones)
Unit V	Spillways: Types of spillway, General principle of design of ogee spillway; Spillway gates – vertical lift, radial, rolling and drum; Gate O.S. Energy dissipation methods.

	Diversion Head Works: Component parts of diversion headworks – Fish ladder, guide wall, divide wall, silt excluder and silt ejector; Causes of failure of weirs on permeable foundation; Bligh's Creep theory; Dr. Khosla's theory for design of weirs on permeable foundation
Text Books	
T.1	"Design of Hydraulic Structure and Hydraulic Structures" authored by Santosh Kumar Garg, Khanna Publisher, 1999.
T.2	"Design of Hydraulic Structure and Water Power Engineering" authored by B.C. Punmia, Laxmi Publication, 1992.
T.3	"Design of Hydraulic Structure" authored by Asawa G. L., New age International, New delhi, 1 January 2005.
T.4	"Design of Hydraulic Structure" authored by S. R Sahasrabudhe, S. K. Kataria and Sons, 2013.
Reference Books	
R.1	"Design of Hydraulic Structure" authored by N N Basak, Mc Graw Hill Education, 2017.
R.2	"Design of Hydraulic Structure" authored by Dr. N, P. Singh, T Banerjee, Charotar Publishing house, 2015
R.3	"Irrigation Water Resources and Water Power Engineering" authored by P N modi, Rajsons Publication Pvt. Ltd, 9th Edition 2014.
R.4	"Design of Hydraulic Structures" Dr. R. P. Rethaliya, Atul Prakashan Ahmedabad, 1st edition, 2021
Useful Links	
1	https://nptel.ac.in/courses/105/105/105105110/
2	https://nptel.ac.in/courses/105/104/105104030/

	Course Outcomes	CL	Class Sessions
BCE3604.1	**Calculate** water requirement for crop patterns.	3	9
BCE3604.2	**Analysis** of flood occurrence in reservoir planning	4	8
BCE3604.3	**Design** of water conveyance canal system for structure.	6	9
BCE3604.4	**Understand** the planning, design and operation of storage reservoir.	2	10
BCE3604.5	**Analyze** the basic profile of dams for checking stability of Gravity Dams and Earth dams.	4	9

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Semester-VI | BCE3605: Hydraulic Modelling **(PE-III)**

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial		**CT-II**	15 Marks
Total Credits	**3**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks
Pre-Requisites: Fluid Mechanics		**Total Marks**	**100 Marks**

Course Contents

Unit I	Dimensional analysis: Units, dimensions of physical quantities, different methods of Obtaining dimension less parameters viz., Rayleigh's method, method of repeating variables, Buckingham π theorem, Reynolds number, Froude number, Mach number, Euler Number and Weber number.
Unit II	Determination of scales for models, Necessity of distortion of scales, scale effects. Movable bed models. Construction and operation of hydraulic models. Wind tunnels, flumes2D, comprehensive models3D.
Unit III	Measuring Equipments: Flumes, Weirs, flow meters, pressure transducers, hot film anemometer, Current meter, Laser doppler, pointer gauges
Unit IV	Application to coastal and tidal problems. Design of Regular & Random (3D and2D) wave modelling techniques, stability of coastal structures, Simulation of littoral drift, Design of sand trap, Distorted scale tidal modelling technique(rigid/movable) for Estuarine Ports,
Unit V	Rigid bed models and movable bed models, bank protection works, barrages and weirs, canal off takes, power intakes, gates, bridges and intakes. Applications for structures in hilly regions – Introduction to basic mathematical modelling techniques for hydraulic phenomena & processes related to various hydraulic structures Dams, spillways and energy dissipaters, combination of rigid and movable bed models, sedimentation and flushing of reservoirs.

Text Books

T.1	"Dimensional Analysis and theory of models" authored Henry Langhaar, Krieger Pub Co, 1 June 1980.
T.2	"Harbour and Coastal Engineering" authored by Narasinhan and S. Kathiroli, Vol I&II, Ocean and Coastal Engineering Publication, NIOT, Chennai, 2002.
T.3	"Flow through open channel" authored by Rajesh Shrivastav, Oxford University Press, New Delhi, 2008.
T.4	"Fluid Mechanics and Machineries" authored by Modi and seth, Standard book House, Delhi, 2002.

Reference Books

R.1	"Fluid Mechanics", authored by Dr. R. J. Garde,New Age Publications, 2011.

R.2	"Hydraulic Modeling" authored by Victor Lyatkher and Alexander Proudovsky, Scrivoner Publishing, 2016.
R.3	"Hydraulic Modelling- An introduction Principles, Methods and Applications" authored by Pavel Novak and Vincent Gunot, CRC press, 2010.
R.4	"Development in Hydraulic Engineering" authored by P Novak, Taylor & Francis Publication, 2018.
Useful Links	
1	https://nptel.ac.in/courses/105/105/105105110/
2	https://nptel.ac.in/courses/105/104/105104030/

	Course Outcomes	CL	Class Sessions
BCE3605.1	**Use** the concept of Dimensional analysis in model making.	3	9
BCE3605.2	**Determination** of types of scales for model making.	3	9
BCE3605.3	**Calculate** vacuum and gauge pressure using measuring equipments.	3	8
BCE3605.4	**Design** hydraulic models using dimensionless number	6	9
BCE3605.5	**Understand** the concept of model making in hydraulic structures.	2	10

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Semester-VI	BCE3606: Urban Hydrology and Hydraulics **(PE-III)**

Teaching Scheme		**Examination Scheme**	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial		**CT-II**	15 Marks
Total Credits	**3**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks
Pre-Requisites:		**Total Marks**	**100 Marks**

Course Contents

Unit I	Urbanisation: Process of urbanization, Trends of urbanization and industrialization, influence on hydrologic cycle, effects and consequences for drainage, Rainfall analysis in urban environment, design storm
Unit II	Urban Runoff computations: Empirical, Time-area and unit hydrograph approaches. Urban storm water runoff : overland flow, Kinematic wave theory approach, infiltrating catchments
Unit III	Design of drainage system elements: Hydraulic fundamentals, infiltration and on-site detention of storm water, design of sewerage and drainage channels, design of appurtenances, road drainage, design of pumping stations
Unit IV	Urban water supply: Estimate of demand, sources in surface and groundwater, Reservoir, capacity estimation. Introduction to urban watershed software - Hydrologic Cistern, water conservation and ecological aspects, Water harvesting
Unit V	Control of storm water pollution: Pollution build-up and wash off process with reference to urban drainage systems. Source control in commercial and industrial complexes, storage options - dry and wet ponds, biological treatment of wastewater, chemical treatment of storm water

Text Books

T.1	"Applied Hydrology: A Compendium of Water resources technology" authored by Chow V T, McGraw Hill, New York, 1964
T.2	"Hydrology and Hydraulic Systems" authored by Gupta R S, Prentice Hall Publishers, New Jersey, 1989.
T.3	"Urban Hydrology , Hydraulics and storm water quality" authored by A Osman and Robert J Houghtalen, Wiley Publication,2003.
T.4	"Engineering hydrology" authored by K Subramanya , Mc Graw Hill Education ,4th edition, 2017.

Reference Books

R.1	"Drainage in Urban Areas- 2 Volumes" authored by Geiger W F, Marsalek J Z, and Rawls G J, UNESCO, Paris, 1987

R.2	"Urban Hydrology" authored by Hall M J, Elsevier Applied Science Publishers, New York, 1984.
R.3	"Stormwater Detention for Drainage, water quality and CSO Management" authored by Stahre P, and Urbonas B, Prentice Hall Publishers, New Jersey, 1983.
R.4	"Urban Hydrology" authored by Timothy R. Lazaro, Revised edition, CRC Press, 1990.
Useful Links	
1	https://nptel.ac.in/courses/105/101/105101002/
2	https://nptel.ac.in/courses/105/104/105104029/

	Course Outcomes	CL	Class Sessions
BCE3606.1	**Understand** the process of urbanization and its influence on the processes and storages associated with hydrological cycle.	2	8
BCE3606.2	**Analyze** computational approaches for urban water supply, flooding by conceptual and physical techniques	4	9
BCE3606.3	**Design** of drainage system elements.	6	10
BCE3606.4	**Evaluate** capacity of reservoirs & demand of reservoir.	5	9
BCE3606.5	**Apply** the knowledge to control storm water pollution	3	9

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Semester-VI | BCE3607: River Engineering **(PE-III)**

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial		**CT-II**	15 Marks
Total Credits	**3**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks
Pre-Requisites:		**Total Marks**	**100 Marks**

Course Contents

Unit I	Introduction, classification of Rivers, Mechanics of alluvial rivers including channel and flood plain features, Sediment transport and budgets, River morphology and various classification schemes.
Unit II	Behavior of Rivers: Introduction, River Channel patterns, Straight River channels, Causes, characteristics and shapes of meanders and control, cutoff, Braided Rivers, Bed forms, Instability of rivers, Hydraulic geometry, Delta formation and control.
Unit III	Mechanics of Alluvial Rivers, Rivers and restoration structures, Socio-cultural influences and ethics of stream restoration.
Unit IV	Bio-engineering Techniques, Classification review, Natural Channel Design Analysis, Time Series Analysis of flow, Sediment and channel geometry data.
Unit V	River Training and Protection Works: Introduction, Classification of River Training, Types of training works, Protection for Bridges with reduced waterway, Design of Guide Band, embankment and spurs/dampners and other river/ flood protection works.

Text Books

T.1	"River Engineering" authored by Margeret Peterson, Prentice hall publication, 1986.
T.2	"Principles of River Engineering (the non tidel alluvial)" authored by PH Jameen, VSSD Publication, 1994.
T.3	"River Behaviour Management and Training (Vol. I & II)" authored by Varma, C. V. J. Saxena, K. R. (Koushal Raj); Rao, M. K. ,CBI&P, New Delhi, 1989.
T.4	"River Engineering" authored by Santosh Kumar, Khanna Publication, 2019.

Reference Books

R.1	"Irrigation & Water Power Engineering" authored by B. C. Punmia and Pande B. B. Lal, Laxmi Publication, 2021.
R.2	"Mechanics of sediment transportation and Alluvial stream problems" authored by R.J. Garde and K.G. Ranga Raju, Wiley Eastern limited, 1977
R.3	"River Engineering" authored by K. D. Gupta, Vayu education of India, 2019.
R.4	"Applied Fluivial Geomorphology for River Engineering and Management" authored by Colin R.

	Thorne and R. Hey ,Wiley Publication, 1997.
Useful Links	
1	https://nptel.ac.in/courses/105/103/105103204/
2	https://nptel.ac.in/courses/105/106/105106145/

	Course Outcomes	CL	Class Sessions
BCE3607.1	**Understand** river morphology & its classification schemes.	2	9
BCE3607.2	**Analyze** river flow hydraulics and its behavior.	4	9
BCE3607.3	**Understand** mechanics of alluvial rivers & restoration structures	2	9
BCE3607.4	**Analyze** hydraulic parameters related to river training works.	4	9
BCE3607.5	**Apply** the knowledge of river training & protection works for river training phenomena.	3	9

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Semester-VI | BCE3608: Building Construction Practice **(PE-IV)**

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial		**CT-II**	15 Marks
Total Credits	**3**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks
Pre-Requisites: Concrete Technology, Building Construction Material		**Total Marks**	**100 Marks**

Course Contents

Unit I	**Foundations**: Necessity and types of R.C.C. foundations, Detail of Deep foundation and precast foundation in general, Details shallow foundations. Bearing capacity of soils and its assessment. Presumptive bearing capacity values from codes. Loads on foundations. Causes of failures of foundations and remedial measures, Foundation on black cotton soils Setting out foundation trenches, excavation timbering of foundation trenches. **Job layout Site:** Clearance, layout for Load bearing and framed structures – Marking – Earthwork
Unit II	**Brickwork:** Qualities of good bricks, classification of bricks tests on bricks as per as codes. Terms used in brickwork, commonly used types of bonds in brickwork such as header, stretcher, English and Flemish bonds, principles of construction. Reinforced brickwork, brick knogging. Parapets, copings, sills and corbels, brief introduction to cavity walls, load bearing and partition walls. Masonry construction using cement concrete blocks and clay walls, load bearing and partition walls. Masonry construction using cement concrete blocks and clay blocks. **Precest Construction**: Introduction to method and materials. Precast elements likes poles, cover, jallies, steps corbets, truss element etc.
Unit III	**Stone Work**: Stones, cutting and dressing, selection of stones types of stone masonary, principles of construction joints in masonary. Lifting heavy stones, common building stones in India. **Arches and Lintels**: Terminology in contraction, types chajjas and canopies, pre cast Lintels & Arches. **Damp Proofing**: Causes and effect of dampness, Various methods of damp proofing, Damp proofing in plinth protection, New Techniques of Damp Proofing Damp Proofing in Plinth Protection, New Techniques of Damp proofing. Epoxy etc.
Unit IV	**SUB STRUCTURE CONSTRUCTION** Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement-Tunneling 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 **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, Material handling – erecting

	light weight components on tall structures - Support structure for heavy Equipment and conveyors - Erection of articulated structures, braced domes and space decks**.**
Unit V	**Floors** : General principles, types and method of construction, floors finished quality, testing floor tiles, synthetic & Ceramic Tiles. **Roofs** : Flat and pitches roofs, roof coverings, types AND their constructional features. Thermal Insulation **Plastering and Pointing :** Necessity, types and methods **Painting :**White washing, colour washing and distempering new materials & Techniques **Temporary Timbering :** Centering and formwork shoring, underpining and scaffolding
Text Books	
T.1	"Building Construction, Planning Techniques and Method of Construction" author by Arora S.P. and Bindra, Dhanpat Rai and Sons Publication, 2010.
T.2	"Building construction" author by Varghese P.C., 2nd edition, Prentice Hall of India Pvt. Ltd, New Delhi Publication, 2007.
T.3	"Building Construction" author by B.C. Punmia, Arun Kumar Jain, Ashook Kumar Jain, 11th Edition Laxmi Publications, 2005
T.4	"Building Construction" author by Rangwala, , 33th Edition, Charotar Publishing House Pvt. Ltd.2017.
Reference Books	
R.1	"Building Materials & Construction" author by Soni,S. 1st edition REPRINT, S. K. Kataria And Sons publication.
R.2	"Building Materials" author by Bhavikatti S.S, Vikas Publication
R.3	"Building Construction," author by Sushil Kumar, 19th Edition, Standard Publisher Distributors New Delhi, 2001.
R.4	"Construction Technology," Author by Sankar, S.K. and Saraswati, S., 3rd Oxford University Press, New Delhi, 2008
Useful Links	
1	https://nptel.ac.in/courses/105/102/105102088/

	Course Outcomes	CL	Class Sessions
BCE3608.1	**Determine** the soil condition, deciding the suitable foundation for Load bearing and Framed structures	3	9
BCE3608.2	**Classify** the appropriate material for building construction.	3	9
BCE3608.3	**Describe** the stonework, lintel arches, dam proofing concept	4	8
BCE3608.4	**Classify** the construction procedures for substructure to the super structure	2	10
BCE3608.5	**Describe** the concepts of floors, roofs, painting, plastering and timbering.	2	9

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Semester-VI | BCE3609: Advanced Building Construction Methods **(PE-IV)**

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial		**CT-II**	15 Marks
Total Credits	**3**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks
Pre-Requisites: Concrete Technology		**Total Marks**	**100 Marks**

Course Contents

Unit I	Types of foundations and construction methods; Basics of Formwork and Staging
Unit II	Common building construction methods (conventional walls and slabs; conventional framed structure with block-work walls); Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures.
Unit III	Basic construction methods for steel structures; 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.
Unit IV	Topographic mapping with LiDAR Technology: - characteristics of LiDAR instruments and platforms used for topographic mapping and geospatial applications, strengths and weaknesses of various LiDAR platforms and instruments for a broad range of application scenarios, LiDAR uses & applications
Unit V	Examination of the current LEED for New Construction rating system, and case study analysis of highly successful recent "green construction projects" through student team assignments and presentations. Preparation for the LEED Green Associate professional licensing exam.

Text Books

T.1	"Building Construction, Planning Techniques and Method of Construction" author by Arora S.P. and Bindra, Dhanpat Rai and Sons Publication, 2010.
T.2	"Building construction" author by Varghese P.C., 2nd edition, Prentice Hall of India Pvt. Ltd, New Delhi Publication, 2007.
T.3	Project Planning & Control with PERT&CPM" author by Punmia B.C. & Khandelwal K.K., ,7th edition Laxmi Publications, New Delhi, 2016.
T.4	"Building Construction" author by Kumar, S., 20th "Building Construction", Standard Publishers. 2014

Reference Books

R.1	"Soil Mechanics And Foundation Engineering" author by Arora K.R. , 7th edition REPRINT Standard Publishers Distributors
R.2	"Design Of Foundation Systems : Principles And Practices" author by Kurian Nainan P., 3rd edition Narosa Publishing House
R.3	"Alternative building Materials and Technologies" author by K. S. Jagdish& B. V. Venkatarama Reddy, 5th edition New age international Publishers, 2007

R.4	"Sustainable Building Design Manual- Volume I & II" author by TERI, 2nd edition, Tata Energy Research Institute, 2009.
Useful Links	
1	https://nptel.ac.in/courses/105/102/105102195/
2	https://nptel.ac.in/courses/105/105/105105157/

	Course Outcomes	CL	Class Sessions
BCE3609.1	**Explain** the types of foundation provided in building construction	2	7
BCE3609.2	**Determine** common building construction methods in civil engineering field.	3	9
BCE3609.3	**Describe** basic construction methods used for steel structures, bridges and their technologies.	2	10
BCE3609.4	**Analyze** the concept of LiDAR technologies and their applications.	4	10
BCE3609.5	**Implement** green construction project case studies and LEED rating system	3	9

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Semester-VI	BCE3610: Structural Audit & Retrofitting of Structures **(PE-IV)**

Teaching Scheme		**Examination Scheme**	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial		**CT-II**	15 Marks
Total Credits	**3**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks
Pre-Requisites: Concrete technology, Structural Analysis		**Total Marks**	**100 Marks**

Course Contents

Unit I	**Introduction:** Causes of structural damages: mechanical actions, chemical attacks, earthquake, fire, damage to steel structures due to corrosion, damage to RC structures due to corrosion: corrosion induced by carbonation of concrete, chloride induced corrosion and corrosion induced by leaching of concrete. Introduction to structural audit, its necessity, introduction to retrofitting of structures, its necessity, repairs, difference between repairs and retrofitting
Unit II	**Structural Audit:** Structural audit, assessment of health of structure, study of structural drawings, visual observations, nature of distress, collapse and investigation, limitations on investigator, tools for investigation, various NDT methods for assessing strength of distressed materials, concrete endoscopy. Investigation management, review of assimilated information, interviews and statements, evaluation and reporting, presentation of report, role of client, architect, consulting engineer and contractor.
Unit III	**Structural Health Monitoring (SHM):** Introduction to SHM, Local and Global techniques for SHM, short and long-term monitoring, active and passive monitoring, remote and wireless SHM Techniques. Instrumentation, data acquisition, data processing for SHM, Artificial Intelligence in SHM.
Unit IV	**Retrofitting of Structures:** Methods of retrofitting: moisture barrier systems, mass reduction technique, jacketing, shortcreting, Ferro cement mesh, inserting new member, base isolation. Suitability of various retrofitting techniques for RC structures, steel structures and masonry structures and introduction to retrofitting of Historical Structures
Unit V	**FRP & Retrofitting of RC Columns and Beams:** Fiber Reinforced Polymer (FRP), Types of FRP and their properties, advantages of FRP retrofitting, FRP retrofitting using FRP plates, FRP wrapping, FRP bars, National and International code provisions. Retrofitting of RC columns using FRP for axial confinement as per provisions of ACI 440. Analysis and design of RC beam using FRP, Retrofitting of RC Beams using FRP for flexural strengthening, shear strengthening, Provisions of ACI 440.

Text Books	
T.1	"Concrete repair and maintenance", Peter.H.Emmons, Galgotia publications Pvt. Ltd., 2001.
T.2	"Building: Structural Audit, Repairs and Restoration", Arun Kelkar, Majestic Publishing House
T.3	"Repair and protection of concrete structures", Noel P. Mailvaganam, CRC Press,1991 1st edition (18 December 1991)
T.4	A Handy Guide to Repairs, Rehabilitation and Waterproofing of RCC Building (Structures), Jayakumar J. Shah
Reference Books	
R.1	ACI 440.2R-08, Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, American Concrete Institute.
R.2	Maintenance, Repair & Rehabilitation & Minor Works of Building, by P C Varghese, PHI
R.3	Handbook on repair and rehabilitation of RCC buildings, CPWD, Government of India.
R.4	Management of Deteriorating Concrete Structures, George Somerville, Taylor and Francis, Publication.
R.5	"Retrofitting Design of Building Structures", Xilin lu, Science Press, New York (2010)
Useful Links	
1	https://nptel.ac.in/courses/105/106/105106202/

	Course Outcomes	CL	Class Sessions
BCE3610.1	**Identify** causes of deterioration in RC and steel structures	2	9
BCE3610.2	**Explore** entire process of structural audit.	4	9
BCE3610.3	**Explore** necessity and methods of structural health monitoring.	4	8
BCE3610.4	**Explain** method of retrofitting for RC, steel and historical structures	2	9
BCE3610.5	**Design** retrofitting using FRP for RC column and RC beam.	6	10

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Semester-VI	BCE3611: Construction Equipment and Automation **(PE-IV)**

Teaching Scheme		**Examination Scheme**	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial		**CT-II**	15 Marks
Total Credits	**3**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks
Pre-Requisites: Concrete Technology, Surveying		**Total Marks**	**100 Marks**

Course Contents

Unit I	**Introduction:** Unique features of construction equipment, Need of construction equipment, past history. **Construction Equipment:** Capacity, Feasibility, owning and operating cost and Productivity of Different Equipment: Excavators, Pavers, Plastering machines; Pre-stressing jacks and grouting equipment; Cranes and Hoists, Concrete Batching Plants, etc.
Unit II	**Automation in Construction Industry:** Need and Benefit of automation, Automation in Canal lining, Automation in Construction of Highway, Automation in concrete technology
Unit III	**Drones:** Photogrammetry, Project Monitoring- real time data, aerial mapping, land survey, quantity survey, quality survey, structural health monitoring survey, underwater survey.
Unit IV	**Robotics in Construction:** Introduction, Benefits of robots in construction industry with respect to time, cost, quality, safety. Use of robots for construction activities like Brick laying, Demolition, Material Handling, Structural steel cutting, Rebar tying/bending, Form work mould making, 3D printing- print complex, layered, parts and objects of homes, buildings, bridges and roads 3D Scanner for surveying and project management
Unit V	**Introduction to Advanced Technologies:** Virtual Reality, Augmented Reality, Building Information Modeling (BIM).

Text Books

T.1	"Construction Planning, Methods and Equipment", R L Peurifoy, McGraw Hill, 2011.
T.2	“Construction Project management, Theory & Practice”, Kumar Neeraj Jha, Pearson Education India, 2011

Reference Books

R.1	“Construction Equipment and its Planning and Application” author by Dr. Mahesh Varma, 1st edition, Metropolitan Book Company, New Delhi-, 1983
R.2	“BIM and Construction Management: Proven Tools, Methods, and Workflows”, By Brad Hardin, Dave McCool, John Wiley & Sons, 2nd Edition, 2015
R.3	“Automation in Construction Management: Automated management of Construction Materials Using RFID Technology”, Javad Majrouhi Sardroud, Scholars' Press, 2014
R.4	“Enhancing BIM Methodology with VR Technology”, Open access peer
R.5	“Robotics and Automation in Construction”, Open access peer- reviewed edited volume

Useful Links	
1	https://nptel.ac.in/courses/105/102/105102088/
2	https://nptel.ac.in/courses/105/106/105106053/
3	https://nptel.ac.in/courses/105103206

	Course Outcomes	CL	Class Sessions
BCE3611.1	**Derive** feasibility of specific equipment in construction project conditions	3	8
BCE3611.2	**Selection** of Automation techniques in construction industry	4	10
BCE3611.3	**Select** suitable Drone technology for surveying and project management	4	8
BCE3611.4	**Analyze** benefits of robotics versus conventional construction equipment	4	14
BCE3611.5	**Classify** application of Virtual Reality, Augmented Reality, BIM in construction industry	3	5

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Semester-VI	BCE3616: Geotechnical Engineering Lab

Teaching Scheme		**Examination Scheme**	
Practical	2 Hrs/week	**CT-I**	--
		CT-II	--
Total Credits	**1**	**CA**	25 Marks
		ESE	25 Marks
Pre-Requisites: Transportation Engineering		**Total Marks**	**50 Marks**

	Course Contents	**CO**
1	To determine the moisture content (water content) of a given soil sample.	**CO1**
2	To determine the specific gravity of the soil sample.	**CO1**
3	To classify the coarse-grained soils	**CO1**
4	To determine liquid limit and plastic limit of soil.	**CO2**
5	To determine the shrinkage limit of soil and calculate shrinkage factors.	**CO2**
6	To determine coefficient of permeability of given soil sample at desired density by a suitable method.	**CO3**
7	To determine the mass density of soils by Sand replacement method.	**CO4**
8	To determine the mass density of soils by Core Cutter method.	**CO4**
9	Proctors' compaction Test and Proctor needle test.	**CO3**
10	To determine the unconfined compressive strength of cohesive soil sample.	**CO5**
11	To determine shear strength parameters of the given soil sample by Direct Shear Test.	**CO5**
12	To determine CBR value of the given soil sample	**CO5**

Text Books

T.1	Soil Mechanics & Foundation Engineering - K.R. Arora, Standard Publisher
T.2	Soil Mechanics & Foundation Engineering - B.C.Punmia, Laxmi Publication
T.3	Basic & Applied Soil Mechanics - Gopal Rajan & Rao, Newage International Publication
T.4	Geotechnical Engineering - P. Raj, Dorling Kindersley Pvt. Ltd

Reference Books

R.1	Soil Mechanics & Foundation Engineering - Modi, Std. Publisher
R.2	Soil Mechanics & Foundation Engineering - V.N.S. Murthy, CBS Publisher

Useful Links

1	https://nptel.ac.in/courses/105/101/105101201/
2	https://nptel.ac.in/courses/105/105/105105168/
3	https://nptel.ac.in/courses/105/106/105106142/

	Course Outcomes	CL	Lab Sessions
BCE3616.1	**Determine** the properties of soil sample and its classification.	3	6
BCE3616.2	**Determine** the index and engineering properties of the soil	3	4
BCE3616.3	**Analyze** the suitability of foundation for a particular type of soils.	4	4
BCE3616.4	**Evaluate** the stresses in the soil mass and to understand the classification of soils.	5	4
BCE3616.5	**Evaluate** the shear strength in the soil mass by method of testing.	5	6

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Semester-VI	BCE3617: Steel Structures Lab

Teaching Scheme		**Examination Scheme**	
Practical	2 Hrs/week	**CT-I**	--
		CT-II	--
Total Credits	**1**	**CA**	25 Marks
		ESE	25 Marks
Pre-Requisites: Mechanics of Solid		**Total Marks**	**50 Marks**

Course Contents

1	a) Design of Connection (Beam to Beam) b) Design of Connection (Beam to Column)	**CO3**
2	a) Design of Laced and Battened Columns b) Design of Bolted and Welded End Connection	**CO5**
3	a) Design of Slab Base Column b) Design of Gusseted Base Column	**CO5**
4	Design of Plate Girder	**CO4**
5	Minimum One Site visit to Steel Structures	**CO1, CO2, CO3, CO4, CO5**

Text Books

T.1	"Fundamentals of Structural Steel Design", authored by M. L. Gambhir, McGraw Hill Education, 2013
T.2	"Design of Steel Structures", authored by N. Subramanian, OXFORD University Press, First Edition, 2008
T.3	"Limit State Design of Steel Structures", authored by S. K. Duggal, McGraw Hill Education Private Limited, 2011
T.4	"Design of steel structure" authored by L.S. Negi, Tata Mc Graw hills Publisher Co. Ltd, New Delhi, 1986.

Reference Books

R.1	"Stability Analysis and Design of Steel Structure",authored By M. L. Gambhir, McGraw Hill Education, 2004.
R.2	"Design of steel structure "authored by S. S. Bhavikatti, dreamtech, distributed by Willey, 2009.
R.3	"Design of steel structure" authored by A. S. Arya and J.L. Ajmani, Nem chand bros, Roorkee, 2011.
R.4	"Design of steel structure" authored by P Dayaratnam , S. Chand of Co. Delhi 2003 edition,2012.

Useful Links	
1	https://nptel.ac.in/courses/105/105/105105162/
2	https://nptel.ac.in/courses/105/104/105104030/
3	https://nptel.ac.in/courses/105/101/105101082/

	Course Outcomes	CL	Lab Sessions
BCE3617.1	**Use** the knowledge of IS code of practice (IS 800) for the design of steel structural elements.	3	2
BCE3617.2	**Design** structural fasteners (Bolted and welded connections) used in steel construction.	6	2
BCE3617.3	**Design** the Tension and Compression members.	6	6
BCE3617.4	**Design** simple & built-up beams and built-up columns.	6	4
BCE3617.5	**Design** Axially loaded columns	6	10

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Semester-VI	BCE3618: Advanced Fluid Mechanics Lab

Teaching Scheme		**Examination Scheme**	
Practical	2 Hrs/week	**CT-I**	--
		CT-II	--
Total Credits	**1**	**CA**	25 Marks
		ESE	25 Marks
Pre-Requisites: Fluid Mechanics I, Engineering mechanics		**Total Marks**	**50 Marks**

Course Contents

1	Study of flow around immersed bodies.	**CO1**
2	Determination of Darcy-Weisbach friction factor for given pipes.	**CO1**
3	Determination of Manning's or Chezy's Constant and for an open channel.	**CO3**
4	Developing specific energy diagram for a rectangular channel.	**CO4**
5	Study of GVF profiles.	**CO3**
6	Study of hydraulic jump in a horizontal rectangular channel.	**CO4**
7	Study and performance of Francis turbine.	**CO5**
8	Study and performance of Pelton Wheel turbine.	**CO5**
9	Study and performance of Centrifugal pump	**CO5**
10	Study and performance of Reciprocating pump	**CO5**
11	Problem on pipe network analysis manually and using application software.	**CO2**
12	Establishment of sub critical, critical and super critical flow in open channel.	**CO3**

Text Books

T.1	" Hydraulics and Fluid mechanics ", authored by Modi& Seth, Standard Book House, Delhi,2017.
T.2	"Fluid Mechanics And Fluid Power Engineering" authored by Kumar D.S., S.K.Kataria And Sons, 1998.
T.3	"Flow in open channels", authored by Subramanya K, Tata McGraw Hill Publication, 2009.
T.4	"Fluid Mechanics: Including Hydraulic Machines" authored by Jain,A.K. ,INT Khanna Publishers,2009.

Reference Books

R.1	"Open channel hydraulics", authored by VenTeChow , International Student Edition. McGraw Hill, 2009.
R.2	"Engineering Fluid Mechanics" authored by Garde, Mirajgaonkar, Scitech Publication, 2010.
R.3	"Flow through open channels", authored by K.G.RangaRaju,Tata McGraw Hill Publications, 1998.
R.4	"Fluid Mechanics, Hydraulics And Hydraulic Machines" authored by Arora K.R.,NT Standard Publishers Distributors, 2005.

Useful Links	
1	https://fmc-nitk.vlabs.ac.in/fluid-machinery/
2	http://eerc03-iiith.vlabs.ac.in/
3	https://nptel.ac.in/courses/105/101/105101082/

	Course Outcomes	CL	Lab Sessions
BCE3618.1	**Determine** the losses in pipe network using Darcy-Weisbach and Hazen William's equation.	3	4
BCE3618.2	**Design** the pipe network system and its components including water hammer pressure.	6	2
BCE3618.3	**Understand** the concepts of uniform and critical flow through open channels including efficient channel sections.	2	6
BCE3618.4	**Analyze** energy concepts in the open channel flow and undertake Rapidly Varied flow.	4	4
BCE3618.5	**Apply** the concept hydraulic machine in performance of Power plant.	3	8

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Semester-VI	BCEXX08: Metro Systems & Engineering **(Open Elective-II)**

Teaching Scheme		**Examination Scheme**	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial		**CT-II**	15 Marks
Total Credits	**3**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks
Pre-Requisites: Transportation Engineering, Surveying		**Total Marks**	**100 Marks**

Course Contents

Unit I	General: Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials.
Unit II	Civil Engineering- Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management
Unit III	Electronics and Communication Engineering- Signaling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors.
Unit IV	Mechanical & TVS, AC: Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators.
Unit V	ELECTRICAL: OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics.

Text Books

T.1	Paul E. Garbutt, “World Metro Systems Paperback”, 1 April 1997.
T.2	S.Ponnuswamy, (Late) Dr. David Johnson Victor,” Urban Transportation: Planning, Operation and Management”, 2012, McGraw Hill.
T.3	M. M. Agarwal, Sudhir Chandra, K. K. Miglani “Metro Rail in India for Urban Mobility”, 2021, Prabha & co.
T.4	“A systems approach to developing a new metro for megalopoleis” September 19, 2016,

Reference Books

R.1	Handbook of Research on Emerging Innovations in Rail Transportation Engineering by B. Umesh Rai (Chennai Metro Rail Limited, India)

Useful Links	
1	https://nptel.ac.in/content/storage2/courses/105101008/downloads/cete_48.pdf
2	https://nptel.ac.in/courses/117/101/117101050/

	Course Outcomes	CL	Class Sessions
BCEXX08.1	**Use** the knowledge of metro systems in its planning and construction	3	9
BCEXX08.2	**Survey** and investigation of construction planning and management	4	9
BCEXX08.3	**Illustrate** electronic signaling systems and Automatic fare collection.	3	9
BCEXX08.4	**Construct** the Tunnel Ventilation, Station Air conditioning and all Mechanical Devices	3	9
BCEXX08.5	**Apply** the knowledge of Traction power, TSS and ASS power for Metro.	3	9

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