DEPARTMENT OF CIVIL ENGINEERING

B.Tech. Civil Engineering

VI Semester

Teaching Scheme & Syllabus

Considering

National Education Policy (NEP) – 2020

From

Academic Year 2025-26

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 forge learning Center of Excellence in the field of Civil Engineering

Mission of the Department

- **M1:** To promote academic and ethical development while upholding high standards.
- **M2:** To provide advance facilities with the skills needed to face Industry and societal challenges.
- **M3:** To promote socially responsible research, innovation, and entrepreneurship in the field of Civil Engineering.
- **M4:** To foster the holistic development of both students and faculty members by inculcating a blend of knowledge and professional work methods for overall progress.

Program Educational Objectives (PEO)

- **PEO 1:** Analyze and design civil engineering structures while keeping social awareness and ethical responsibilities in mind.
- **PEO 2:** Demonstrate leadership abilities in supporting sustainable practices in Civil Engineering
- **PEO 3:** Exhibit a commitment to lifelong learning, staying updated on developing technologies and industry trends, and adjusting to the evolving world of Civil Engineering.
- **PEO 4:** Execute proficiency in creative problem-solving and innovation, demonstrating an entrepreneurial attitude within the context of Civil Engineering.

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.

Program Specific Outcomes (PSO)

- **PSO1:** Competency to manage large infrastructure projects while providing safe and cost-effective project execution, along with expertise of rapid construction and project management.
- **PSO2:** Plan, execute, manage, maintain and rehabilitate civil engineering systems and processes.
- **PSO3:** Apply innovative construction and management techniques to compete with modern structural design and construction within the budget and time frame.

Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

SCHEME OF INSTRUCTION & SYLLABUS

Program: Civil Engineering

Scheme of Instructions: Second Year B.Tech. in Civil Engineering (As Per NEP 2020)

Semester – VI

SN	Sem	Type	BoS/ Dept	Sub Code	Subject	T/P	Contact Hours			Credits	% Weightage			ESE Duration	Total Marks
							L	P	Hrs.		CT/IA	CA	ESE		
1	VI	PCC	CE	BCE33601	Reinforced Cement Concrete Structures	T	3	0	3	3	30	10	60	3 Hrs.	100
2	VI	PCC	CE	BCE33602	Transportation Engineering	T	3	0	3	3	30	10	60	3 Hrs.	100
3	VI	PCC	CE	BCE33603	Irrigation Engineering	T	2	0	2	2	14	06	30	2 Hrs.	50
4	VI	PEC	CE	BCE33606-09	Program Elective – II	T	3	0	3	3	30	10	60	3 Hrs.	100
5	VI	PEC	CE	BCE33610-13	Program Elective – III	T	3	0	3	3	30	10	60	3 Hrs.	100
6	VI	MDM	EE	BEE33613	Green Energy Technology	T	2	0	2	2	14	06	30	2 Hrs.	50
7	VI	PCC	CE	BCE33604	Transportation Engineering - Lab	P	0	2	2	1	-	25	25	-	50
8	VI	PCC	CE	BCE33605	Concrete Testing Lab	P	0	2	2	1	-	25	25	-	50
9	VI	PCC	CE	BCE33614	Geomatics Lab	P	0	2	2	1	-	25	25	-	50
10	VI	VSEC	CE	BCE33615	Building Information Modelling and Management	P	0	2	2	1	-	25	25	-	50
							16	**08**	**24**	**20**	**148**	**152**	**400**	**16 Hrs.**	**700**

Course Category	BSC/ ESC (Basic Science Course/ Engineering Science Course.)	PCC (Programme Core courses)	PEC (Programme Elective courses)	Multidisciplinary courses	SEC (Skill Course)	Humanities Social Science & Management	Experiential Learning Courses	CC (Liberal Learning Courses
Credits (6th sem)	--	10	06	02	02	--	--	--
Cumulative Sum	16 / 13	41	09	18	08	14	02	04

PROGRESSIVE TOTAL CREDITS: 105 +20=125

Chairperson	Dean Academics	Vice Principal	Principal	Nov, 2025	1.00	Applicable for AY 2025-26 Onwards
				Date of Release	Version	

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T. Nagpur

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Vice Principal
(Academics)
TGPCET, NAGPUR

Dr. Premanand Nakto
Principal
TGPCET, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

Program: Civil Engineering

List of **Program Electives** offered By Civil Engineering Department

Program Elective- I	Program Elective- II	Program Elective- III	Program Elective- IV	Program Elective- V
Semester V	**Semester VI**	**Semester VI**	**Semester VIII**	**Semester VIII**
BCE33506-Water Resources Engineering	BCE33606-Rural Water Supply and Sanitation	BCE33610- Building Construction Practice	BCE34802-Pavement Design	BCE34806-High Rise Structures
BCE33507-Water Quality Engineering	BCE33607-Environmental Laws and Policy	BCE33611- Advanced Building Construction Methods	BCE34803-Urban Transportation Planning	BCE34807-Industrial Structures
BCE33508-Surface Hydrology	BCE33608-Solid and Hazardous Waste Management	BCE33612- Structural Audit & Retrofitting of Structures	BCE34804-Airport Planning and Design	BCE34808-Prestressed Concrete
BCE33509-Flood Control & Drainage Engineering	BCE33609-Air and Noise Pollution Control	BCE33613- Construction Equipment & Automation	BCE34805-High Speed Rail Engineering	BCE34809-Earthquake Engineering

List of **Open Electives** offered By Civil Engineering Department

Open Elective-I	Open Elective-II	Open Elective-III
Semester-III	**Semester-IV**	**Semester-V**
BCE32306: Green Structures and Smart Cities	BCE32406: Plastic Waste Management	BCE33510: Railways & Airport Engineering

List of **Multidisciplinary Minor Courses** offered By Civil Engineering Department

SN	Sem	Type	BoS/ Dept	Sub. Code	Subject
1.	III	MDM-I	S&H	BSH32302	Numerical Methods for Engineers
2.	IV	MDM-II	ECE	BEC32406	Instrumentation & Sensor Technologies for Civil Engineering Applications
3.	V	MDM-III	IT	BIT33516	Cyber Security & Laws
4.	VI	MDM-IV	EE	BEE33613	Solar Energy Engineering & Technology
5.	VIII	MDM-V	BA	BBA34801	Professional Practices, Laws & Ethics

Chairperson	Dean Academics	Vice Principal	Principal	Nov, 2025	1.00	Applicable for AY 2025-26 Onwards
				Date of Release	Version	

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T. Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil College Of Engineering and Technology, Nagpur

Dr. Premanand Nakto
Vice Principal
(Academics) TGPCET, Nagpur

Principal
TGPCET, NAGPUR

Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

Program: Civil Engineering

Course Category	BSC (Basic Science Course)	ESC (Engineering Science Course.)	PCC (Program Core courses	PEC (Program Elective courses)	Multidisciplinary courses	VSEC (Skill Course)	Humanities Social Science & Management	Experiential Learning Courses	CC (Liberal Learning Courses	Semester Wise Credits
Semester -I	08	05	02	--	--	02	02	--	02	21
Semester -II	08	08	--	--	--	02	02	--	02	22
Semester -III	--	--	08	--	06	--	04	02	--	20
Semester -IV	--	--	10	--	04	02	06	--	--	22
Semester -V	--	--	11	03	06	--	--	--	--	20
Semester -VI	--	--	10	06	02	02	--	--	--	20
Semester -VII	--	--	08	--	--	--	--	12	--	20
Semester -VIII	--	--	03	07	04	--	--	08	--	22
Cumulative Sum	**16**	**13**	**52**	**16**	**22**	**08**	**14**	**22**	**04**	**167**

Chairperson	Dean Academics	Vice Principal	Principal	Nov, 2025	1.00	Applicable for AY 2025-26 Onwards
				Date of Release	Version	

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T.Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Vice Principal
(Academics) TGPCET, Nagpur

Dr. Premanand Naktode
Principal
TGPCET, NAGPUR

Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441 108
NAAC Accredited with A+ Grade
(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third Year (Semester-VI)

BCE33601: Reinforced Cement Concrete Structures

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

Course Objectives:

1.	To introduce RCC design using Working Stress and Limit State Methods as per IS 456:2000.
2.	To enable understanding and design of RCC beams under flexural collapse using limit state concepts.
3.	To develop the ability to analyze and design RCC columns and footings under axial load and bending using limit state principles.
4.	To understand and apply design principles for one-way and two-way RCC slabs.
5.	To introduce the fundamentals of prestressed concrete, materials, methods, losses, and common pre-stressing systems.

Course Contents

Unit I	Introduction to the Working Stress Method of RCC design. Basic concept in design for flexure, assumptions, design constants. Introduction to Limit State Design: Concept of probabilistic design and limit state design. Characteristic values, partial safety factors, stress strain relationship stress block parameters, failure criteria, types and properties of reinforcement, limit state of Serviceability and limit state of collapse, other limit states. Review of IS – 456-2000.
Unit II	Limit state of collapse in flexure: Analysis and design of singly reinforced & Doubly reinforced rectangular section. Balanced failure mode, primary tension failure mode and primary compression failure mode.
Unit III	Limit state of collapse in compression: Analysis & design of axial, uniaxial, biaxial loaded column. Columns subjected to uniaxial bending, use of interaction curves. Design of footing for axial load, compression member, wall types of compression member.
Unit IV	Design of simply supported One-way slab, Two-way slab,.
Unit V	Introduction to Prestress Concrete: Properties of high grade materials, concepts of prestress concrete, method of pre-stressing, losses in pre-stressing. Various systems for pre-stressing with particular reference to Freyssinet, Magnel Blatton and Giffod Udall system

Text Books

T.1	"Limit State Design of Reinforced Concrete" author by P.C. Vergese, Prentice Hall Publishers

T.2	"Advanced Reinforced Concrete Design" author by Varghese, P.C., Phi Learning Private Limited.
T.3	"Reinforced Concrete Design" author by Pillai, S.Unnikrishn a, Menon, Devdas, Mc Graw Hill
T.4	"Structural Design And Drawing: Reinforced Concrete And Steel" author by Raju N. Krishna, Universities Press Pvt. Ltd
Reference Books	
R.1	"Reinforced Concrete Structures (Vol-I)", author by Punmia B.C., Ashok Kumar Jain., Arun Kumar Jain, Laxmi Publications Pvt Ltd, New Delhi
R.2	"Design Of Reinforced Concrete Structures" author by Ramamrutham,S. & Narayan, R., Dhanpatrai Publications (P) Ltd.
R.3	"Prestressed Concrete" author by N. Krishana Raju, 5th edition, Tata McGraw Hill Publishing Company Limited, New Delhi
R.4	"Fundamentals Of Reinforced Concrete" author by Sinha, N.C., Roy, S.K., S. Chand publication
Useful Links	
1	https://nptel.ac.in/courses/105/105/105105104/

	Course Outcomes	CL
BCE33601.1	**Illustrate** reinforced cement concrete design by working stress method and limit state method.	3
BCE33601.2	**Design** the singly reinforced rectangular sections and doubly reinforced rectangular sections	5
BCE33601.3	**Design** the compression members by limit state method.	5
BCE33601.4	**Design** and detailing of one-way & two-way slab.	5
BCE33601.5	**Analyze** the concept of pre-stressed concrete for RCC structure.	4

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T.Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited with A+ Grade

(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third Year (Semester-VI)

BCE33602: Transportation Engineering

Teaching Scheme	
Theory	3 Hrs./week
Tutorial	
Total Credits	**3**
Duration of ESE: 3Hrs.	

Examination Scheme	
CT-I	15Marks
CT-II	15 Marks
CA	10 Marks
ESE	60 Marks
Total Marks	**100 Marks**

Course Objectives:

1.	To convey knowledge about the Road development in India, highway alignment & materials for highway construction
2.	To introduce the fundamental concepts of highway geometric designs and construction procedures, design of super elevation, transition & vertical curves
3.	To enable the students, understand the factors related with pavement design, highway construction & management
4.	To understand the concept of consideration of wheel loads, axle loads in the analysis and design of the pavement along with bridge engineering concepts.
5.	To impart knowledge about rapid mass transportation system, it's civil, electrical & mechanical engineering aspects along with green building, carbon credits & clean air mechanics.

Course Contents

Unit I	Highway Development & Planning: Principles of Highway planning, Road development in India, Classification of roads, network patterns, Planning, Surveys. **Highway Alignment:** Requirements, Engineering Surveys. **Highway Materials:** Properties of sub grade and pavement component materials, Tests on sub-grade soils, aggregates and bituminous materials. Application of Geo-synthetics,IS 73:2013, IS 1201:1220, IS 2386.
Unit II	**Highway Geometric Design**: Cross Section elements, carriageways, camber, stopping & overtaking sight distances, IRC-56 **Horizontal alignment-** Curves, design of super elevation, widening, transition curves, vertical curves.
Unit III	**Pavement Design:** Types of pavements & characteristic, Design parameters, Axle & Wheel load, tyre pressure, ESWL for dual Wheels, repetitions, Group Index & IRC method of flexible pavement design. Analysis of load & temperature stresses of rigid pavement, joints **Highway Construction & Maintenance:** Earthen/Gravel road, Bituminous pavement, Cement Concrete pavement. Pavement failures, Pavement evaluation
Unit IV	**Traffic Engineering:** Traffic characteristics (Road User, Driver and Vehicular characteristics) Traffic Studies (Volume studies, speed studies, parking studies and accident

	studies.) Traffic Safety (Causes and types of accidents, Use of intelligent transportation system) **Bridge Engineering:** Classification, identification and site selection. Flood discharge, waterways, scour depth, economic span. IRC classification of Loads, Forces, Stresses: IRC Specification & code of practices, Critical combinations, IRC-112. **Rating and Maintenance:** Methods & Techniques of rating of existing bridges Inspection, Repairs, maintenance, corrosion-causes and prevention, aesthetics.
Unit V	**Rapid Mass Transport system**: Need for Metros, Basic planning & finances, Civil Engineering aspects, Surveys & Investigations, Electronics & Communication Engineering aspects, Signaling systems, Mechanical & Tunnel Ventilation systems, Electrical Engineering aspects, OHE, Green buildings, Carbon credits & clear air mechanics, Introduction of Airport its transportation system.
Text Books	
T.1	Highway Engineering – Khanna and Justo, Nem Chand Publication
T.2	Textbook of Highway & Traffic Engineering – Subhash C. Saxena, CBS Publishers & Distributors
T.3	Bridge Engineering - S. C. Rangwala, Charotar Publishing House Pvt. Limited
T.4	Principles, practices and design of Highway Engineering - S. K. Sharma, S. Chand & Company
T.5	Traffic Engineering & Transport Planning - L.R.Kadiyali, Khanna Publishers,
Reference Books	
R.1	Principles of Pavement Design - Yoder and Witzak, Wiley India Pvt. Ltd.
R.2	World Metro Systems – Paul E. Garbutt, Capital Transport Publishing
R.3	Traffic & Highway Engineering – Nicholas Garber, Wadsworth Publishing
R.4	Highway Engineering – L.R. Kadiyali, Khanna Publishers
Useful Links	
1	https://nptel.ac.in/courses/105/101/105101087/
2	https://nptel.ac.in/courses/105/105/105105107/
3	https://nptel.ac.in/courses/105/101/105101008/

	Course Outcomes	CL
BCE33602.1	**Classify** Highway Planning and Engineering surveys for highway alignment	3
BCE33602.2	**Evaluate** the Geometric Elements of Highways and Urban roads, Flexible and Rigid pavements.	5
BCE33602.3	**Analyze** the load and temperature stresses of rigid pavement, joints and judge the Highway Construction and Maintenance	4
BCE33602.4	**Summarize** and undertake the concepts of Traffic studies & classification, identification, site selection for Bridge Engineering	3
BCE33602.5	**Apply** the knowledge regarding Rapid Mass Transportation System	3

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T.Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited with A+ Grade

(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third Year (Semester-VI)

BCE33603: Irrigation Engineering

Teaching Scheme	
Theory	2 Hrs./week
Tutorial	
Total Credits	2
Duration of ESE: 2 Hrs.	

Examination Scheme	
CT-I	7 Marks
CT-II	7 Marks
CA	6 Marks
ESE	30 Marks
Total Marks	50 Marks

Course Objectives:

1.	To enable students understand the necessity, scope, and impact of irrigation engineering, along with the soil-water-plant relationship and water requirements of crops for effective irrigation planning.
2.	To equip students with the ability to apply knowledge of irrigation methods and diversion head works to design and manage water distribution systems effectively.
3.	To develop students' skills in analyzing the design and functionality of cross drainage works and canal regulation structures for efficient irrigation water management.

Course Contents

Unit I	**Introduction:** Necessity of irrigation, scope of irrigation engineering, benefits and ill effects of irrigation, irrigation development in India, types of irrigation systems, Soil-water plant relationship: depth of soil water available to plants, permanent and ultimate wilting point. **Water requirements of crops:** Depth of water applied during irrigation, Duty of water and delta improvement of duty, command area and intensity of irrigation, consumptive use of water and evapotranspiration, irrigation efficiencies, assessment of irrigation water
Unit II	**Methods of Irrigation:** Classification, choice of method of irrigation, surface and subsurface irrigation methods, Sprinkler and Drip Irrigation. Water logging: Causes, Measures, surface and sub-surface drains, land reclamation. **Design of Irrigation Channel:** Alignment, canal capacity, losses, FSL of canal, design of canal in alluvial soil and non-alluvial soils, balancing depth, lining of irrigation channels. Water logging: Causes.
Unit III	**Cross drainage works:** Types, selection of suitable type of CD works, aqueduct and Syphon aqueduct, determination of maximum flood discharge and waterway for drain, fluming of canal, uplift pressure on underside of barrel roof and at the floor of the culvert, design of bank connections. **Canal regulation works:** Canal fall, necessity and location, types of falls, Cross regulator and distributary head regulator, their functions, Silt control devices, Canal escapes, types of escapes.

Text Books	
T.1	Modi, P.N., Irrigation Water Resources and Water Power Engineering, Standard Book House, New Delhi.
T.2	Garg, S.K., Irrigation Engineering and Hydraulic Structures, Khanna Publishers, New Delhi.
T.3	Punmia, B.C., and B.B. Pande, "Irrigation and Water Power Engineering", Laxmi Publication Pvt. Ltd., New Delhi
Reference Books	
R.1	A.M. Micheal, "Irrigation, Theory and Practice", Vikas Publishing House Pvt. Ltd. New Delhi
R.2	Sharma, R.K., Text book of Irrigation Engineering and Hydraulic Structures, Oxford and IBK Publishing House, New Delhi.
R.3	Sharma, S.K., Principles and Practice of Irrigation Engineering, S. Chand & Company Pvt. Ltd, New Delhi.
Useful Links	
1	https://archive.nptel.ac.in/courses/105/105/105105110/
2	https://archive.nptel.ac.in/courses/105/108/105108081/

	Course Outcomes	CL
BCE33603.1	**Explain** irrigation benefits, soil water types, and crop water needs.	2
BCE33603.2	**Classify** irrigation methods and diversion head works design.	3
BCE33603.3	**Differentiate** cross drainage works and canal regulation structures.	4

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T.Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited with A+ Grade

(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third Year (Semester-VI)

BCE33606: Rural Water Supply & Sanitation (Program Elective-II)

Teaching Scheme	
Theory	3 Hrs./week
Tutorial	
Total Credits	**3**
Duration of ESE: 3 Hrs.	

Examination Scheme	
CT-I	15 Marks
CT-II	15 Marks
CA	10 Marks
ESE	60 Marks
Total Marks	**100 Marks**

Course Objectives:

1.	To study the principles of irrigation, soil–water–plant relationships, irrigation methods, water logging control, and water requirements of crops for efficient water resource management.
2.	To study the design, alignment, and control structures of irrigation channels for efficient canal system management.
3.	To study types and selection of cross drainage works, and understand their design aspects including flood discharge estimation, waterway determination, fluming, uplift pressure, and bank design.
4.	To understand the concept of environment and rural sanitation, assess water supply challenges and national policies, and study the selection, development, and low-cost treatment methods for rural water sources.
5.	To study rural water supply, wastewater disposal, and low-cost sanitation systems.

Course Contents

Unit I	Concept of environment and scope of sanitation in rural areas. Magnitude of problem of water supply and sanitation – population to be covered and difficulties. National policy. Introduction to Jal Jeevan Mission and its implication in rural India
Unit II	Various approaches for planning of water supply systems in rural areas. Selection and Development of preferred sources of water, springs, wells, infiltration wells, radial wells and infiltration galleries, collection of raw water from surface source
Unit III	Specific problems in rural water supply and treatment iron, manganese, fluorides etc., Low-cost treatment, appropriate technology for water supply and sanitation. Improvised methods and compact system of treatment of surface and ground waters such as MB settlers, slow sand filter
Unit IV	Water supply through spot sources, hand pumps, open dug-wells, Planning of distribution system in rural areas, Water supply during fairs, festivals and emergencies
Unit V	Treatment and disposal of wastewater/sewage, various methods of collection and disposal of night soil. Sanitation system and community latrines. Simple wastewater treatment system for rural areas and small communities such as stabilization ponds, septic tanks, and soakage pits etc., Composting, land filling, and Biogas plants

Text Books

T.1	Modi, P.N., Irrigation Water Resources and Water Power Engineering, Standard Book House, New Delhi.
T.2	Garg, S.K., Irrigation Engineering and Hydraulic Structures, Khanna Publishers, New Delhi.
T.3	Punmia, B.C., and B.B. Pande, "Irrigation and Water Power Engineering", Laxmi Publication Pvt. Ltd., New Delhi
T.4	Rural Water Supply and Sanitation – Sanjay Gupta, Vayu Education of India
T.5	Rural Development (Principles, Policies and Management) – Katar Singh, SAGE Publications India Pvt. Ltd
Reference Books	
R.1	A.M. Micheal, "Irrigation, Theory and Practice", Vikas Publishing House Pvt. Ltd. New Delhi
R.2	Sharma, R.K., Text book of Irrigation Engineering and Hydraulic Structures, Oxford and IBK Publishing House, New Delhi.
R.3	Sharma, S.K., Principles and Practice of Irrigation Engineering, S. Chand & Company Pvt. Ltd, New Delhi.
R.4	Rural Water Supply & Sanitaion – Krieger Publishing Company
R.5	Manual of Water supply and Treatment, CPHEEO, GOI, New Delhi
R.6	Water supply for Rural areas and small communities, EG Wagner and N Lanoik, Geneva, W.H.O
Useful Links	
1	https://archive.nptel.ac.in/courses/105/105/105105110/
2	https://archive.nptel.ac.in/courses/105/108/105108081/
3	https://nptel.ac.in/courses/105/105/105105201/
4	https://nptel.ac.in/courses/105/101/105101010/

	Course Outcomes	CL
BCE33606.1	**Explain** irrigation benefits, soil water types, and crop water needs.	3
BCE33606.2	**Classify** irrigation methods and diversion head works design.	3
BCE33606.3	**Differentiate** cross drainage works and canal regulation structures.	4
BCE33606.4	**Explain** rural sanitation concepts and low-cost water supply and treatment methods.	3
BCE33606.5	**Describe** rural water supply systems, wastewater disposal methods, and low-cost sanitation and treatment solutions.	2

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T. Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441 108
NAAC Accredited with A+ Grade
(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third Year (Semester-VI)

BCE33607: Environmental Laws & Policy (Program 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
		Total Marks	100 Marks

Course Objectives:

1.	To introduce the role of law, policy and institutions in the conservation and management of natural resources
2.	To understand the laws and policies at the national level relating to environment protection such as Water Act (1974), Air Act (1981), Environment Protection Act (1986)
3.	To equip the students with the skills needed for interpreting laws, policies and judicial decisions
4.	To understand the important role of pollution control boards in curbing environmental pollution like Environmental Tribunals & Green Benches

Course Contents

Unit I	Environment Definitions and Acts: Environment definition in Indian law - Different environmental protection legislations- History of Environmental protection in India - Provisions in Indian Penal Code for Environmental protection-The constitutions of India – Union list- State list – Concurrent list - Panchayats and Municipalities role
Unit II	Water (prevention & control of Pollution) Act 1974: Water pollution – definition – Objectives of Water Act – Legislation to control water pollution – Functions of CPCB and SPCB - Local bodies role – Water (prevention & control of pollution) Act 1974 as amended by Amendment Act 1988. Air (prevention & control of Pollution) Act 1981-Sections of Air (prevention & control of Pollution) Act 19, 20, 21, 22-Penalties -Ambient air quality standards-Noise and the Laws
Unit III	Environmental (Protection) Act 1986: Environment and pollution - definition as per Environmental law-General powers of Central and state Government under EPA-Important Notification in EPA 1986- The Indian Forest Act 1927- Forest Conservation Act 1980 - Wild Life (Protection) Act 1972 - Constitution of Pollution Control Boards – Powers & functions – Equitable remedies for pollution control.
Unit IV	Municipal Solid Waste Management Rules: Solid waste management – Hazardous Wastes (Handling and Management) Rules 1998-Bio-medical Wastes (Handling and Management) Rules 1998-Recyclled plastics (Manufacture and Usage) Rules, 1999-Municipal Solid Waste Management Act 2003- Rules - E.I.A and Public Hearing- Ecolabeling-Eco Mark
Unit V	Coastal Regulation Zone Notification and Green Benches: Coastal Regulation Zone - definition-Importance of coral reef-Regulation activities in CRZ - The Biological Diversity Act 2002-Bio diversity Rules 2004 - The Intellectual Property Rights (IPR)-National

	Environment Appellate Authority –Environmental Tribunal and Green Benches - Some Important cases on Environment - International Conventions - Protocols for protection of the Environment
Text Books	
T.1	Environmental Policies in India - Surendra Kumar, Northan Book Centre, New Delhi
T.2	Environmental law and policy in India – Shyam Divan and Armin Roseneranz, Oxford University Press, New Delhi
T.3	Textbook of Environmental Law – Dr. N. Maheshwara Swamy, Asia Law House
T.4	Environmental Science and Engineering – Suresh K. Dhameja, S.K. Katania & Sons
Reference Books	
R.1	The Impact of Environment Laws on Industry – Surendra Kumar, Aditya Books
R.2	Environmental Pollution and Control – Dr. H.S. Bhatia – Galgotia Publication
R.3	Environmental Law – Dr. H. N. Tiwari, Allahabad Law Agency
R.4	CPCB, "Pollution Control acts, Rules and Notifications issued there under "Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi
Useful Links	
1	https://nptel.ac.in/courses/105/107/105107181/

	Course Outcomes	CL
BCE33607.1	**Use** basic knowledge of environment, pollution, legislations & Acts	3
BCE33607.2	**Relate** & learn about the legal provisions of the water pollution & air pollution	3
BCE33607.3	**Apply** the knowledge of Constitutional provisions for the Protection of environment& forests	3
BCE33607.4	**Interpret** the knowledge of Municipal solid waste & Hazardous waste management Acts	3
BCE33607.5	**Distinguish** international conventions & protocols for environment protection	4

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T. Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441 108
NAAC Accredited with A+ Grade
(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third Year (Semester-VI)

BCE33608: Solid and Hazardous Waste Management (Program Elective-II)

Teaching Scheme	
Theory	3 Hrs./week
Tutorial	
Total Credits	3
Duration of ESE: 3Hrs.	

Examination Scheme	
CT-I	15 Marks
CT-II	15 Marks
CA	10 Marks
ESE	60 Marks
Total Marks	100 Marks

Course Objectives:

1.	To impart comprehensive overview of solid and hazardous waste management including structure, sources, classification & characteristics
2.	To provide knowledge on solid waste management, processing & design aspects along with concept of Reduce, Reuse & Recycle (3 R's)
3.	To learn about composting, incineration & sanitary land filling methods of solid waste management
4.	To understand hazardous waste remedial & minimization measures, their importance & disposal practices used in Indian industries

Course Contents

Unit I	Introduction to solid waste management (SWM): Structure, necessity and responsibility, Sources, Quantity and quality, Sources of solid waste, classification and components, physical and chemical characteristics, per capita contribution, sampling and analysis.
Unit II	Collection and transportation of solid waste: Method of collection, equipment used for collection and transportation, transfer stations, optimization of transport route. Solid waste processing: Methods of processing, choice of methods, merits and demerits of various methods, gas control measures. The 3R's concept.
Unit III	Composting of waste, methods of composting, factors affecting composting. Sanitary land filling: Site requirements, methods, leachate management, control of gases. Incineration: Principles of incineration, types of incinerators, advantages and disadvantages, 3T Diagrams
Unit IV	Need for hazardous waste management – Sources of hazardous wastes – Effects on community – terminology and classification – Storage and collection of hazardous wastes – Problems in developing countries – Protection of public health and the environment.
Unit V	Management of Hazardous Waste: Identifying a hazardous waste – methods – Quantities of hazardous waste generated – Components of a hazardous waste management plan – Hazardous waste minimization – Disposal practices in Indian industries – Future challenges.

Text Books

T.1	Solid and Hazardous Waste Management – M. N. Rao, Butterworth-Heinemann Publication
T.2	Solid and Hazardous Waste Management – P. M. Cherry, CBS Publishers
T.3	Solid Waste Management – K. Sasikumar, PHI Learning

T.4	Textbook of Solid Wastes Management – Iqbal H Khan, CBS Publishers
Reference Books	
R.1	Solid Waste Management in Developing Countries – A.D. Bhide, B.B. Sundaresan (NEERI, India) Indian National Scientific Documentation Centre
R.2	Integrated Solid Waste Management – George Tchonoglobus, McGraw-Hill, New York
R.3	CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi
R.4	Standard Handbook of Hazardous Waste Treatment and Disposal – Freeman H.M.
Useful Links	
1	https://nptel.ac.in/courses/105/106/105106056/
2	https://nptel.ac.in/courses/105/103/105103205/

	Course Outcomes	CL
BCE33608.1	**Evaluate** sampling and characterization of solid waste	5
BCE33608.2	**Apply** steps in solid waste management-waste reduction at source, collection techniques, materials and resource recovery/recycling	3
BCE33608.3	**Relate** engineering, financial and technical options for solid waste management	3
BCE33608.4	**Relate** & become aware of environment and health impacts of hazardous waste mismanagement	3
BCE33608.5	**Analyze** hazardous waste constituents including QA/QC issues	4

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T.Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441 108
NAAC Accredited with A+ Grade
(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third Year (Semester-VI)

BCE33609: Air and Noise Pollution Control (Program Elective-II)

Teaching Scheme	
Theory	3 Hrs./week
Tutorial	
Total Credits	3
Duration of ESE: 3Hrs.	

Examination Scheme	
CT-I	15 Marks
CT-II	15 Marks
CA	10 Marks
ESE	60 Marks
Total Marks	100 Marks

Course Objectives:

1.	To describe types of air pollutants & their sources, air pollution standards, Effects of air pollutants on humans, animals, plants and materials
2.	To understand determination techniques of primary & secondary meteorological parameters in air pollution, wind rose diagram
3.	To exemplify methods of sampling and analysis of particulate & gaseous air pollutants
4.	To highlight control of various air pollutants – principles, methodology and equipment
5.	To impart knowledge of noise pollution, its management and control parameters, understand the difference between outdoor & indoor noise propagation, noise standards & limits

Course Contents

Unit I	Introduction to AIR POLLUTION: Definition, air pollution episodes, atmosphere & its zones. Classification and sources of air pollutants, Standards for air pollution (as per Indian Standards and CPHEEO). Effects of air pollutants on humans, animals, plants and materials.
Unit II	Meteorological parameters and Air sampling: Primary and secondary parameters, atmospheric stability, plume behavior. Wind rose diagram, wind data analysis & wind impact area diagram, Stack height determination.
Unit III	Air sampling and measurement: ambient air sampling and stack sampling, collection of particulate and gaseous pollutants, site selection criteria methods of estimation. Automobile exhaust: Introduction to Pollution due to diesel & petrol engines
Unit IV	Air pollution controls methods and equipment; Principles of control methods for particulates and gaseous pollutants, gravity settlers, electrostatic precipitators, bag filters, cyclones and wet scrubbers, adsorption, absorption, incineration, condensation
Unit V	NOISE POLLUTION: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psycho-acoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infra-sound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices.

Text Books

T.1	Air Pollution – M. N. Rao, McGraw Hill Education

T.2	Environmental Pollution Control Engineering – C. S. Rao, New Age Iternational Publishers
T.3	Sewage Disposal & Air Pollution Engineering – S. K. Garg, Khanna Publishers
T.4	Air Pollution – Pallavi Saxena & Vaishali Naik, CABI Publishing
Reference Books	
R.1	Air: Pollution, Climate change & India's choice between Policy & Pretence – Dean Spears, Harper Collins India Publication
R.2	Clearing the Air – Tim Smedley, Bloomsbury Sigma Publication
R.3	Fundamentals of Air Pollution – Daniel A. Vallero, Academic Press
R.4	Air pollution Control Theory - Martin Crawford, McGraw-Hill Inc. US
Useful Links	
1	https://nptel.ac.in/courses/105/102/105102089/
2	https://nptel.ac.in/courses/105/102/105102175/

	Course Outcomes	CL
BCE33609.1	**Analyze** history of air pollution, air pollution episodes, sources and classification of air pollutants	4
BCE33609.2	**Classify** fundamentals of air pollution and its associated environmental impacts	3
BCE33609.3	**Relate** techniques and instrumentation of ambient air sampling & monitoring	3
BCE33609.4	**Evaluate** the key concepts of air quality management & control	5
BCE33609.5	**Analyze** the concepts of noise pollution & its monitoring procedures	4

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T.Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited with A+ Grade

(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third Year (Semester-VI)

BCE33610: Building Construction Practice (Program Elective-III)

Teaching Scheme	
Theory	3 Hrs./week
Tutorial	
Total Credits	3
Duration of ESE: 3Hrs.	

Examination Scheme	
CT-I	15 Marks
CT-II	15 Marks
CA	10 Marks
ESE	60 Marks
Total Marks	100 Marks

Course Objectives:

1.	To Execute safe practices in building construction activities.
2.	To provide a basic understanding of the different types of foundation and to introduce about the job layout site and their important parameter in the civil engineering field.
3.	To identify the good materials to be used for the construction work as well as different material available for floors and roofs.
4.	To supervision of different types of masonry and understand basic concepts of various building services.
5.	To understand the basic concept of substructure components and superstructure components in building as well as in bridge.

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. **Precast 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 principals, 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
T.2	"Building construction" author by Varghese P.C., Prentice Hall of India Pvt. Ltd, New Delhi Publication
T.3	"Building Construction" author by B.C. Punmia, Arun Kumar Jain, Ashook Kumar Jain, Laxmi Publications
T.4	"Building Construction" author by Rangwala, Charotar Publishing House Pvt. Ltd.
Reference Books	
R.1	"Building Materials & Construction" author by Soni,S. 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, Standard Publisher Distributors New Delhi
R.4	"Construction Technology," Author by Sankar, S.K. and Saraswati, S., Oxford University Press, New Delhi
Useful Links	
1	https://nptel.ac.in/courses/105/102/105102088/

	Course Outcomes	CL
BCE33610.1	**Illustrate** the foundation and job site layout of Building.	3
BCE33610.2	**Analyze** various materials and precast construction techniques for building construction.	4
BCE33610.3	**Identify** the concept of stonework, lintel arches, damp proofing.	4
BCE33610.4	**Analyze** construction technique for substructure and superstructure.	4
BCE33610.5	**Apply** the knowledge of timbering, floors, roofs, painting and plastering for building construction.	3

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T.Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited with A+ Grade

(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third Year (Semester-VI)

BCE33611: Advanced Building Construction Methods (Program Elective-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
		Total Marks	**100 Marks**

Course Objectives:

1.	Understand foundation types, construction methods, formwork, and staging basics.
2.	Learn common and modular building construction methods, including precast and slip forming.
3.	Explore steel and bridge construction; identify sustainable construction materials and technologies.
4.	Analyze LiDAR technology for topographic mapping and geospatial applications.
5.	Evaluate LEED certification, analyze green projects, and prepare for LEED Associate exam.

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, advanced painting and pointing its chemical physical properties.
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	LEED certification points & evaluation parameters, 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
T.2	"Building construction" author by Varghese P.C., Prentice Hall of India Pvt. Ltd, New Delhi Publication
T.3	Project Planning & Control with PERT&CPM" author by Punmia B.C. & Khandelwal K.K., Laxmi Publications, New Delhi

T.4	"Building Construction" author by Kumar, S., 20th "Building Construction", Standard Publishers
Reference Books	
R.1	"Soil Mechanics And Foundation Engineering" author by Arora K.R., Standard Publishers Distributors
R.2	"Design Of Foundation Systems : Principles And Practices" author by Kurian Nainan P., Narosa Publishing House
R.3	"Alternative building Materials and Technologies" author by K. S. Jagdish& B. V. Venkatarama Reddy, New age international Publishers
R.4	"Sustainable Building Design Manual- Volume I & II" author by TERI, Tata Energy Research Institute
Useful Links	
1	https://nptel.ac.in/courses/105/102/105102195/
2	https://nptel.ac.in/courses/105/105/105105157/

	Course Outcomes	CL
BCE33611.1	**Explain** the types of foundation provided in building construction	3
BCE33611.2	**Determine** common building construction methods in civil engineering field.	3
BCE33611.3	**Illustrate** basic construction methods used for steel structures, bridges and their technologies.	3
BCE33611.4	**Analyze** the concept of LiDAR technologies and their applications.	4
BCE33611.5	**Implement** green construction project case studies and LEED rating system	3

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T.Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited with A+ Grade

(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third Year (Semester-VI)

BCE33612: Structural Audit & Retrofitting of Structures (Program Elective-III)

Teaching Scheme	
Theory	3 Hrs./week
Tutorial	
Total Credits	**3**
Duration of ESE: 3Hrs.	

Examination Scheme	
CT-I	15 Marks
CT-II	15 Marks
CA	10 Marks
ESE	60 Marks
Total Marks	**100 Marks**

Course Objectives:

1.	Understand structural damage causes, audit necessity, and retrofitting introduction.
2.	Learn structural audit processes, NDT methods, investigation, and reporting.
3.	Explore structural health monitoring (SHM) techniques and data processing.
4.	Understand various retrofitting methods for different structural materials.
5.	Learn FRP properties and its application in retrofitting RC members.

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, forensic Study and failure analysis.
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.
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
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
Useful Links	
1	https://nptel.ac.in/courses/105/106/105106202/

	Course Outcomes	CL
BCE33612.1	**Identify** causes of deterioration in RC and steel structures	3
BCE33612.2	**Explore** entire process of structural audit.	4
BCE33612.3	**Explore** necessity and methods of structural health monitoring.	4
BCE33612.4	**Explain** method of retrofitting for RC, steel and historical structures	3
BCE33612.5	**Design** retrofitting using FRP for RC column and RC beam.	6

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T. Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited with A+ Grade

(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third Year (Semester-VI)

BCE33613: Construction Equipment & Automation (Program Elective-III)

Teaching Scheme	
Theory	3 Hrs./week
Tutorial	
Total Credits	**3**
Duration of ESE: 3Hrs.	

Examination Scheme	
CT-I	15 Marks
CT-II	15 Marks
CA	10 Marks
ESE	60 Marks
Total Marks	**100 Marks**

Course Objectives:

1.	Understand construction equipment features, capacity, cost, and productivity.
2.	Learn the need and benefits of automation in construction.
3.	Explore drone applications in construction surveying and monitoring.
4.	Understand the benefits and applications of robotics in construction.
5.	Introduce virtual reality, augmented reality, and Building Information Modeling (BIM).

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), Modern trends in civil engineering.

Text Books

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

Reference Books

R.1	"Construction Equipment and its Planning and Application" author by Dr. Mahesh Varma, 1st edition, Metropolitan Book Company, New Delhi
R.2	"BIM and Construction Management: Proven Tools, Methods, and Workflows", By Brad Hardin, Dave McCool, John Wiley & Sons

R.3	"Automation in Construction Management: Automated management of Construction Materials Using RFID Technology", Javad Majrouhi Sardroud, Scholars' Press
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
BCE33613.1	**Derive** feasibility of specific equipment in construction project conditions	3
BCE33613.2	**Selection** of Automation techniques in construction industry	4
BCE33613.3	**Select** suitable Drone technology for surveying and project management	4
BCE33613.4	**Analyze** benefits of robotics versus conventional construction equipment	4
BCE33613.5	**Classify** application of Virtual Reality, Augmented Reality, BIM in construction industry	3

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T. Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited with A+ Grade

(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third Year (Semester-VI)

BEE33613: Green Energy Technology

Teaching Scheme		Examination Scheme	
Theory	2 Hrs./week	**CT-I**	7 Marks
Tutorial		**CT-II**	7 Marks
Total Credits	**2**	**CA**	6 Marks
Duration of ESE: 2 Hrs.		**ESE**	30 Marks
		Total Marks	**50 Marks**

Course Objectives:	
1.	To analyze the sun-earth geometry and the physics of solar radiation to accurately estimate terrestrial solar radiation under various climatic conditions.
2.	To design a standalone photovoltaic system based on the principles of PV cell operation and performance analysis.
3.	To evaluate the performance of solar thermal collectors and storage systems for various applications.

Course Contents	
Unit I	Energy Scenario, overview of solar energy conversion devices and applications, physics of propagation of solar radiation from the sun to earth. Sun-Earth Geometry, Extra-Terrestrial and Terrestrial Radiation, Solar energy measuring instruments. Estimation of solar radiation under different climatic conditions, Estimation of total radiation
Unit II	Fundamentals of solar PV cells, principles and performance analysis, modules, arrays, theoretical maximum power generation from PV cells. PV standalone system components, Standalone PV-system design. Components of grid-connected PV system, Fundamentals of solar collectors, Physical significance of Transmissivity – absorptivity product.
Unit III	Performance analysis of Liquid flat plate collectors and Solar Air heaters. Solar thermal power generation (Solar concentrators). Thermal Energy Storage (sensible, latent and thermochemical) and solar pond. Applications: Solar Refrigeration, Passive architecture, solar distillation, and emerging technologies.

Text Books	
T.1	G. N. Tiwari, Solar Energy, Fundamentals, Design, Modeling and Applications, Narosa
T.2	S. P. Sukhatme and J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill
T.3	C. S. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, Prentice Hall India
T.4	J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley
T.5	T. C. Kandpal and H.P. Garg, Financial Evaluation of Renewable Energy Technologies, McMillan India Ltd.

Reference Books	
R.1	D.Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor & Francis.
R.2	H. P. Garg and J. Prakash, Solar Energy: Fundamentals and Applications, Tata McGraw Hill
R.3	M. A. Green, Third Generation Photovoltaics: Advanced Solar Energy Conversion, Springer
R.4	A. Goetzberger and V. U. Hoffmann, Photovoltaic Solar Energy Generation, Springer- -verlag
R.5	K. Jager, O. Isabella, A. H. M. Smets, R.A.C.M.M. Van Swaaij, and M. Zeman, Solar Energy – fundamentals, technology and systems, Delft University of Technology
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc20_ph14/preview

	Course Outcomes	CL
BEE33613.1	**Calculate** total solar radiation on a surface using appropriate models and measurement data.	3
BEE33613.2	**Evaluate** solar collector and PV module performance applying physical laws.	5
BEE33613.3	**Apply** thermal storage and solar power principles to analyze systems.	3

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T.Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

HOD
Department Of Electrical Engineering
Tulsiramji Gaikwad - Patil College
Of Engineering And Technology
Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441 108
NAAC Accredited with A+ Grade
(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third year (Semester-VI)

BCE33604: Transportation Engineering Lab

Teaching Scheme		Examination Scheme	
Practical	2 Hrs./week	**CA**	25 Marks
Tutorial			
Total Credits	**1**	**ESE**	25 Marks
Duration of ESE:			
		Total Marks	**50 Marks**

Course Objectives:

1.	Determine the properties of Sub grade soil using AASHTO soil classification system
2.	Determine the properties of aggregates like crushing, abrasion & impact value, flakiness & elongation index
3.	Determine the properties of bitumen like penetration value, softening point, flash & fire point
4.	Understand the basic differences between flexible pavement & rigid pavement

	Course Contents (Perform any 8)	**CO**
1	Perform California Bearing Ratio Test	**CO1**
2	Study AASHTO Classification of Sub grade Soil	**CO1**
3	Determine the abrasion value of coarse aggregate by using Los Angles machine	**CO2**
4	Determine the aggregate impact value of the given specimen	**CO2**
5	Determine the Specific gravity and water absorption of an aggregate sample	**CO2**
6	Determine the aggregate crushing value of the given specimen	**CO3**
7	Determine the Penetration Value of the given bitumen	**CO4**
8	Determine the ductility value of the given bitumen	**CO4**
9	Determine the Softening point of the given bitumen	**CO5**
10	Determine the Flash point and Fire point of the given bitumen	**CO5**

Text Books

T.1	Highway Engineering: Khanna and Justo, Nem Chand Publication
T.2	Principles and practices of Highway Engineering - S. K. Sharma, Khanna Publication

Reference Books

R.1	Pavement Design: Yoder and Witzak, Wiley Publication
R.2	Traffic Engineering: L.R.Kadiyali, Khanna Publishers
R.3	Relevant IS Codes: IS-2720-PART-16-1979, AASHTO manual, IS:2386-Part 1 to 6-1963, IS:1203-1978, IS 1208-1978, IS 1201 to 1220 (1978).

Useful Links

1	https://nptel.ac.in/courses/105/101/105101087/
2	https://nptel.ac.in/courses/105/105/105105107/
3	https://nptel.ac.in/courses/105/101/105101008/

	Course Outcomes	CL
BCE33604.1	**Identify** the properties of highway materials and draw appropriate conclusion	3
BCE33604.2	**Determine** the properties of aggregate used for road construction	3
BCE33604.3	**Determine** flakiness index & elongation index of aggregate.	3
BCE33604.4	**Determine** the suitability of bitumen and check the properties of bitumen by Penetration & Ductility tests	3
BCE33604.5	**Relate** complete knowledge of softening point, Flash and Fire point of bitumen.	4

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T.Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited with A+ Grade

(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third year (Semester-VI)

BCE33605: Concrete Testing Lab

Teaching Scheme		Examination Scheme	
Practical	2 Hrs./week	**CA**	25 Marks
Tutorial			
Total Credits	1	**ESE**	25 Marks
Duration of ESE:		**Total Marks**	**50 Marks**

Course Objectives:

1.	To understand and perform various tests on cement to determine its properties and quality for construction work.
2.	To analyze workability tests on fresh concrete and strength tests on hardened concrete for performance evaluation.
3.	To study the principles and operation of non-destructive testing (NDT) equipment used for concrete assessment.
4.	To apply knowledge in preparing concrete mix designs of different grades and study the effect of admixtures on concrete properties.
5.	To evaluate the properties of aggregates through standard laboratory tests to ensure their suitability for concrete production.

Course Contents (Perform any 8)		**CO**
1	Determine Fineness test of cement	CO1
2	Determine the Normal consistency, initial and final setting times of cement	CO1
3	Determine soundness of cement	CO1
4	Determine compressive strength of cement	CO1
5	Determine particle shape, texture and elongation/ flakiness index of aggregate	CO5
6	Perform Sieve analysis and particle size distribution of aggregate.	CO5
7	Determine Bulking and Percentage silt in sand.	CO5
8	Determine Workability of fresh concrete.	CO2
9	Determine strength of hardened concrete.	CO4
10	Determine the quality of concrete by the NDT method.	CO2

Text Books

T.1	"Concrete Technology Theory and Practice "authored by M.S. Shetty 6 th edition, S. Chand & Company, Limited, 2008
T.2	"Concrete Technology" authored by Gambhir M.L.,Tata McGraw-Hill Education,2004

T.3	"Properties of Concrete" authored by AM Neville ELBS, Pearson, 28 October 2011
T.4	"Concrete Technology" authored by A R Santhakumar, Oxford higher education,2006
Reference Books	
R.1	"Concrete Microstructures: Properties and materials" authored by PK Mehta and PJ Monterio, McGraw Hills Professional, 2013.
R.2	"Concrete Technology", authored by DF Orchard, Applied SciencesPublications,1976
R.3	"Concrete Technology and Good Construction Practices" authored by Y P Gupta, New age international publisher, 2013.
R.4	"Concrete Technology", authored by R.S. Varshney, Oxford and IBH,1982
R.5	Relevant IS Codes: IS: 5513 – 1976, IS 4031 (Part 1 to 6)-1988, IS: 2386 (Part 1)-1963, IS: 2386 Part-4 (1963), IS: 2386 (Part 4)-1963, IS 2386-3 (1963), IS 1199-1959, IS 10262 (2009), IS 516 (1959). IS 13311-2 (1992)
Useful Links	
1	https://nptel.ac.in/courses/105/103/105103192/
2	https://nptel.ac.in/courses/105/103/105103095/
3	http://nptel.ac.in/courses/117103064

	Course Outcomes	CL
BCE33605.1	Determine the test on cement which is used on the construction site.	3
BCE33605.2	Analyze workability tests on fresh concrete and various tests on hardened concrete.	4
BCE33605.3	Analyze working of Nondestructive testing equipment.	3
BCE33605.4	Apply the knowledge of prepare mix design at different grade of concrete and understanding of application of admixture and its effect on properties of concrete.	3
BCE33605.5	Evaluate the test on aggregate.	5

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T. Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited with A+ Grade

(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third year (Semester-VI)

BCE33614: Geomatics Lab

Teaching Scheme		Examination Scheme	
Practical	2 Hrs./week	**CA**	25 Marks
Tutorial			
Total Credits	**1**	**ESE**	25 Marks
Duration of ESE:		**Total Marks**	**50 Marks**

Course Objectives:

1.	To understand the principles and techniques of tachometric surveying for determining distances and elevations.
2.	To study and illustrate different methods used for setting out simple circular curves in the field.
3.	To apply the knowledge of modern surveying techniques and advanced instruments in various surveying applications.
4.	To develop the skill of operating different survey instruments accurately and efficiently.
5.	To design and execute a mini project by integrating various surveying methods and practical applications.

Course Contents (Perform any 8)		**CO**
1	Determination of constants of Tachometer.	CO1
2	Determination of elevation of points by Tacheometric surveying	CO1
3	Determination of elevation of points and horizontal distance between them by Tacheometric survey	CO1
4	Determination of gradient of given length of road by Tacheometric survey	CO1
5	Setting out of simple circular curve by offsets from chord produced method	CO2
6	Setting out of simple circular curve by Rankine method of tangential angle	CO2
7	Setting out of simple transition curve by tangential angle method	CO2
8	Use of Advanced techniques of surveying – Study of Stereoscope	CO4
9	Toposheet: Understanding and identification of different features of drawing	CO4
10	Study of Total station and Use of Total Station to measure horizontal distance	CO3
11	Use of Total Station to measure angles and elevations	CO3
12	Use total Station to carry out survey Project for closed traverse	CO3
13	Study of GPS, GIS, Drone & Aerial Survey Components and its Working Principle	CO3
14	Study of EDM Principles and its Instrument Components	CO3

15	Survey project should be carried out for minimum 2 days in the following areas: (a) Road Project (b) Irrigation Project (c) Water Supply Project	CO5
Text Books		
T.1	Surveying and Levelling - Kanetkar and Kulkarni (Vol.II), Pune Vidyarthi Griha Prakashan	
T.2	Surveying and Levelling - Dr. B.C. Punmia (Vol. II & III), Laxmi Publications	
Reference Books		
R.1	Remote sensing & G.I.S. by Dr. M. Anji Reddy	
Useful Links		
1	https://nptel.ac.in/courses/105/107/105107122/	

	Course Outcomes	**CL**
BCE33614.1	Use the techniques of Tachometric surveying.	3
BCE33614.2	Illustrate the methods of setting of simple circular curve.	4
BCE33614.3	Apply the concepts of modern surveying techniques & instrumentation.	3
BCE33614.4	Operate survey instruments effectively with precision.	4
BCE33614.5	Design mini project using the surveying techniques.	6

H.O.D.
Department of Civil Engineering
T.G.P.C.E.T.Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
& Technology, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur-441 108

NAAC Accredited with A+ Grade

(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

B.Tech. Civil Engineering - Third year (Semester-VI)

BCE33615: Building Information Modelling and Management Lab

Teaching Scheme		Examination Scheme	
Practical	2 Hrs./week	**CA**	25 Marks
Tutorial		**ESE**	25 Marks
Total Credits	1	**Total Marks**	**50 Marks**
Duration of ESE:			

Course Objectives:

1.	To gain practical proficiency in industry-standard BIM software like Revit for civil engineering modeling.
2.	To integrate BIM workflows with core civil engineering disciplines for design, planning, and surveying.
3.	To apply BIM principles for efficient project information management adhering to industry standards.
4.	To explore advanced BIM applications and emerging trends such as clash detection and generative design.
5.	To enhance collaboration and communication skills within a digital BIM project environment.

	Course Contents	**CO**
1	Modelling of a simple residential building in BIM software.	**CO1**
2	Creating structural framing plans (beams, columns, slabs) in BIM.	**CO1**
3	Developing a 4D construction schedule linked to the BIM model.	**CO2**
4	Performing quantity takeoff for concrete and steel from the BIM model.	**CO2**
5	Setting up a collaborative project environment within the BIM platform.	**CO3**
6	Implementing information management standards (e.g., naming conventions) in a BIM project.	**CO3**
7	Conducting clash detection between structural and architectural elements.	**CO4**
8	Exploring a computational design tool integrated with the BIM software.	**CO4**
9	Generating a building section and elevation drawings from the BIM model.	**CO5**
10	Creating a visual walkthrough of a modeled infrastructure project.	**CO5**

Text Books

T.1	*BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors* by Chuck Eastman.
T.2	*The BIM Manager's Handbook: Guidance for Professionals in Architecture, Engineering, and Construction* by Dominik Holzer.
T.3	*Building Information Modeling: BIM in Current and Future Practice* by Karen Kensek.

T.4	*Building Information Modelling (BIM) for Civil Engineering: Transforming Project Design and Management* by S. Manikandan, Dr.
Reference Books	
R.1	*The BIM-Manager: A Practical Guide for BIM Project Management* by Mark Baldwin.
R.2	*Autodesk Revit 2025 BIM Management* by ASCENT
Useful Links	
1	**Autodesk Knowledge Network (Revit):** https://www.autodesk.com/support/technical/article/caas/sfdcarticles/sfdcarticles/Learning-resources-for-Autodesk-Revit.html - Official learning resources for Revit.
2	**VDCI - How to Learn BIM Online:** https://vdci.edu/learn/bim/how-to-learn-bim-online - Resources and pathways for learning BIM.

	Course Outcomes	CL
BCE33615.1	**Develop** a Building Information Model of a simple residential building and generate structural framing plans including beams, columns, and slabs using BIM software.	6
BCE33615.2	**Integrate** a 4D construction schedule with a BIM model and perform quantity takeoff for concrete and steel to support construction planning and cost estimation.	5
BCE33615.3	**Establish** a collaborative project environment within a BIM platform and **apply** information management standards, such as naming conventions, to ensure effective coordination in a BIM project.	3
BCE33615.4	**Analyze** clashes between structural and architectural elements using BIM software and explore computational design tools integrated within the BIM environment to enhance design efficiency.	4
BCE33615.5	**Generate** building section and elevation drawings from a BIM model and a visual walkthrough of a modeled infrastructure project to effectively communicate design intent.	6

H.O.D.
Department of Civil Engineering
T.G.P.C.E.Y.Nagpur.

Dean Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur