NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B Tech Civil Engineering**
Course Code:	
Course Title:	**Advanced Concrete Technology**
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 the applications of supplementary cementitious materials in concrete construction (BL4)
2. perceive use of construction chemicals in concrete construction (BL5)
3. recommend suitable type of concrete and concreting techniques for diversified applications in construction (BL5)
4. examine information regarding emerging trends in concrete technology. (BL4)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	Supplementary Cementitious Materials Introduction, fly ash, ground granulated blast furnace slag, silica fume, metakaolin, rice husk ash: proportioning of concrete, effect of incorporation on fresh and hardened concrete properties including durability of concrete, codal provisions, practical applications and case studies.	10
Unit-II	Construction Chemicals Overview, rheology of concrete: introduction, factors affecting, measurement; water-reducing and super plasticizing admixtures, retarding and accelerating admixtures, other types, effect of incorporation on properties of concrete, recent advances and future trends, practical applications and case studies.	10
Unit-III	Concrete Types and Techniques High strength concrete, high performance concrete, self-compacting concrete, mass concrete, high density concrete, light weight concrete, fiber reinforced concrete, cold and hot weather concreting, underwater concreting, pumped concreting, precast and ready-mix concrete, pervious concrete, geopolymer concrete, 3D-printing and advanced formwork for concrete structures, case studies, other advancements.	20
Unit-IV	Emerging Trends in Concrete Technology Nanotechnology in concrete: benefits and applications, self-healing and smart concrete technologies, carbon capture and utilization in concrete production, sustainable concretes, future prospects and other advancements.	05

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.
- Malhotra, V.M. & Ramezanianpour, A., *A Fly Ash in Concrete*, Canmet.
- Gambir, M. L., *Concrete Technology Theory and Practice,* McGraw Hill.
- Shetty, M. S., *Concrete Technology Theory and Practice,* S. Chand.
- Santhakumar A. R., *Concrete Technology*, Oxford University Press
- Codes: IS:10262, IS:456.

Laboratory Work:

Laboratory work will be based on the above syllabus with minimum 05 experiments 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.	Testing of cement, fine aggregate, coarse aggregate, mineral admixture and chemical admixture	06
2.	Development of concrete mix design and testing of mechanical properties for Control Concrete	05
3.	Development of concrete mix design and testing of mechanical properties for High strength Concrete	05
4.	Development of concrete mix design and testing of mechanical properties for Self-Compacting Concrete	06
5.	Development of concrete mix design and testing of mechanical properties for Special Concrete	06

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B Tech Civil Engineering**
Course Code:	
Course Title:	**Advanced Structural Mechanics**
Course Type:	**Department Elective**
Year of introduction:	**2024-2025**

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

Course Learning Outcomes (CLOs):

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

1. apply matrix methods of analysis for different types of skeletal structures (BL3)
2. analyse skeletal structures using stiffness member approach (BL4)
3. assess composite structures and incorporate secondary effects (BL5)
4. develop computer programs and use software for analysis of structures. (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	Introduction of Matrix Methods Types of structures, Static and Kinematic indeterminacy of structures, Review of methods for analysis of skeletal structures, Concepts of matrix methods, Introduction of stiffness method, Different approaches.	10
Unit-II	Analysis of Skeletal Structures Concept of member axis and structural axis, Formulation of stiffness matrix along member axis, Rotation transformation of axis, Analysis of two-dimensional structures beam, truss, plane frame and grid using stiffness member approach, Concept of symmetry and anti-symmetry of structures.	15
Unit-III	Composite Structures and Secondary Effects Analysis of composite structures using stiffness method, Incorporation of secondary effects in analysis: support settlement, temperature change, elastic support.	10
Unit-IV	Computer Applications Development of computer program for analysis of skeletal structures using stiffness member approach, Application of software to analyse different types of structures.	10

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:

- Gere, J. M. & Weaver, W. *Matrix Analysis of Framed Structures*, C. B. S. Publishers & Distributors.
- Kassimali, A. *Matrix Analysis of Structures*, Cengage Learning.
- Ghali, A., Neville, A. M. & Brown, T. G. *Structural Analysis: A Unified Classical and Matrix Approach*, CRC Press.
- Pandit, G., Gupta, S., *Structural Analysis – A Matrix Approach,* McGraw Hill Education.
- Menon, D., *Advanced Structural Analysis,* Alpha Science International Ltd.

Suggested List of Experiments:

Laboratory exercise will be based on above syllabus with minimum 05 experiments 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.	Stiffness member approach for analysis of beam	04
2.	Stiffness member approach for analysis of truss	06
3.	Stiffness member approach for analysis of frame	06
4.	Development of a computer program for analysis of skeletal structures	06
5.	Application of software for analysis of structures	06

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B Tech Civil Engineering**
Course Code:	
Course Title:	**Sustainable Building Technologies**
Course Type:	**Department 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. illustrate concepts of sustainability and rating systems (BL3)
2. apply effective energy conservation systems (BL3)
3. examine sustainable building materials and technologies (BL4)
4. analyse strategies for water conservation and waste management. (BL4)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	Introduction to Sustainability Concept, need, sustainable development goals, three pillars of sustainability, ethical considerations and equity, meteorological and climatic considerations, site selection and planning.	05
Unit-II	Energy Conservation Embodied energy of materials, energy efficient lighting, building automation, ventilation and air quality requirement, passive cooling and thermal comfort. renewable energy harvesting and usage in buildings, National and international energy conservation policies, Role of government regulations and incentives, Energy labelling and certification programs, Corporate social responsibility and reporting.	10
Unit-III	Building Materials and Technologies Features and characteristics of alternative and natural materials like bamboo, timber, rammed earth, stabilized mud blocks, agro and industrial wastes; Sustainable construction technologies, carbon footprint for building materials and technologies, concept of life cycle assessment.	12
Unit-IV	Water Conservation and Wastewater Management Water usage minimization, planning and systems for water conservation, sustainable wastewater treatment techniques, use of rated materials and fixtures. Role of individuals, industries, and governments in water conservation,	06
Unit-V	Solid Waste Management Need, type, objectives and scope, domestic solid waste management, construction and demolition waste utilization, recycling and resource recovery, waste management regulations and policies.	06

Unit-VI	Green Building Rating Systems Environmental issues and challenges, Benefits, Principles and criteria of green building assessment, Leadership in Energy and Environment Design (LEED), Indian Green Building Council (IGBC), Green Rating for Integrated Habitat Assessment (GRIHA), importance of certification.	06

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:

- Jagadish K.S. *Sustainable Building Technologies*, IK International Publishing House
- Jagadish K.S. Venkatarama Reddy B.V. and Nanjunda Rao K.S. *Alternative building Materials and Technologies*, New Age International.
- Bhatia, S.C. *Wealth from Waste. Volume I-II.* Atlantic Publication.
- Pandel, U. & Poonia, M.P. *Environmental Technologies for Sustainable Development*, Prime Publishing.
- Wright, R.T. & Boorse, D.F. *Environmental Science towards a sustainable development*, Pearson.
- Rai G.D. *Non-conventional energy resources*, Khanna Publishers.

Suggested List of Tutorial: Tutorial work will be based on the above syllabus with minimum of 05 tutorials.

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B Tech Civil Engineering**
Course Code	
Course Name	**Building Services**
Course Type:	**Department 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. select different types of pipes and fixtures used in plumbing installations (BL3)
2. apply electrical and lighting system in building (BL3)
3. examine proficiency in designing, sizing, and selecting HVAC equipment (BL4)
4. analyse function of vertical transportation in modern buildings and infrastructure. (BL4)
5. evaluate appropriate safety and security systems in building. (BL5)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	Plumbing Systems Water storage and distribution, heating methods, pipe staking, dual plumbing, drainage system, maintenance, pipes and fittings, pipe sizing and selection for water supply and drainage, plumbing codes and standards	08
Unit-II	Electrical Lighting and Illumination Systems Electrical system installations, electrical control and safety devices: fuse, circuit breakers, lightning arresters, Electrical wiring systems: material and specifications; Factors affecting illumination in building, modern theory of light and colour, synthesis of light, Luminous flux, utilization factor, artificial light sources, types of energy efficient lamps.	12
Unit-III	Heating, Ventilation and Air Conditioning (HVAC) Concept, importance, components, planning of HVAC systems. Basics of heat transfer: conduction, convection, radiation, Psychrometric properties and air conditioning processes, applications of Psychrometric charts, design principles of HVAC system, Renewable energy integration: solar heating, geothermal systems; green building standards.	07
Unit-IV	Vertical Transportation Importance, evolution of technology, role in building functionality and accessibility, Elevator: types, components, car design and interior considerations, functioning of escalators and moving walkways, safety regulations and codes for vertical transportation systems	06

Unit-V	Building Automation and Fire Safety System Need, types and concept of smart building automation, Access control systems: biometrics, RFID, smart cards, Intrusion detection systems, and perimeter security, Closed-circuit television (CCTV) and video surveillance, Integration of security systems for comprehensive protection, Causes of fire, fire resistance materials, safety regulations, fire-fighting devices and systems, fire escapes, Types of fire detection sensors: smoke, heat, flame detectors, Fire alarm systems and their components, Fire suppression systems: sprinklers, gas suppression, Design considerations for effective fire safety measures.	12

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:

- Hassan G., *Building Services*, Macmillan.
- Greeno R. *Building Services, Technology and Design*, Routledge publication
- Hall, F. & Greeno, R. *Building Services Handbook*, Butterworth-Heinmann.
- Philips D., *Lighting Modern buildings*, Architectural Press
- Hall, F., *Building services and equipment*, Routledge
- Rao, S., Jain R.K. & Saluja, S., *Electrical Safety, fire safety Engineering and Safety Management*, Khanna Publishers.

Suggested Tutorial: List of 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:	**Ground Improvement Techniques**
Course Type:	**Department Elective**
Year of Introduction:	**2024-2025**

L	T	Practical Component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

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

1. choose suitable soil stabilization and drainage technique (BL3)
2. discover geosynthetics in infrastructure applications (BL4)
3. appraise the application of reinforced soil (BL5)
4. experiments with geosynthetics and reinforced soil. (BL3)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	Ground Improvement Introduction, need, classification, potential, land reclamation: material, methods.	05
Unit-II	Soil Stabilization Terminologies, Mechanical: Compaction, Vibration methods, Pre-loading; Chemical: cementitious, bituminous, lime, polymers; Construction Methods. Grouting: introduction, types, material, methods, procedure, applications. Anchoring: ground anchor, rock bolts, and soil nailing.	09
Unit-III	Drainage Techniques Methods, design principles; Precompression: compressibility, preloading and monitoring; Vertical drains: sand drain, prefabricated vertical drain.	06
Unit-IV	Geosynthetics Need, type, functions, introduction to soil-geosynthetics integration, experimental evaluation for engineering properties, applications: pavement engineering, erosion controls, slope stabilisation, case study.	12
Unit-V	Application of Reinforced Soil Reinforced Soil Wall: Analysis and design of systematically reinforced soil wall; Introduction of randomly reinforced earth. Foundations on Reinforced soil: Bearing capacity for foundation on reinforced soil, settlement analysis Transportation Infrastructure: Geosynthetics for separation, drainage and filtration, overlay, design of pavements subgrade, soil improvement for railway tracks Environmental Geotechnics: Liners for ponds, canal and landfill, mitigation methods for landslide and soil erosion.	13

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:	• Shukla, S.K., *Handbook of Geosynthetic Engineering*, ICE Publishing. • Sivakumar Babu G.L., *An Introduction to Soil Reinforcement and Geosynthetics*, Universities Press • Rao G. V., Banerjee P.K., Shahu J.T., Ramana G.V., *Geosynthetics: New Horizons*, Asian Books Pvt Ltd. • Purshotum Raj P., *Ground Improvement Methods*, Laxmi Publications. • Patra N. R., *Ground Improvement Methods*, Vikas Publishing House Pvt. Ltd.
Suggested List of Experiments	Laboratory work will be based on the above syllabus with a minimum 06 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.	Pull-out strength Test	04
2.	Soil-geosynthetic interface friction Test	06
3.	Puncture Strength Test	02
4.	Evaluation of Mechanically stabilised / reinforced soil	06
5.	Evaluation of Chemically stabilised soil	04
6.	Design of Reinforced earth walls.	06

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B Tech Civil Engineering**
Course Code:	
Course Title:	**Geomatics**
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. explain the need for map projections, datum and coordinate system (BL5)
2. apply remote sensing techniques for civil engineering problems (BL3)
3. make use of Geographical information system (GIS) (BL3)
4. examine the need for navigation satellite systems. (BL4)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	Overview of Geodesy Importance of map, Types of maps, Scales and plotting accuracy, map projection systems. Datum: Geoid, Spheroid and WGS-84, datum transformation. Coordinate systems: cartesian, geographical and local and conversion.	07
Unit-II	Remote Sensing Definition, components and types, electromagnetic radiation, spectral signatures, sensor characteristics, satellites and orbit, resolution concept, data products and characteristics, visual image interpretation, digital image processing, data integration, analysis and presentation, applications.	10
Unit-III	Geographic Information System concept and components; Data: source, capture, processing, analysis; attribute data management, metadata and spatial data, spatial analysis: interpolation, buffer, overlay; terrain modelling and network analysis.	15
Unit-IV	Global Navigation Satellite System (GNSS) Global and regional navigation satellite systems; global positioning System: principle, segments, signals, receivers, positioning methods, code and carrier phase measurement, data processing, accuracy, survey methods, applications.	10
Unit-V	Advances in Geomatics Introduction to multispectral, hyperspectral, microwave remote sensing, LIDAR and drone survey applications.	03

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:	• Bhatt B., *Remote Sensing and GIS*, Oxford University Press. • Chang, K., *Introduction to Geographic Information Systems*, McGraw-Hill. • Kiefer, L., *Remote Sensing and Image Interpretation*, John Wiley & Sons. • Rabbany, A. *Introduction to Global Positioning System*, Artech house. • Reddy, M. A., *Remote Sensing and Geographical Information System*, B S Publication.
Laboratory work:	Laboratory work will be based on the above syllabus with minimum 07 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 Experiment/Exercise	Hours
1.	Study of toposheet and maps	02
2.	Geo-referencing of satellite imagery	04
3.	Digital image processing	04
4.	Layer stacking, mosaicking and digitization of images	06
5.	Preparation of map using ArcGIS/QGIS.	06
6.	Collection of point, line and area features using GPS	02
7.	Demo of drone survey and its processing	04