

NIRMA UNIVERSITY

Institute:	Institute of Technology, School of Engineering
Name of Programme:	BTech in Civil Engineering
Course Code:	3CL106ME24
Course Title:	Maintenance and Rehabilitation of Structures
Course Type:	Departmental Elective-II
Year of introduction:	2024-25

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

Course Learning Outcomes (CLO):

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

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

Unit	Contents	Teaching hours (Total 45)
Unit-I	Maintenance of Structures Importance, classification and various aspects related to maintenance, maintenance of buildings, rigid and flexible pavements, bridge structures.	08
Unit-II	Durability of Concrete Durability & 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 & 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 Materials and Strengthening of Structures Repair Materials: grouts, epoxies, polymers, quick setting/hardening concrete & 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

07

Meaning, causes, prevention, investigation of failures, Forensic engineering, case studies.

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:

- Mehta, P. K., *Concrete: Microstructure, Properties and Materials*, McGraw Hill.
- Emmons, P. & Sabnis, G., *Concrete: Repair and Maintenance Illustrated, Problem Analysis, Repair strategy and Techniques*, Galgotia Publishers.
- *Handbook on Repair and Rehabilitation of RCC Buildings* CPWD.
- Bungey, J. H., Millard, S. G. & Grantham, M. G., *Testing of Concrete in Structures*, Taylor and Francis.
- Gupta, B. L. & Gupta, A., *Maintenance & Repair of Civil Structures*, Standard Publications.
- Kaminetzky, D., *Design and Construction Failures-Lessons from Forensic Investigations*, Galgotia Publications.
- Codes: IS 516, IS 456

Suggested Case List:

Learning from Failure of Structures

Laboratory work:

Laboratory work will be based on the above syllabus with minimum 05 experiments to be incorporated.

Suggested List of Experiments:

Sr. No.	Name of Experiment/Exercise	Hours
1.	Evaluation of durability of concrete	12
2.	Use of non-destructive test: rebound hammer ultra-sonic pulse velocity test	08
3.	Semi-destructive test: core test	02
4.	Evaluation of corrosion in reinforced concrete: half-cell potentiometer test	04
5.	Carbonation test, cover meter test	04

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	BTech in Civil Engineering
Course Code:	3CL107ME24
Course Title:	Advanced Design of Concrete Structures
Course Type:	Departmental Elective-II
Year of introduction:	2024-25

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 design principles for RC buildings subjected to wind and earthquake loads (BL3)
2. make use of serviceability criteria for the design of RC members (BL3)
3. analyse and design columns, flat slabs and shear wall (BL4)
4. design and detail retaining wall and frame structures. (BL6)

Unit	Contents	Teaching hours (Total 45)
Unit-I	Estimation of wind and earthquake load Factors affecting wind and earthquake loads, Evaluation of wind and earthquake load, principles of earthquake resistant design, ductile detailing.	10
Unit-II	Serviceability Criteria Serviceability criteria for RC members: deflection - short term & long term, crack width.	07
Unit-III	Analysis and Design of Structural Elements Column with axial loading, uniaxial moment and biaxial moment, P-M interaction, Design charts, slender column, primary and secondary moments, codal provisions, design of biaxial short and slender column; requirements of flat slabs, codal provisions, design of flat slab; nccd, definition and classification of shear wall, codal provisions, design of shear wall.	14
Unit-IV	Analysis and Design of Structures Retaining wall: requirement, classification and behavior of retaining wall, components of shear wall, design philosophy and stability checks, design of cantilever and counterfort retaining wall. Frame Structure: moment-resisting frame, concept of ductility, codal provisions, ductile design and detailing of beam and column elements of the frame.	14



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

Laboratory work: Laboratory work will be based on the above syllabus with minimum 07 exercises to be incorporated.

Suggested List of Experiments:

Sr. No.	Name of Experiment/Exercise	Hours
1.	Estimate wind and earthquake loads on reinforced concrete building	04
2.	Assess the serviceability criteria for reinforced Concrete members	04
3.	Design and detailing of biaxial short column and slender column	06
4.	Design and detailing of flat slab`	04
5.	Design and detailing of shear wall	04
6.	Design and detailing of retaining wall	04
7.	Design of framed structure	04

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	BTech in Civil Engineering
Course Code:	3CL208ME24
Course Title:	Advanced Construction Technologies
Course Type:	Departmental Elective-II
Year of Introduction:	2024-25

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

Course Learning Outcomes (CLO):

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

1. make use of techniques for construction and demolition of tall building (BL3)
2. demonstrate the knowledge of precast and prefabricated construction (BL3)
3. explain specialized construction techniques for Civil infrastructure (BL5)
4. choose 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, formwork, common construction equipment for excavation, concreting and lifting, concrete placement and curing techniques, floor by floor construction method, in-situ prestressing in high rise structures, structural glazing. Demolition Techniques: Demolition by machines, demolition by 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 & disadvantages, modular co-ordination & standardization, types, precast components & joints, planning & designing, fabrication, curing techniques, stacking, transportation, lifting, erection.	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 & 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.	05



Unit V	Tunnel Construction Site investigation and geological studies, drilling, pneumatic breakers, explosives, blasting, tunnelling technology: mechanized, shield, micro, special methods; hazards and safety, trenchless techniques.	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

Tutorial Work:

This shall consist of at least 06 tutorials based on the above syllabus.

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.



NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	BTech in Civil Engineering
Course Code:	3CL302ME24
Course Title:	Port, Airport and Railway Engineering
Course Type:	Departmental Elective-II
Year of Introduction:	2024-25

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. interpret the requirement of port, airport and railway (BL3)
2. identify components, protection & navigational aids for port (BL3)
3. plan and design airport geometry, pavement and traffic control (BL4)
4. apply geometric principles on railway track components. (BL3)

Unit	Contents	Teaching hours (Total 45)
Unit-I	Port Planning selection of site and planning, site investigations: hydrographic survey, topographic survey, soil investigations and tidal observations. port components: breakwaters, dry & wet docks, jetties, piers, wharves, fenders, dolphins, trestle, mooring accessories.	08
Unit-II	Dredging, Coastal Protection & Navigational Aids classification, types and choice of dredger, coastal erosion and protection, sea wall, revetment, bulkhead. requirements of signals, fixed navigation structures: lighthouses, beacon lights, floating navigational aids - lightships, buoys, radar.	07
Unit-III	Geometric Design of Airport civil aviation policy, aircraft characteristics, airport classification, runway orientation, length analysis and design, taxiway design, terminal building requirements, terminal configurations, vehicular circulation and parking area.	07
Unit-IV	Airport Pavement Design and Control design factors, flexible pavement, rigid pavement, pavement failures, drainage, maintenance and evaluation, markings, lighting, runway protection surfaces, air traffic control network, air traffic control aids.	08



Unit-V	Components of Railway Track permanent way and its components, rail gauges and their significance, coning of wheels and its impact, rails: types, characteristics, and maintenance, creep of rail and its effects, rail fastenings, sleepers, ballast, points and crossings.	07
Unit-VI	Geometric Design of Railway Track gradients in railway tracks, grade compensation on curves, superelevation and negative superelevation, cant deficiency and excess, permissible speed on tracks.	08

Tutorial Work:

This shall consist of at least 04 tutorials based on the above syllabus.

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:**

- Chandra S. & Agarwal, M.M., *Railway Engineering*. Oxford University Press.
- Srinivasan, R., *Harbour, Dock and Tunnel Engineering*, Charotar Publishing House.
- Bindra, S. P., *A course in Docks and Harbour Engineering*, Dhanpat Rai Publications.
- International Civil Aviation Organization, *Aerodrome Design Manuals, Parts I-VI*.
- Khanna, S. K., Arora, M. G. & Jain, S. S., *Airport Planning and Design*, Nem Chand and Bros.
- Ashford, N. J., Mumayiz, S. A. & Wright, P. H., *Airport Engineering Planning, Design, and Development of 21st Century*, Wiley.
- Saxena, S.C. & Arora, S.P., *A Text Book on Railway Engineering*. Dhanpat Rai Publications.