

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B Tech Civil Engineering
Course Code:	
Course Title:	Maintenance and Rehabilitation of Structures
Course Type:	Department Elective
Year of introduction:	2024-2025

L	T	Practical Component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLO):

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

1. examine critical aspects related to infrastructure maintenance (BL4)
2. determine factors affecting durability aspects of concrete (BL5)
3. analyse the distress in structures using non-destructive techniques (BL4)
4. apply different materials and techniques for repair and rehabilitation of different structures. (BL3)
5. evaluate different construction failures (BL5)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	Maintenance of Structure Importance, classification and various aspects related to maintenance, maintenance of buildings, rigid and flexible pavements and bridge structures.	08
Unit-II	Durability of Concrete Durability and Compatibility of Concrete: microstructure of concrete, physical and chemical causes of distress in concrete, corrosion in concrete, carbonation of concrete, effect of fire on concrete, shrinkage of concrete, Importance of cover	10
Unit-III	Assessment of Distress Condition assessment of structures, Destructive, semi-destructive and non-destructive methods of testing: core test, carbonation test, rebound hammer, UPV test, cover meter, Half-cell potentiometer test, resistivity meter test, etc.	10
Unit-IV	Repair Material and Strengthening of Structure Repair Material: grouts, epoxies, polymers, quick-setting/hardening concrete and mortars, Repair Methods: grouting and guniting, underpinning. Strengthening and Retrofitting of structures: different methods for strengthening and retrofitting of columns, beams, walls and footings for concrete structures, evaluation of repaired structures.	10
Unit -V	Construction Failure Meaning, Causes, Prevention, Investigation of failures, Forensic engineering, case studies.	07

Self Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/ References:

- J. H. Bungey, S G. Millard and M. G. Grantham, Testing of Concrete in Structures, Taylor and Francis
- Mehta, P.K. Concrete: Microstructure, Properties and Materials, McGraw Hill.
- Handbook on Repair and Rehabilitation of RCC Buildings CPWD, India
- Maintenance & Repair of Civil Structures by B L Gupta and Amit Gupta
- Design and Construction Failure by Dov Kaminetzky
- Peter Emmons and Gajanan Sabnis, Concrete: Repair and Maintenance Illustrated, Problem Analysis, Repair Strategy and Techniques, Galgotia Publishers
- Codes: IS 516, IS 456

Suggested List of Experiments:

Laboratory exercise will be based on above syllabus with minimum 05 exercise to be incorporated. The students in a suitable group size will design and perform one experiment as a part of laboratory work.

Sr. No.	Name of Experiment/Exercise	Hours
1.	Evaluation of durability of concrete	10
2.	Use of Non-destructive test: Rebound Hammer Ultra Sonic Pulse Velocity Test	08
3.	Semi-destructive test: Core test	02
4.	Determination of corrosion in reinforced concrete: Half-cell potentiometer	04
5.	Carbonation test	04

Suggested Case List:

Learning from Failure of Structures

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B Tech Civil Engineering
Course Code:	
Course Title:	Advanced Design of Concrete Structures
Course Type:	Department Elective
Year of introduction:	2025-2026

L	T	Practical Component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. identify wind and earthquake loads for RC building using codal provisions (BL3)
2. examine serviceability criteria for the design of RC members (BL4)
3. design short and slender columns, flat slab, and shear wall (BL4)
4. design retaining walls and frame structure (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	Estimation of wind and earthquake loads Factors affecting wind and earthquake loads, Evaluation of wind and earthquake loads using codal provisions, principles of earthquake-resistant design	09
Unit-II	Serviceability Criteria Serviceability criteria for RC members: deflection - short-term and long- term	06
Unit-III	Analysis and Design of Structural Elements Column: classifications, behaviour of short and slender columns with axial loading, uniaxial moment and biaxial moment, P-M interaction, design charts, codal provisions, design of uniaxial, biaxial short and slender columns Flat Slab: requirements and codal provisions, design of flat slab Shear Wall: definition and need, component and classification, codal provisions, design of shear wall	15
Unit-IV	Analysis and Design of Structures Retaining Wall: requirement, classification, and behaviour of retaining wall, design philosophy and stability checks, design of cantilever and counterfort retaining walls Frame Structure: Moment Resisting (MR) frame, analysis and design of MR frame, concept of ductility, codal provisions, ductile detailing of beam and column elements of the MR frame	15

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/ References:

- Sinha, S.N. *Reinforced Concrete Design*, Tata McGraw Hill.
- Pillai, S.U. and Menon, D. *Reinforced Concrete Design*, Tata McGraw Hill.
- Shah, V.L. and Karve, S.R. *Illustrated Design of Reinforced Concrete Buildings (Design of G+3 Storeyed Buildings + Earthquake Analysis & Design)*, Structures Publications.
- Subramanian, N. *Design of Reinforced Concrete Structures*, Oxford Press.
- Varghese, P.C. *Advanced Reinforced Concrete Design*, PHI Learning Pvt. Ltd.
- Shah, H. J. *Reinforced Concrete (Volume – I & II)*, Charotar Publishing House Pvt. Ltd.
- Codes: IS:456, IS:875, IS:1893, IS:13920, SP16, SP34.

Laboratory Work

Laboratory work will be based on the above syllabus with a minimum of 07 exercises to be incorporated. The students in a suitable group size will design and perform one experiment as a part of laboratory work.

Sr. No.	Name of Exercise / Experiments	Hours
1.	Estimate wind and earthquake loads on a reinforced concrete building	04
2.	Assess the serviceability criteria for reinforced concrete members	04
3.	Design and detailing of uniaxial and biaxial short columns and slender columns	04
4.	Design and detailing of flat slab	04
5.	Design and detailing of shear walls	04
6.	Design and detailing of retaining walls	04
7.	Design of a framed structure	04

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B Tech Civil Engineering
Course Code:	
Course Title:	Advanced Construction Technologies
Course Type:	Departmental Elective
Year of Introduction:	2024-2025

L	T	Practical component				C
		LPW	PW	W	S	
3	1	-	-	-	-	4

Course Learning Outcomes (CLO):

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

1. make use of techniques for construction and demolition of tall and precast structures (BL3)
2. examine the use cases of precast and prefabricated construction (BL4)
3. apply specialized construction techniques (BL3)
4. explain the suitable construction techniques for bridge, tunnel and offshore structures. (BL5)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	Construction and Demolition of Highrise Building Introduction to high rise buildings, establishing site, deep excavation, earth support system, advanced formwork systems, advance construction tools, plants and equipment for high-rise construction, construction methods. Demolition Techniques: Demolition by machines and explosives, Advanced techniques using robotic machines, demolition sequence, dismantling techniques, safety precaution in demolition and dismantling.	10
Unit-II	Precast and Pre-Fabrication Construction Techniques Need, advantages and disadvantages, modular co-ordination and standardization, types, precast components and joints, planning and designing, fabrication, curing techniques, stacking, transportation, lifting, erection and safety.	06
Unit-III	Specialized Construction Techniques Construction aspects and procedures of specialized construction techniques like box pushing, diaphragm walls, reinforced earth wall, gabion wall, ground water control techniques, pipe laying, vacuum dewatering- finishing and curing methods, 3D printing.	15
Unit-IV	Bridge Construction Types, bridge construction methods: in-situ and pre-cast construction methods, balanced cantilever methods, span-by-span method, incremental launching method etc.	05

Unit V	Tunnel Construction Need, site investigation and geological studies, Tunnelling methods: drill and blast, cut and cover, NATM and TBM, tunnelling equipment, trenchless techniques, hazards and safety.	05
Unit VI	Offshore Construction: Equipment: crane barges, derrick barges, drilling vessels; underwater construction; Stages of offshore structure, construction, facilities and methods of fabrication.	04

Self-Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

- Suggested Readings/
References:
- Chudley, R. & Greeno, R., *Advanced construction techniques*, Pearson.
 - Levitt, M., *Precast concrete - Materials, manufacture properties and usage*, Applied Science Publications.
 - Jha, K. N., *Formwork for concrete structures*, McGraw Hill Education.
 - Beer, G., *Technology Innovation in Underground Construction*. CRC Press.
 - Gerwick, B., *Construction of marine and offshore structures*. CRC Press.
 - Michael, C. Y. L., *Construction Technology for Tall Buildings*, Singapore University Press.
 - Irvine, J., *Advanced Construction Techniques*, California Rocketry Publisher.
 - Patrick Powers. J., *Construction Dewatering: New Methods and Applications*, John Wiley & Sons.
 - Cooke, B., *Construction Practices*, Wiley Blackwell.

Suggested List of Tutorial: Tutorial work will be based on the above syllabus with minimum of 04 tutorials.

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B Tech Civil Engineering
Course Code:	
Course Title:	Geotechnical Design
Course Type:	Department Elective
Year of Introduction:	2025-2026

L	T	Practical Component				C
		LPW	PW	W	S	
3	-	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. examine the soil strata using field test (BL4)
2. select appropriate in-situ test method for static soil properties (BL3)
3. analyse dynamic soil properties using in-situ tests (BL4)
4. make use of advanced laboratory soil testing and report the results (BL3)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	Site Characterisation and In-situ Testing Soil exploration, Soil sampling: type of samplers, disturbance, underwater soil sampling; In-situ tests: static soil properties, dynamic soil properties, advanced geophysical tests, instrumentation and monitoring; Advanced laboratory tests, Result interpretation and report drafting	09
Unit-II	Retaining Wall and Braced Cut Design Design of retaining walls: Introduction, types, design principles, gravity wall, cantilever wall, counterfort wall, sheet pile wall, reinforced earth wall, drainage through backfill Design of braced cuts: braced excavation, design of bracing components, diaphragm wall construction	10
Unit-III	Foundation Design Shallow foundation: Strap footings, raft foundations Deep foundation: Open, pneumatic and floating caissons, well foundations, Introduction to piled-raft foundation Machine foundation: Types, design criteria	10
Unit-IV	Transportation Geotechnics Coefficient of subgrade reaction, subgrade soil properties and its stabilization, highway and railway embankment construction, airport runways, surface and subsurface drainage, geosynthetics in transportation, introduction to tunnelling	08
Unit-V	Automation and AI-ML Applications in Geotechnical Engineering Geotechnical data sources, data acquisition technologies, geotechnical design optimization through AI-ML, automated site investigation, construction automation and safety, automation in monitoring and maintenance, case studies	08

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study contents.

**Suggested Readings/
References:**

- Kameshwar Rao, N.S.V. *Dynamic Soil Tests and Applications*, Wheelers Publications
- Lambe, T.W. and Whitman, R.V., *Soil Mechanics*, John Wiley
- Terzaghi K.V., Peck R.B and Mesri G., *Soil Mechanics in Engineering Practice*, John Wiley
- Coduto D.P., *Foundation design; principles and practices*, Pearson Publication
- Bowles J.W., *Foundation Analysis and Design*, Tata McGraw Hill
- Mittal, S, and Shukla, J .P., *Soil Testing For Engineering*, Khanna Publication

**Suggested List of
Experiments**

Laboratory work will be based on the above syllabus with a minimum 08 experiments/exercises to be incorporated. The students in a suitable group size will design and perform one experiment as a part of laboratory work.

Sr. No.	Name of Experiments/Exercises	Hours
1.	Sampling of rock	02
2.	Compressive strength of rock	02
3.	Collection of soil sample	02
4.	Preparation of representative sample	02
5.	Dynamic penetrometer	02
6.	Triaxial compression tests (CU, CD)	06
7.	Design of retaining walls foundations	06
8.	Design of Subgrades	06

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B Tech Civil Engineering
Course Code:	
Course Title:	Traffic Engineering and Road Safety
Course Type:	Departmental Elective
Year of Introduction:	2024-2025

L	T	Practical Component				C
		LPW	PW	W	S	
3	1	-	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. analyse traffic stream characteristics its externalities using specific models. (BL4)
2. analyse the safety of roads based on traffic parameters (BL4)
3. evaluate various traffic control systems based on given traffic demand and safety criteria. (BL5)
4. construct safety interventions based on road safety analysis. (BL3)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	Introduction to Road Transportation System Objectives of traffic engineering, mobility and accessibility, elements and their characteristics.	05
Unit-II	Traffic Studies Data collection, analysis and interpretation of results of classified traffic volume, traffic forecasting, spot speed, speed and delay, origin and destination studies.	10
Unit-III	Traffic Flow Parameters Traffic stream flow characteristics, Speed-Flow-Density relations, travel time, headway, spacing, time-space diagram, time mean speed, space mean speed and their relation, passenger car units, capacity and level of service.	10
Unit-IV	Traffic Regulation and Control Regulations and controls on driver, vehicle and flow, parking regulations, enforcement of regulations, traffic signs and design of two phase and three phase signals at intersections, IRC method of signal design, road markings, road intersections and design, design of roundabouts, parking management.	10
Unit-V	Road Safety Analysis Crash data analysis, road safety audit, road safety countermeasures, speed management strategies.	10

Self-Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings/
References:

- Roess, R. P., Prassas, E. S. & McShane. W. R., *Traffic Engineering*. Pearson/Prentice Hall.
- Slinn, M., Matthews, P., Guest, P., *Traffic Engineering Design*, Taylor & Francis.
- Garber, N. J., & Hoel, L. A. (2019). *Traffic and highway engineering*. Cengage Learning.
- Mannering, F. L., & Washburn, S. S. (2020). *Principles Of Highway Engineering And Traffic Analysis*. John Wiley & Sons.
- Khanna, S. K., Justo, C. E. G., Veeraragavan, A., *Highway Engineering*, Nem Chand Publishers.
- Kadiyali, L. R., *Traffic Engineering and Transport Planning*, Khanna Publishers.
- IRC Manuals – IRC 53, IRC 62, IRC 65, IRC 70, IRC 64, IRC 106, IRC 79, IRC 93, IRC 99.

Suggested List of
Tutorial:

Tutorial work will be based on the above syllabus with minimum of 04 tutorials.

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B Tech Civil Engineering
Course Code:	
Course Title:	Solid Waste Management
Course Type:	Department Elective
Year of introduction:	2025-2026

L	T	Practical Component				C
		LPW	PW	W	S	
3	1	-	-	-	-	4

Course Learning Outcomes (CLOs):

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

1. classify solid waste for suitable processing methods (BL4)
2. apply appropriate methods for treatment of hazardous waste (BL3)
3. identify suitable methods for e-waste and plastic waste management (BL3)
4. choose standard practice for management and handling of plastic waste (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	Solid Waste waste generation in India, need for waste management, types and sources of waste, nature and characteristics, quantitative and qualitative aspects.	04
Unit-II	Municipal Solid Waste Management handling and segregation of wastes, collection systems, methods of waste processing: physio-chemical, thermal and biological, waste disposal methods, legal requirements of disposal.	11
Unit-III	Hazardous Waste Management sources, characterization, categories, human exposure and health hazards, storage and transportation, treatment by incineration, bioremediation, oxidation and reduction, legal requirements of disposal.	10
Unit-IV	E-waste Management introduction, sources, characteristics, effects on human health and environment, risk assessment, minimization techniques, recycling and recovering techniques, rules and regulations.	12
Unit-V	Plastic Waste Management need, sources, types, impact on human health and environment, issues and challenges, recycling and reuse of plastic waste, rules and regulations.	08

Self Study: The self-study components of the syllabus are declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/
References:

- Ramachandra T.V., Management of Municipal Solid Waste, TERI.
- Tchobanoglous G., Kreith F., Handbook of Solid Waste Management, McGraw Hill.
- Peavy H. S., Rowe D. R., Tchobanoglous G., Environmental Engineering, McGraw Hill.
- Johri R., E-waste: Implications, regulations and management in India and current global practices, TERI.
- Nabil M., Plastic Waste Management: Disposal, Recycling and Reuse, New York Marcel Dekker.
- LaGrega, M.D., Buckingham, P.L. & Evans, J.C. Hazardous Waste Management, Waveland Press.
- Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India.
- Electronic Waste Management Rules, Ministry of Environment, Forest and Climate Change, Government of India, New Delhi.
- Plastic Waste Management Rules, Ministry of Environment, Forest and Climate Change, Government of India.
- Hazardous Waste Management Rules, Ministry of Environment, Forest and Climate Change, Government of India

Suggested List of
Tutorial:

Tutorial work will be based on the above syllabus with minimum of 04 tutorials.