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 2024-25

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

- To strive for rearing standard and stature of the students by practicing high standards of professional ethics , transparency and accountability.
- To provide facilities and services to meet the challenges of Industry and Society.
- To facilitate socially responsive research, innovation and entrepreneurship.
- To ascertain holistic development of the students 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

- To promote academic and ethical development while upholding high standards.
- To provide advance facilities with the skills needed to face Industry and societal challenges.
- To promote socially responsible research, innovation, and entrepreneurship in the field of Civil Engineering.
- 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 Education Objectives (PEO)

Graduates will be able to

- PEO1 : Analyse and design civil engineering structures while keeping social awareness and ethical responsibilities in mind.
- PEO2 : Demonstrate leadership abilities in supporting sustainable practices in Civil Engineering
- PEO3 : Exhibit a commitment to lifelong learning, staying updated on developing technologies and industry trends, and adjusting to the evolving world of Civil Engineering.
- PEO4 : Executing 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.

Tulsiramji Gaikwad Patil College of Engineering & Technology, Nagpur

SCHEME OF INSTRUCTION & SYLLABI

Programme: Civil Engineering

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

Semester – VII **(Group-A)**

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	BCE4701	Estimating & Costing	3	1	-	4	4	15	15	10	60	100
2	PCC	BCE4702	Advanced Design of Reinforced Concrete Structure.	3	1	-	4	4	15	15	10	60	100
3	PEC	BCE4703-06	Program Elective-V	3	-	-	3	3	15	15	10	60	100
4	PEC	BCE4707-10	Program Elective-VI	3	-	-	3	3	15	15	10	60	100
5	OEC	B$$XX01-14	Open Elective-III	3	-	-	3	3	15	15	10	60	100
6	PEC	BCE4715-18	Program Elective-VII	3	-	-	3	3	15	15	10	60	100
7	PCC	BCE4719	Estimating & Costing Lab	-	-	2	2	1	-	-	25	25	50
8	PCC	BCE4720	Advanced Concrete Structure Lab	-	-	2	2	1	-	-	25	25	50
9	PROJ	BCE4721	Seminar based on Emerging Courses*	-	-	2	2	2	-	-	25	25	50
10	MCC	BAU4707	Behavioral and Interpersonal Skills	2	-	-	2	Audit	-	-	-	-	-
			Total	**20**	**2**	**6**	**30**	**24**	**90**	**90**	**175**	**475**	**850**

***There will be two presentations, based on seminar topic to be selected in consultation with a guide preferably based on emerging trends.**

***Group (A) students will Remain in campus and Group (B) students will go for Industry Based Project/ Industry Internship and (Vice Versa)**

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	--	--	--	8	09	03	02	Yes
Cumulative Sum	04	27	20	63	21	09	06	--

PROGRESSIVE TOTAL CREDITS :126+24 = 150

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SCHEME OF INSTRUCTION & SYLLABI

Programme: Civil Engineering

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

Semester – VIII **(Group-B)**

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs./Wk	Credits	EXAM SCHEME				
									CT1	CT2	TA/CA	ESE	TOTAL
1	PROJ	BCE4801	Industry Based Project/ Industry Internship	-	-	16	16	08	-	-	75	75	150
2	PCC	BCE4802	Comprehensive Viva-voce	-	-	-	-	3	-	-	-	100	100
3	HSMC	BCE4803	Extra-Curricular Activities / Co-Curricular Activities/ Competitive Exam	-	-	-	-	2	-	-	100	-	100
4	MCC	BAU4808	Project based Science, Technology, Social, Design and Innovation	2	-	-	2	Audit	-	-	-	-	-
			Total	2	-	16	18	13	-	-	175	175	350

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	02	--	--	03	--	--	08	Yes
Cumulative Sum	06	27	20	66	21	09	14	--

PROGRESSIVE TOTAL CREDITS :150+13 =163

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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 Onsite Sanitation Systems	**BCE3508**-Water Resources Field Methods	**BCE3604**-Design of hydraulic structures	**BCE3608**-Building Construction Practice
BCE3505-Environmental Laws and Policy	**BCE3509**-Water Quality Engineering	**BCE3605**-Hydraulic modelling	**BCE3609**- Advanced Concrete Technology & Sustainable Construction Methods
BCE3506-Solid and Hazardous Waste Management	**BCE3510**-Surface Hydrology	**BCE3606**-Urban Hydrology and Hydraulics	**BCE3610**-Repairs & Rehabilitation of Structures
BCE3507-Air and Noise Pollution and Control	**BCE3511**-Environmental Fluid Mechanics	**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	**B$$XX07**- Introduction to art and Aesthetics	**B$$XX08**-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-VII	BCE4701: Estimating & Costing

Teaching Scheme		**Examination Scheme**	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial	1 Hr/week	**CT-II**	15 Marks
Total Credits	**4**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks
Pre-Requisites: Building Design and Drawing, Building Construction Practices.		**Total Marks**	**100 Marks**

Course Contents

Unit I	Introduction: Importance and purpose of the subject, Units of measurement as per code Items of work and Description of items of work, administrative approvals, technical sanction, preliminary estimates, objectives, and its methods
Unit II	Detailed estimates, objectives, importance, and accuracy. Methods of detailed estimates, Detailed estimates of load bearing and framed structures. Calculation of reinforcing steel with Bar bending Schedule.
Unit III	Specifications: Purpose and principles of specifications writing, Types of specifications, writing and developing detailed specifications. Tenders and Contracts: Methods of carrying out works, tender notice, acceptance of tender, essentials of contract, type of contracts, contract documents, land acquisition act, BOQ.
Unit IV	Rate Analysis: Introduction, Purpose and principles of CSR, Factors affecting analysis of rates, labour guidelines from National Building Organization, market rates of materials and labor, Rate analysis of major items of work.
Unit V	Valuation: Purpose of valuation, Factors affecting property price and cost, Types of Value. Real Estate, Tenure of land, Free hold and lease hold, sinking fund, Depreciation, and its methods, Capitalized value, Methods of valuation, Net & Gross income, Rent fixation

Text Books

T.1	“Estimating, Costing, Specification & valuation in Civil Engineering”, authored by Chakraborti M., UBS Publication, Calcutta, 2010
T.2	“Estimating and costing” authored by Dutta B.N., S, Dutta & Co, Lucknow-I (1995)
T.3	“Civil Estimating, costing and valuation”, authored by Amarjit Aggarwal, R.C. Chaudhary, S. Kumar Katson Publishing, 1984.
T.4	“Textbook of Estimating and Costing”, authored by Birdie G.S.”, Dhanpat Rai and sons, Delhi-1996

Reference Books	
R.1	"Estimating & Costing" authored by Chandola S.P. &Vazirani V.N, Khanna Publishers 2-B, Nath market, Naisarak,Delhi, 2010
R.2	"Estimating & Costing in civil Engineering", authored by Dutta B.N, UBS Publishers distributors ltd., 5 Ansari Road, NewDelhi, February 1999
R.3	"Estimating, Costing and Valuation" authored by Rangawala S.C., Charotar publishing Pvt ltd. Anand (1998)
R.4	"Estimate, Costing and Valuation" authored by Dr. R P Rathaliya, Mayur Rathaliya, Atul Prakashan Gandhi Road, Ahmedabad,2018.
Useful Links	
1	https://nptel.ac.in/content/storage2/courses/105103023/pdf/mod5.pdf
2	https://nptel.ac.in/courses/105/103/105103093/

	Course Outcomes	CL	Class Sessions
BCE4701.1	**Prepare** the tender documents; fill the contracts by using the knowledge of contract submission and opening in awarding the work to the contractor.	6	9
BCE4701.2	**Relate** the concept of SD, EMD, MAS, Running Bill, Final Bill during the entire project.	4	9
BCE4701.3	**Apply** the preliminary estimate for administrative approval and technical sanction for a civil engineering project.	3	9
BCE4701.4	**Apply** the technique of Rate analysis in estimating the exact cost of material and manpower and hence the entire project.	3	9
BCE4701.5	**Analyze** the bill of quantities using the types of preliminary techniques and detailed estimation of buildings and roads.	4	9

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Program: B.Tech. Civil Engineering

Semester-VII	BCE4702: Advanced Design of Reinforced Concrete Structure.

Teaching Scheme		**Examination Scheme**	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial	1 Hr/week	**CT-II**	15 Marks
Total Credits	**4**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks
Pre-Requisites: Reinforced Concrete Structure, Steel Structure		**Total Marks**	**100 Marks**

Course Contents

Unit I	Design of circular water tank with roof slab/dome resting on ground by approximate methods/IS code method, Design of rectangular water tank with one-way roof slab resting on ground by approximate methods/ IS code method
Unit II	Analysis and design of columns subjected to biaxial moments.
Unit III	Design of RCC Cantilever and Counter-fort Retaining wall.
Unit IV	Design of combined rectangular & combined trapezoidal footing.
Unit V	Analysis and design of portal frames (single bay single storey) hinged or fixed at base.

Text Books

T.1	"Concrete Technology "author by Gambhir M.L 4th Edition,: Tata McGraw Hill Publication 1995.
T.2	"Concrete Technology" author by Neville A. M. ; Brooks J. J. , Pearson Educationpublication.
T.3	"Design of Concrete Structures" author by Nilson, A. H., D. Darwin, and C. W. Dolan, 13th edition. McGraw-Hill Publication, 2004.
T.4	"Reinforced Concrete Structural Elements: Behaviour Analysis and Design" author by Purushothaman, P, 1st edition, Tata McGraw Hill Publication, 1986

Reference Books

R.1	Bhavikatti S. S., Advanced R. C. C. Design Volume-II, New age international publisher, New Delhi, Ist edition – 2006.
R.2	Krishna Raju N, Advanced R. C. C. Design, CSB Publisher and Distributor, New Delhi, 2nd edition-2005
R.3	"Fundamentals of RC Design" author by M L Gambhir, Prentice Hall India Learning Private Limited 2006

R.4	"Brook Properties of Concrete" author by 1st edition Neville A.M., J.J. Addison Wesley publisher 1999.
Useful Links	
1	https://nptel.ac.in/courses/105/105/105105104/

	Course Outcomes	CL	Class Sessions
CE4702.1	**Apply** the knowledge of IS code (Water tank), code provisions to design all components of water tank.	3	9
CE4702.2	**Evaluate** the column and footing by designing it for structural conditions.	5	9
CE4702.3	**Design** of RCC Cantilever and Counter-fort Retaining wall.	6	9
CE4702.4	**Design** of combined rectangular & combined trapezoidal footing.	6	9
CE4702.5	**Analyze** the Portal frames with fixed end conditions and also apply concepts used to design Staircase and retaining wall structure.	4	9

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Program: B.Tech. Civil Engineering

Semester-VII	BCE4703: Program Elective-V (Pavement Design)

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, Structural Analysis, Advanced Structural Analysis, Reinforced Concrete Structure		**Total Marks**	**100 Marks**

Course Contents

Unit I	**Types of pavement** – Factors affecting design of pavements – wheel loads –ESWL Concept- tyre pressure – contact pressure, Material characteristics – Environmental and other factors
Unit II	**Material characteristics:** AASHO subgrade soil classification. Group index, CBR, North Dakota cone bearing value, plate load test for K, modulus of rupture, elasticity, poisons's ratio and coefficient of thermal expansion of concrete. Layer equivalent concepts.
Unit III	**Analysis of flexible and rigid pavements:** stress, strain, deflection analysis for single, two, three and multi layered flexible pavement system. Stress and deflections for rigid pavements due to load and temperature, influence charts, ultimate load analysis, joints and its types.
Unit IV	**Flexible Pavement design**: Flexible pavement design using CBR Method, IRC method, AASHTO Method, Restrengthenig of Pavement
Unit V	**Rigid Pavement Design**: IRC method of Rigid pavement design – Importance of Joints in Rigid Pavements- Types of Joints – Use of Tie Bars and Dowell Bars. AASHTO method of Rigid pavement design.

Text Books

T.1	Principles of Pavement Design *by* Yoder, E. J& Witczak, M.W., John Wiley and Sons, USA
T.2	Pavement analysis and Design by Huang, Y. H. (1993), Prentice Hall, Englewood Cliffs, New Jersey
T.3	Highway Engineering – S.K. Khanna & C.J. Justo, Nemchand & Bros., 7th Edition (2000)
T.4	Principles and Practices of Highway Engineering – Dr. L. R. Kadiyali & Dr.N.B.Lal – Khanna publishers – (2003)

Reference Books

R.1	Highway Engg *by* S.K. Khanna & C.E.G. Justo, Nem Chand Bros., Roorkee.
R.2	Relevant IRC Code: 37, 58, (latest) and BIS standards
R.3	Principles and Practice of Highway Engg. byL.R.Kadiyali, Khanna Publishers, Delhi

R.4	Hot-Mix Asphalt Paving Handbook 2000, National Asphalt Pavement Association and US Army Corps of Engineers, 2000
Useful Links	
1	https://nptel.ac.in/content/storage2/courses/105104098/TransportationII/lecture6/2slide.htm
2	https://nptel.ac.in/courses/105/104/105104098/

	Course Outcomes	CL	Class Sessions
BCE4703.1	**Analyze** and Design pavement and under different loading conditions for highways and airfields taking into consideration different characteristics.	4	9
BCE4703.2	**Show** a pavement management system framework.	3	9
BCE4703.3	**Design** of highway appurtenance and highway drainage.	6	9
BCE4703.4	**Experiments** Performance considering different field conditions	3	9
BCE4703.5	**Recommend** to increase the strength of pavements along with its economy point of view	5	9

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Program: B.Tech. Civil Engineering

Semester-VII | BCE4704: Program Elective-V (Urban Transportation Planning)

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		**Total Marks**	**100 Marks**

Course Contents

Unit I	**Introduction** to Urban transportation planning; systems approach to Urban transportation planning; types of models; concept of travel demand and supply; socio-economic, Urban morphology – Urbanization, Urban activity systems
Unit II	**Urban land use**, network, and transport system characteristics affecting urban transportation planning; study area definition, zoning principles, cordon and screen lines, data collection through primary
Unit III	**Data collection** through primary and secondary sources, sampling techniques; four-stage sequential modelling approach; trip generation; trip distribution; modal split; trip assignment;
Unit IV	**land use**-transport models; public transport planning, integration of different modes; travel demand management measures; case studies
Unit V	**Path assignment,** Capacity restrained assignment and Multi path assignment - Route-choice behavior; Land use transportation models – Urban forms and structures - Location models - Accessibility – Lowry derivative models - Quick response techniques - Non-Transport solutions for transport problems; Preparation of alternative plans - Evaluation techniques – Plan implementation - Monitoring - Financing of Project – urban development planning policy - Case studies.

Text Books

T.1	Urban Transportation Planning: A Decision-Oriented Approach (McGraw-Hill Series in Transportation) Hardcover – Import, 1 January 2001
T.2	Urban Transportation: Planning, Operation and Management Hardcover – 25 September 2012
T.3	Advance in transportation engineering, pulugurtha,ghosh and biswas,,2018
T.4	Optimization models and methods for equilibrium traffic assignment, krylatov zakhorov and tuoivinen, 2019

Reference Books

R.1	Transportation Engineering and Planning, C. S. Papacostas and P. D. Prevedouros, Trans Tech Publications
R.2	Urban Transportation Planning, Michael D. Meyer, Eric J. Miller, McGraw-Hill
R.3	Public Transportation, G. E. Gray and L. A. Hoel, New Jersey, 1992

R.4	Highway Engineering, Khanna,S.K;Justo, C.E.G. NT.M.C.N.Limited
Useful Links	
1	https://nptel.ac.in/content/storage2/courses/105104098/TransportationII/lecture6/2slide.htm
2	https://nptel.ac.in/courses/105/104/105104098/

	Course Outcomes	CL	Class Sessions
BCE4704.1	**Illustrate** to Urban transportation planning; systems approach, types of models; concept of travel demand and supply;	3	9
BCE4704.2	**Infer** the Urban land use, network, and transport system characteristics affecting urban transportation planning; study area definition, zoning principles	4	9
BCE4704.3	**Appraise** Data collection through sources, sampling techniques; modelling approach; trip generation; trip distribute, trip assignment;	4	9
BCE4704.4	**Defend** land use-transport models; public transport planning, integration of different modes; travel demand its management with case study.	5	9
BCE4704.5	**Modify** Path assignment**,** Capacity restrained assignment and Multi path assignment - Route-choice behavior; Land use transportation models .	6	9

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Program: B.Tech. Civil Engineering

Semester-VII | BCE4705: Program Elective-V (Airport Planning and Design)

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		**Total Marks**	**100 Marks**

Course Contents

Unit I	**History and organisation** of air transport, Aircraft characteristics related to airport design, Airport configuration, Airport planning and air travel demand forecasting, Classification of airports- ICAO standards ; Zoning laws ;
Unit II	**Air Traffic Management**: Navigational aids: ground based systems, satellite based systems**,** air traffic control, Grading, Environmental guidelines for airport projects, air-traffic demand estimation. Airport hangars- their planning and design criteria ; Airport landscaping, grading and drainage-general aspects ; Airport terminal and amenities ;
Unit III	**Taxiway** and Gate Capacity, Taxi way design, Taxiways- alignment- geometry and turning radius-exit taxiways - Aprons- planning and design ; Holding Aprons - Terminal Aprons – Airport drainage - Function of Airport Passenger and Cargo Terminal - Design of Air Freight Terminals - Airport access - Airport Landside planning - Capacity
Unit IV	**Runway** Capacity and configuration, Runway design, Runway sorientation and geometric design-Runway patterns, Design principles of critical, semi-critical, non-critical airport pavements, FAA and PCA methods ; maintenance and rehabilitation of airfield pavements,
Unit V	**Airport terminal area**, Airport airside capacity and delay, Planning and design of the terminal area, terminal area lay-out, Airport access, airport lighting and marking, Financial strategies for implementation, Environmental impacts of airports

Text Books

T.1	Wells, Alexander; Young, Seth, Airport Planning & Management, McGraw Hill,5th Edition, July,2009
T.2	Yoder and Witzack, Principles of Pavement Design, John Willey and Sons.,1975
T.3	Huang, Y. H., Pavement Analysis and Design, Prentice-Hall, Inc. Englewood Cliffs, New Jersey, 2004
T.4	Shahin, M. Y., Pavement Management for Airports, Roads and Parking Lots, Chapman and Hall, New York, 1994

Reference Books

R.1	R. Horonjeff and F. X. Mckelvey, Planning & Design of Airports, 5th Edition, Mc Graw Hill, New York, 2010
R.2	N. Ashford, S. Mumayiz and P. H. Wright, Airport Engineering, 4th Edition, John Wiley, New York, 2011.
R.3	Khanna, Arora and Jain, Planning and Design of Airports, Nemchand Bros., 2001

R.4	De N. Richard, & Odoni, Airport Systems: Planning, Design, and Management, McGraw Hill Amedeo, 1st Edition, 2004.
Useful Links	
1	https://nptel.ac.in/courses/105/107/105107123/
2	https://nptel.ac.in/courses/105/104/105104098/
3	https://nptel.ac.in/courses/105/105/105105107/

	Course Outcomes	CL	Class Sessions
BCE4705.1	**Infer** Airport planning and air travel demand forecasting, ICAO standards ; Zoning laws	4	9
BCE4705.2	**Explain** Air Traffic Management: Navigational aids: ground based systems, satellite based systems, air traffic control, Grading,	4	9
BCE4705.3	**Compile** Taxi way , Aprons- planning and design ; Airport drainage - Design of Air Freight Terminals	6	9
BCE4705.4	**Modify** Runway, - critical airport pavements, FAA and PCA methods ; maintenance and rehabilitation of airfield pavements,	6	9
BCE4705.5	**Compose** of the terminal area, terminal area lay-out, Airport access, airport lighting and marking,	6	9

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Program: B.Tech. Civil Engineering

Semester-VII | BCE4706: Program Elective-V (High Speed Rail 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: Engineering Mechanics, Transportation Engineering		**Total Marks**	**100 Marks**

Course Contents

Unit I	Formulation of HSR Basic Plan in India, Necessity of HSR System in India, Traffic Frequency, Basic Technical Standard and System Selection, Loading gauge and Structural gauge, Platform Clearance, Track Spacing, Gradients, Track Structure, Rolling Stock.
Unit II	Key elements of HSR systems and subsystems including: core systems (trains, power, signal, communication and control), Polyamide guide plate, Static response, Rail pad, Anchorage components, Construction of the catenary, Testing, Loss prevention.
Unit III	Track system and civil infrastructure (earthwork, bridges, viaducts and tunnels).General loss experience from tunnels building, Channel Tunnel Rail Link, Loss prevention Tunneling risks,
Unit IV	basic design and construction of HSR stations and rolling stock maintenance facilities, Design Parameters, Construction Method, Operation Method, Interoperability and Gauge Selection, Required Levels on Services / Facilities
Unit V	High speed rail engineering : definition, network, comparison with other mode, Development, engineering, design and construction of high speed rail (HSR) passenger transport systems with particular emphasis on the unique engineering elements of HSR technology.

Text Books

T.1	High Speed Trains Hardcover – Import, 1 November 2011.
T.2	Construction and management of high speed rail, 2015
T.3	Design of High-Speed Railway Turnouts,ping wang, 2015
T.4	A Text Book Of Railway Engineering, by S.C. Saxena, S.P.Arora,

Reference Books

R.1	High Speed Rail Planning, Policy, and Engineering, Volume I: Overview of Development and Engineering Requirements Paperback – Import, 8 February 2016
R.2	Railway Engineering Paperback , satish Chandra, Agrawal, – 21 January 2013
R.3	Railway Track Engineering by JS Mundrey, 5th edition,
R.4	Railway Engineering by Satish Chandra, Aqarwal,2008

Useful Links

1	https://nptel.ac.in/courses/105/107/105107123/
2	https://nptel.ac.in/courses/117/106/117106089/
3	http://www.nptelvideos.in/2012/11/transportation-engineering-ii.html

	Course Outcomes	CL	Class Sessions
BCE4706.1	**Explain** High speed rail engineering, network, comparison, Development, design and construction, passenger transport systems , elements of HSR technology.	4	9
BCE4706.2	**Infer** Key elements and subsystems including: communication and control, Polyamide guide ,Construction Testing , Loss prevention - Lessons learnt and recommendations,	4	9
BCE4706.3	**Contrast** track system and civil infrastructure loss, Channel Tunnel Rail Link, Loss prevention – lessons learnt and recommendation, Tunnelling risks,	4	9
BCE4706.4	**Compose** HSR stations and rolling stock maintenance facilities, Parameters, Construction Method , Operation Method, Interoperability and Gauge Selection, Levels on Services / Facilities	6	9
BCE4706.5	**Write** Formulation of HSR Basic Plan in India, Necessity, Traffic Frequency, Countermeasures against Earthquakes and Natural Disasters, Basic Technical Standard and System Selection, Loading gauge and Structural gauge, Platform Clearance, Track Spacing, Gradients, Track Structure, Rolling Stock.	6	9

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Program: B.Tech. Civil Engineering

Semester-VII | BCE4707: Program Elective-VI (High Rise 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: Reinforced Cement Concrete		**Total Marks**	**100 Marks**

Course Contents

Unit I	Performance of buildings, behaviors of various types of buildings in past earthquakes. Modes of failures influence of unsymmetrical, infill walls, foundations, soft story & detailing of reinforcements in buildings.
Unit II	Frames shear walled buildings, mathematical modeling of building with different structural systems Analysis of frames shear walled buildings, Analysis of coupled shear walled building
Unit III	Special aspects in Multi-story buildings, Effect of torsion, flexible first story ,P-delta effect, soilstructure interaction on building response, drift limitation
Unit IV	Strength, ductility and energy absorption, ductility of reinforced members subjected to flexure, axial loads & shear. Detailing of RCC members, beam, column, Beam-column joints for ductile behaviors, IS code provisions.
Unit V	Design of multi-story buildings with bracings & infills. Tall Buildings, Structural Concept, Configurations

Text Books

T.1	Seismology Committee (1999). *Recommended Lateral Force Requirements and Commentary*. Structural Engineers Association of California.
T.2	Design of Seismic Isolated Structures- Farzad Naeim, James M. Kelly, Published 2 DEC 2007
T.3	A K. Chopra, Dynamics of Structures: Theory and Applications to Earthquake Engineering (3rd Edition), Prentice-Hall of India.
T.4	Housner, G. W. &Jenning, P.C. “Earthquake Design Criteria”, Earthquake Engineering Research Institute, Oakland, California, USA, 1982

Reference Books

R.1	IS 13920, Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces – Code of Practice, 1993.
R.2	A.K. Chopra, Dynamics of Structures, 3rd Edition, Pearson, 2007.
R.3	PankajAgarwal and Manish Shrikhande, Earthquake Resistant Design of Structures, Prentice Hall India, 2006.
R.4	Kramer, S. L. “Geotechnical Earthquake Engineering”, Prentice Hall, New Jersey, 1996.

Useful Links

1	https://nptel.ac.in/courses/105/101/105101004/
2	https://nptel.ac.in/courses/105/102/105102016/
3	https://nptel.ac.in/content/syllabus_pdf/105101004.pdf

	Course Outcomes	CL	Class Sessions
BCE4707.1	**Differentiate** between Earthquake and Tsunami	4	9
BCE4707.2	**Analyze** earthquake loading effect on structures.	4	9
BCE4707.3	**Design** of structures against earthquake loading.	6	9
BCE4707.4	**Evaluate** the earthquake loading for multi-storey structure using different methods like Equivalent Static Lateral Load Method and Response Spectrum Method	5	9
BCE4707.5	**Use** the knowledge in practical situation and Understand the different seismic retrofitting techniques and its implementation.	3	9

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Program: B.Tech. Civil Engineering

Semester-VII	BCE4708:Program Elective-VI (Industrial Structure)

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	Industrial Building: Structural layout of industrial building, Design of roof with trusses, Effect of wind loads on purlin and trusses, bracing systems, columns
Unit II	Design of Gantry Girder with Static and Moving loads
Unit III	Transmission and Communication towers: Types and configuration, Loads & load combinations be considered, Analysis and design of tower & foundations
Unit IV	Chimneys: Loads and stresses in chimney shaft, Earthquake and wind effect, Stresses due to temperature difference, combined effect of loads and temperature, temperature. Design of RC chimney
Unit V	Bunkers & Silos: Introduction, Jassen's theory, Airy's theory, Shallow and deep bins, Design of RC circular/cylindrical bunkers, silos using Jensen's theory as per IS.

Text Books

T.1	Punmia, B.C.; Jain, Ashok Kumar; Jain, Arun Kumar, "Limit State Design Of Reinforced Concrete", Laxmi Publications.
T.2	Varghese P. C., "Limit State Design Of Reinforced Concrete", Prentice Hall Of India.
T.3	Ghosh, Karuna Moy, "Practical Design Of Reinforced Concrete Structure", Prentice Hall Of India.
T.1	Punmia, B.C.; Jain, Ashok Kumar; Jain, Arun Kumar, "Limit State Design Of Reinforced Concrete", Laxmi Publications.

Reference Books

R.1	Punmia,B.C.;Jain Ashok Kumar;Jain,Arun Kumar, "Reinforced Concrete Structure",Laxmi Publications
R.2	Pillai,S.Unnikrishna., "Reinforced Concrete Design",Tata McGraw Hill.

Useful Links

1	https://nptel.ac.in/content/storage2/courses/105105104/pdf/m11l28.pdf
2	https://nptel.ac.in/courses/105/105/105105039/

	Course Outcomes	CL	Class Sessions
BCE4708	**Design** structural layout of an industrial building, including roof trusses and the impact of wind loads on purlins and trusses, employing appropriate bracing systems and columns.	6	9
BCE4708	**Design** gantry girders subjected to static and moving loads, ensuring structural stability and efficiency.	6	9
BCE4708	**Design** of towers and their foundations with considering various load combinations	6	9
BCE4708	**Design** an RC chimney or the effects of earthquakes, wind, temperature differences, and the combined impact	6	9
BCE4708	**Design** RC circular/cylindrical bunkers and silos, distinguishing between shallow and deep bins as per IS standards.	6	9

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Semester-VII	BCE4709: Program Elective-VI (Prestressed Concrete)

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: Reinforced cement concrete structures, Concrete Technology		**Total Marks**	**100 Marks**

Course Contents

Unit I	Design of high strength concrete mixes. Loss of pre-stress in single span and continuous beams. Use of IS 1343, Analysis Limit State Design of beams for Tension Type II and III problems, Cracking moment, untensioned reinforcement, Partial pre-stressing, Stress Corrosion.
Unit II	Transfer of pre-stress by bond, Transverse tensile stresses, End zone reinforcement. Behaviour of Bonded and unbounded pre-stressed concrete beams.
Unit III	Deflection of Pre-stressed concrete members, short and long term, control of deflections. Crack width considerations. Flexural strength of pre-stressed concrete sections: Types of flexural failures, Limit state concept.
Unit IV	Shear resistance of pre-stressed concrete members: Principal stresses and ultimate shear Resistance, Design of shear reinforcement, pre-stressed concrete members in Torsion, Design of reinforcement in torsion shear and bending.
Unit V	Stress distribution in end block, Analysis and Anchorage Zone reinforcement. Composite Construction of pre-stressed precast and cast in situ concrete. Statically Indeterminate structures: Continuous beams, primary and secondary moments, Continuity, concordant cable profile, Analysis and Design of continuous beams.

Text Books

T.1	Raju N. Krishna, “Pre-stressed Concrete”, Tata McGraw Hill, 2002.
T.2	Lin,T.Y;Burns,Ned .H, “Design of Pre-stressed Concrete Structures”, Wiley India.
T.3	Nildon,Arthur.H, “ Design of Pre-stressed Concrete”, Wiley India .

Reference Books

R.1	N Krishna Raju, “Prestressed Concrete: Problems and Solutions”, CBS, 2017
R.2	M.K.Hurst, “ Prestressed Concrete Design”, CRC Press, 2019

Useful Links

1	https://nptel.ac.in/courses/105/106/105106117/
2	https://nptel.ac.in/courses/105/106/105106118/
3	http://www.nptelvideos.in/2012/11/prestressed-concrete-structures.html

	Course Outcomes	CL	Class Sessions
BCE4709.1	**Understand** the design of high strength concrete mixes and basic properties of pre-stressed concrete.	2	9
BCE4709.2	**Analyze** the pre-stressed beams for bonded and unbounded by Limit state method.	4	9
BCE4709.3	**Analyze** the flexural behavior of Pre-stressed concrete members by Limit state concept.	4	9
BCE4709.4	**Design** of reinforcement in torsion shear and bending of pre-stressed concrete members.	6	9
BCE4709.5	**Design** of Composite Construction of pre-stressed precast and cast in situ concrete members.	6	9

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Semester-VII	BCE4710: Program Elective-VI (Earthquake 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: Geology, Geotechnical Engineering		**Total Marks**	**100 Marks**

Course Contents

Unit I	Engineering seismology, Elastic rebound theory, Theory of plate tectonics and movement of Indian plate. Seismic waves. Seismic intensity, Richter scale.
Unit II	Introduction to tsunami, Seismic zoning maps of India, Response spectra, Strong motion characteristics
Unit III	Earthquake effects on the structures, classification of loads, Seismic damages during past earthquakes, effect of irregularities and building architecture on the performance of RC structures
Unit IV	Seismic methods of analysis, seismic design methods, Mathematical modeling of multistoried RC buildings with modeling of floor diaphragms and soil foundation, (Winkler model.)
Unit V	Concept of earthquake Resistant design, design philosophy, Four virtues of EQRD: Stiffness, Strength, ductility and Configurations, Introduction to Capacity design concepts.

Text Books

T.1	Hector Estrada, Luke S. Lee, “Introduction to Earthquake engineering”, CRC Press, 2017.
T.2	Shabana, Ahmed, “Theory of Vibrations”, Springer, 2019.
T.3	Amrs. Elnashai, Luigi Di Samo“Fundamentals of Earthquake Engineering”, Willey, 2005.

Reference Books

R.1	Anil K Chopra, “Dynamics of Structures”, Pearson,1981.
R.2	S Rajasekaran, “Structural Dynamics of Earthquake Engineering”, Woodhead, 2009.

Useful Links

1	http://www.cdeep.iitk.ac.in/nptel
2	http://wwwnptel.iitm.ac.in

	Course Outcomes	CL	Class Sessions
BCE4710.1	**Illustrate** the concept of inertia and damping with static and dynamic forces and response of SDOF systems.	4	9
BCE4710.2	**Analyze** the response of SDOF systems and natural frequencies and mode shapes.	4	9
BCE4710.3	**Analyze** the response of MDOF systems and mode shapes and Elements of seismology.	4	9
BCE4710.4	**Asses** the response of structures and difference between the magnitude, intensity and acceleration of earthquake.	5	9
BCE4710.5	**Analyze** structure for earthquake forces according to IS code provisions	4	9

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Program: B.Tech. Civil Engineering

Semester-VII	BCE4715: Program Elective-VII (Foundation 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: Geotechnical Engineering		**Total Marks**	**100 Marks**

Course Contents

Unit I	**Analysis of foundations**, types of foundations, bearing capacity and settlement of foundations; ground movements due to construction; Bearing Capacity from SPT and SCPT and Plate load Test data, Proportioning of footing based on settlement criteria. Foundations on Problematic soils: Problems and Remedies.
Unit II	**Well Foundations: Caissons** – Types, advantages and disadvantages, Shapes and component parts, Grip length, Bearing capacity and settlement, Forces acting, Sinking of wells, Rectification of Tilts and Shifts, Foundation Failures - Types and causes of failures, Remedial measures, Shoring and Underpinning.
Unit III	**Raft Foundation:** Settlement and Bearing Capacity analysis, Analysis of flexible and rigid raft as per IS 2950. Computation of settlements (Immediate & Consolidation); Permissible settlements, Allowable total and differential settlement of structures. Proportioning of footing, Inclined & Eccentric loads. Settlement of footings on stratified deposits.
Unit IV	**Shallow Foundation:** Terzaghi's bearing capacity equation, General bearing capacity equation, different bearing capacity theories, I.S. Code method, Effect of foundation shape, eccentricity and inclination of load, Influence of soil compressibility and water table, Footing pressure for settlement on sand, Soil pressure at a depth, Boussinesq's & Westergaard methods, Limit state design of reinforced concrete in foundations;
Unit V	**Pile Foundations;** Classification and Uses, Carrying capacity of Single pile, Pile load tests, cyclic pile load test, pull out resistance, laterally loaded Piles; Pile groups – Group efficiency, Settlement of single pile and pile groups, Negative skin friction, sharing of loads, : Limit state design of reinforced concrete in foundations;

Text Books

T.1	B. M Das, Principles of Foundation Engineering, Thomson Brooks/Cole
T.2	J. E. Bowles, Foundation Analysis and Design, McGraw-Hill Book Company
T.3	N.P. Kurien, Design of Foundation Systems : Principles & Practices, Narosa, New Delhi 1992
T.4	H. F. Winterkorn and H Y Fang, Foundation Engineering Hand Book, Galgotia Booksource

Reference Books

R.1	A. Singh, Modern Geotechnical Engineering, 3rd Ed., CBS Publishers, New Delhi, 1999
R.2	B.M. Das, Principles of Foundation Engineering, 5th Ed., Thomson Asia, Singapore, 2003.

R.3	N. Som, Theory and Practice of Foundation Design, Prentice Hall, New Delhi, 2003
R.4	W. C. Teng, “Foundation Design”, Prentice Hall of India Ltd.
Useful Links	
1	https://nptel.ac.in/courses/105/104/105104162/
2	https://nptel.ac.in/courses/105/105/105105176/
3	https://nptel.ac.in/courses/105/105/105105185/

	Course Outcomes	CL	Class Sessions
BCE4715.1	**Contrast** foundations, types of foundations, bearing capacity and settlement of foundations; ground movements due to construction, Foundations on Problematic soils: Problems and Remedies.	4	9
BCE4715.2	**Explain** Well Foundations: Caissons – Types, advantages and disadvantages, Shapes and component parts, Foundation Failures, Remedial measures, Shoring and Underpinning.	4	9
BCE4715.3	**Infer** Raft Foundation**:** Settlement and Bearing Capacity analysis, settlements. Proportioning of footing, Inclined & Eccentric loads. Settlement of footings on stratified deposits.	4	9
BCE4715.4	**Create** Shallow Foundation: General bearing capacity equation, I.S. Code method, Effect of foundation shape, eccentricity and inclination of load, Influence of soil compressibility and water table, Limit state design .	6	9
BCE4715.5	**Design** Pile Foundations; Classification and Uses, Carrying capacity, Pile groups – Group efficiency, Negative skin friction, sharing of loads, : Limit state design.	6	9

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Semester-VII	BCE4716: PE VII (Geotechnical Design)

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: Geotechnical Engineering		**Total Marks**	**100 Marks**

Course Contents

Unit I	**Shallow Foundation:** Terzaghi's bearing capacity equation, General bearing capacity equation, different bearing capacity theories, Effect of foundation shape, eccentricity and inclination of load, Influence of soil compressibility and water table.
Unit II	**Deep foundation:** Pile foundation design for compressive load, uplift lateral load, design of pile group, concept of negative skin friction, soil structure interaction and introduction.
Unit III	**Design of retaining walls:** Design of retaining wall with or without surcharge loads, Factor of safety against overturning, sliding, bearing capacity and drainage.
Unit IV	**Sheet Pile wall design** : Failure mode, preliminary data for the design, Cantilever wall penetrating cohesion less soil and cohesive soil
Unit V	**Soil nail wall design** : Initial design parameter and condition, Global stability failure, sliding failure, bearing capacity failure

Text Books

T.1	J. E. Bowles, "Foundation Analysis & Design", Mc.Graw Hill Book Co., 2001
T.2	Swami Saran, Analysis and Design of Sub structures, Oxford and IBH Publishing Co. PVT. Ltd, New Delhi. 2018
T.3	B. M Das, Principles of Foundation Engineering, Thomson Brooks/Cole,2002
T.4	S.K.Khurana, Principles, Practice and Design of Highway Engineering,2015

Reference Books

R.1	N.P. Kurien, Design of Foundation Systems : Principles & Practices, Narosa, New Delhi 1992
R.2	Punmia,B.C.;Jain, Ashok;Jain,Arun K.,Soil Mechanics And Foundations,LaTxmi Publications,2005
R.3	Arora,K.R.Soil Mechanics And Foundation Engineering,TStandard Publishers Distributors,2008
R.4	Kumar,Srinivasa. R,Pavement Design,Universities Press,2013

Useful Links

1	https://www.digimat.in/nptel/courses/video/105105185/L01.html
2	https://www.digimat.in/nptel/courses/video/105105168/L01.html
3	https://www.digimat.in/nptel/courses/video/105101084/L01.html

	Course Outcomes	CL	Class Sessions
BCE4716.**1**	**Analyze** shallow foundation bearing capacity and its affection by shape size, water, loads and types of soil.	4	9
BCE4716.**2**	**Construct** rectangular, mat or raft footing in isolate and combined condition to carry superimpose load of structure	6	9
BCE4716.**3**	**Create** retaining wall with and without surcharge load also use pile foundation consideration	6	9
BCE4716.**4**	**Compile** flexible pavementby various methods, classify its types with limitations	6	9
BCE4716.**5**	**Compose** flexible and rigid pavement by using stress distribution and effective methods	6	9

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Semester-VII	BCE4717: PE VII (Structural Geology)

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: Geotechnical Engineering		**Total Marks**	**100 Marks**

Course Contents

Unit I	**Structural Geology:** Description, classification, and origin of earth structures. Ways in which the continental crust can deform; link scales of structure from the field, outcrops, hand specimen, thin section by integrating analytical techniques with practical examples, principles of geological mapping and map reading, field techniques of structural mapping, scale of map, top and bottom criteria of sedimentary, metamorphic and igneous rock, differentiation of sedimentary and tectonic structures**.**
Unit II	**Theory of stress and strain :** stress and strain relationship of elastic, plastic and viscous material, behavior of minerals and rocks under deformation condition, different types of failure and sliding criteria, role of fluid in deformation processes, time relationship between crystallization and deformation**.**
Unit III	**Stress analysis:**description, classification,compressive and shear stresses, Mohr's circle, 2D and 3D analysis, mean and deviatoric stress, stress on plane , principle stress, stress ellipsoid, paleo stress analyses, maximum shear stress, fundamental stress equation,
Unit IV	**Strain analysis:** kind of strain, strain ellipsoid, strain markers, techniques of strain analysis, strain measurements, progressive strain history and methods for its determination, practical 2D strain analysis, 3D strain concepts; incremental strain,kinematics and polyphase deformations.
Unit V	**Geological fold and faults :** fold construction and classes; fault evolution and section balancing; fault rock microstructures; fault and fold mechanics, current concepts in plate tectonics, cross-section construction techniques, structural interpretation of seismic data, structural styles in different tectonic settings (thrust and fold belts, rifts, strike and slip, gravity tectonics, inversion), structural geology of reservoir units, stereographic projection and their use in structural analysis, structure and major tectonic features of Indian subcontinent.

Text Books

T.1	Terzaghi, K., and Peck, R.B., Soil Mechanics in Engineering Practice, John Wiley& Sons, 1967
T.2	R. Jumikis, Theoretical Soil Mechanics, Van Nostrand Reinhold Company, New York, 1969
T.3	Das, B.M., Advanced Soil Mechanics, Taylor and Francis, 2nd Edition, 1997
T.4	Craig, R.F., Soil Mechanics, Van Nostrand Reinhold Co. Ltd., 1987

Reference Books

R.1	Ranjan, Gopal; Rao, A.S.R., Basic And Applied Soil Mechanics, TNew Age International,1991
R.2	Lambe T. William;Whitman Robert V., Soil Mechanics ; Si Version, Wiley India,2012

R.3	Arora K R, Soil Mechanics And Foundation Engineering : Geotechnical Engineering Standard Publishers Distributors,2008
R.3	Punmia,B.C.;Jain,Ashok;Jain,Arun B K. ,Soil Mechanics And Foundations, Laxmi Publications,2005
Useful Links	
1	https://nptel.ac.in/courses/105/104/105104191/
2	https://nptel.ac.in/courses/105/104/105104147/
3	https://www.digimat.in/nptel/courses/video/105104191/L01.

	Course Outcomes	CL	Class Sessions
BCE4717.1	**Discriminate** origin, classification and deformation of earth structure with its mapping its mapping and scale.	4	9
BCE4717.2	**Contrast** stress strain relationship of elastic plastic and viscous material its failure conditions.	4	9
BCE4717.3	**Evaluate** compressive and shear stress with its classification, plane and ellipsoid peleostress 2D and 3D analysis.	5	9
BCE4717.4	**Estimate** compressive and shear strain with its classification, plane and ellipsoid peleostress 2D and 3D analysis.	5	9
BCE4717.5	**Prioritize** geological fold and fault construction, evolution, section, balancing, mechanics and curranttectonic concept.	4	9

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

Program: B.Tech. Civil Engineering

Semester-VII | BCE4718: Program Elective-VII (Rock 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: Geotechnical Engineering		**Total Marks**	**100 Marks**

Course Contents

Unit I	**Foundation Geology:** Methods of rock investigation for major Civil engineering projects, Geological Drilling Method, borehole logs, Correlation, percent recovery and Rock quality designation, Engineering classification of Rock based on RMR, RQD, Strength and Weathering resistance.
Unit II	**Rock Strengthening**: Defects in rock masses, Grouting method and material, Design of Rock bolts and anchors. Water percolation tests at foundation site. Case studies of Civil Engineering projects in India
Unit III	**Groundwater Hydrology**: Groundwater and well Hydraulics, Determination of permeability, storage capacity, transmissivity, specific capacity, safe yield. Groundwater trends and fluctuations. Construction of Wells
Unit IV	**Groundwater Exploration**: Surface and sub-surface investigations of Groundwater. Geological, Geophysical methods and remote sensing; Water balance technique, Artificial recharge of ground-water **Methods of Improving Rock Mass properties:** Rock Reinforcement – Rock bolting – Mechanism of Rock bolting – Principles of design – Types of rock bolts. Pressure grouting – grout curtains and consolidation grouting.
Unit V	**Environmental Geology: -** Land use/cover planning; pollution of surface and groundwater; waste disposal site selection for solid and liquid wastes. **Geological Hazards**: Natural Disaster Management with emphasis on Earthquakes, Stability of slopes and landslides. Prediction, Prevention and Rehabilitation

Text Books

T.1	Fundamentals of Engineering Geology- F.G. Bell Publisher BS Publications Edition 2005
T.2	R. E. Goodman, “Introduction to Rock Mechanics” John Wiley & Sons, New York, 1989
T.3	Wakter Wittke, “Rock Mechanics” Springer Verlag, New York, 1990
T.4	Kiyoo Mogi “Experimental Rock Mechanics” Taylor & Francis Group, UK, 2007

Reference Books

R.1	Engineering Geology- Parbin Singh, S K Katariya& Sons Edition Sixth Edition.
R.2	Principles of Physical Geology- Homes Arthur and Homles Doris, ElBS Publications Edition 1987.

R.3	Engineering Geology- Parbin Singh, S K Katariya& Sons Edition Sixth Edition.
R.4	Daryl L. Logan, A First Course in the Finite Element Method, Cengage Learning, 2010.
Useful Links	
1	https://nptel.ac.in/courses/105/106/105106055/
2	https://nptel.ac.in/courses/105/107/105107208/
3	https://nptel.ac.in/courses/105/105/105105212/

	Course Outcomes	CL	Class Sessions
BCE4718.1	**Use** knowledge of existing rocs, its failure and its remedial methods.	3	9
BCE4718.2	**Analyze** the Rock Strengthening	4	9
BCE4718.3	**Classify** the application of Geological fundamentals in various fields of Civil Engineering.	4	9
BCE4718.4	**Point out** different Geological Hazards on earth and	4	9
BCE4718.5	**Plan** Preparation for the mitigation of such hazards.	6	9

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Semester	Course Code	Name of Course	L	T	P	Credits
VII	BCE4720	Advanced Concrete Structure Lab	-	-	2	1

Pre-Requisites:

	Course Contents	CO
1	Design of Circular Water Tank	**CO1, CO2**
2	Design of Rectangular Tank	**CO1, CO2**
3	Design of RCC Column subjected to biaxial moment	**CO2, CO3**
4	Design of Retaining Wall: Cantilever	**CO2, CO3**
5	Design of Retaining Wall: Counter-fort	**CO2, CO3**
6	Design of Combined Footing: Rectangular Footing	**CO2, CO3**
7	Design of Combined Footing: Trapezoidal Footing	**CO2, CO3**
8	Analysis and Design of Portal Frame	**CO1, CO2, CO4**

Text Books

T.1	"Concrete Technology "author by Gambhir M.L 4th Edition,: Tata McGraw Hill Publication 1995.
T.2	"Concrete Technology" author by Neville A. M. ; Brooks J. J. , Pearson Educationpublication.
T.3	"Design of Concrete Structures" author by Nilson, A. H., D. Darwin, and C. W. Dolan, 13th edition. McGraw-Hill Publication, 2004.
T.4	"Reinforced Concrete Structural Elements: Behaviour Analysis and Design" author by Purushothaman, P, 1st edition, Tata McGraw Hill Publication, 1986

Reference Books

R.1	Bhavikatti S. S., Advanced R. C. C. Design Volume-II, New age international publisher, New Delhi, Ist edition – 2006.
R.2	Krishna Raju N, Advanced R. C. C. Design, CSB Publisher and Distributor, New Delhi, 2nd edition-2005
R.3	"Fundamentals of RC Design" author by M L Gambhir, Prentice Hall India Learning Private Limited 2006
R.4	"Brook Properties of Concrete" author by 1st edition Neville A.M., J.J. Addison Wesley publisher 1999.

Useful Links

1	https://nptel.ac.in/courses/105/105/105105104/

	Course Outcomes	CL	Lab Sessions
BCE4720.1	**Apply** the knowledge of IS code (Water tank), code provisions to design all components of water tank.	2	9
BCE4720.2	**Analyze** the column and footing by designing it for various conditions.	6	9
BCE4720.3	**Understand** the behavior, failure mode and Analyze the beams with various fixed end conditions to understand Moment redistribution.	8	9
BCE4720.4	**Design** the bridge deck slab for culvert and bridges using IRC guidelines.	4	9
BCE4720.5	**Analyze** the Portal frames with fixed end conditions and also apply concepts used to design Staircase and retaining wall structure.	4	9

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Semester	Course Code	Name of Course	L	T	P	Credits
VII	BCE4719	Estimating and costing Lab	-	-	2	1

Pre-Requisites:

	Course Contents	CO
1	Preliminary estimate using Plinth area method.	**CO5**
2	Detailed estimate of Load bearing structure.	**CO5**
3	Detailed estimate of Frame structure.	**CO5**
4	Calculation of steel with Bar bending Schedule.	**CO4**
5	Draft Detailed specification for 8 major items.	**CO4**
6	Analysis the unit rate of 8 major items of work contained.	**CO4**
7	Draft a short tender notice for proposed work.	**CO1**
8	Calculation of annual and total Depreciation and book value of the end of each year.	**CO2**
9	Fixation of standard rent of property.	**CO4**
10	Market survey for material and labour rates for various items.	**CO4**
11	Detailed planning and estimate of plumbing work.	**CO5**
12	Estimation of M.D.R with C.D. works	**CO4**

Text Books

T.1	"Estimating, Costing, Specification & valuation in Civil Engineering", authored by Chakraborti M., UBS Publication, Calcutta, 2010
T.2	"Estimating and costing " authored by Dutta B.N. ,S, Dutta & Co, Lucknow-I(1995)
T.3	"Civil Estimating, costing and valuation", authored by Amarjit Aggarwal , R.C. Chaudhary, S. Kumar Katson Publishing, 1984.
T.4	"Textbook of estimating and costing" ,authored by Birdie G.S." ,Dhanpat rai and sons, Delhi-1996

Reference Books

R.1	"Estimating & Costing" authored by , Chandola S.P. &Vazirani V.N, Khanna Publishers 2-B, Nath market, Naisarak,Delhi, 2010
R.2	"Estimating & Costing in civil Engineering", authored by Dutta B.N, UBS Publishers distributors ltd., 5 Ansari road, NewDelhi, February 1999
R.3	"Estimating, Costing And Valuation" authored by Rangawala S.C. ,Charotar publishing Pvt ltd. Anand(1998)
R.4	"Estimate ,costing and Valuation " authored by Dr. R P Rathaliya , Mayur Rathaliya ,Atul Prakashan Gandhi road, Ahmedabad,2018.

Useful Links

1	https://nptel.ac.in/content/storage2/courses/105103023/pdf/mod5.pdf
2	https://nptel.ac.in/courses/105/103/105103093/

	Course Outcomes	CL	Lab Sessions
BCE4719.1	**Prepare** the tender documents; fill the contracts by using the knowledge of contract submission and opening in awarding the work to the contractor.	6	2
BCE4719.2	**Remember** the concept of SD, EMD, MAS, Running Bill, Final Bill during the entire project.	1	2
BCE4719.3	**Apply** the preliminary estimate for administrative approval and technical sanction for a civil engineering project.	3	2
BCE4719.4	**Apply** the technique of Rate analysis in estimating the exact cost of material and manpower and hence the entire project.	3	4
BCE4719.5	**Analyze** the bill of quantities using the typesof preliminary techniques and detailed estimation of buildings and roads.	4	8

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