NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. in Civil Engineering**
Course Code:	3CL201ME24
Course Title:	**Advanced Concrete Technology**
Course Type:	**Departmental Elective**
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 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. appraise information regarding emerging trends in concrete technology. (BL5)

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 & 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** 05

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.

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.

Suggested List of Experiments (not restricted to the following):
(Only for Information)

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	06
3.	Development of concrete mix design and testing of mechanical properties for High strength Concrete	06
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. in Civil Engineering**
Course Code:	3CL102ME24
Course Title:	**Advanced Structural Mechanics**
Course Type:	**Departmental Elective**
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. classify different types of structures and illustrate matrix methods of analysis for structures (BL2)
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.

Laboratory Work: Laboratory work will be based on the above syllabus with minimum 05 exercises to be incorporated.

Suggested List of Experiments (not restricted to the following):
(Only for Information)

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	08

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech in Civil Engineering**
Course Code:	3CL202ME24
Course Title:	**Sustainable Building Technologies**
Course Type:	**Departmental Elective**
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. identify concepts of sustainability and rating systems (BL3)
2. apply effective energy conservation systems (BL3)
3. examine sustainable building materials and technologies (BL4)
4. develop strategies for water conservation and waste management. (BL3)

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

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:

- 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.
- Rai, G. D., *Non-conventional energy resources*, Khanna Publishers.
- 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.

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. in Civil Engineering**
Course Code:	3CL401ME24
Course Title:	**Advanced Geotechnical Engineering**
Course Type:	**Departmental Elective**
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. examine stresses and flow in soils (BL4)
2. assess shear strength of cohesionless soils (BL5)
3. design shallow foundations (BL6)
4. analyse and design deep foundations (BL4)

Unit	Contents	Teaching hours (Total 45)
Unit-I	**Stresses in Soil** Soil as elastic body, principal stresses and strains, problems of plane stresses and strains; stress distribution: Boussinesq's and Westergaard's theory, Newmark's chart.	06
Unit-II	**Permeability and Seepage** Field permeability measurement, seepage force, effective stress, Laplace equations of fluid flow for seepage, flow nets, piping.	06
Unit-III	**Shear Strength of Soil** Mohr-Coulomb theory; measurement of shear strength, drainage conditions, stress paths, pore pressure parameters, effect of strain rate, stress history, critical void ratio, dilatancy, soil-structure, sensitivity, elastic and plastic analysis of soil, introduction to liquefaction.	14
Unit-IV	**Shallow Foundations** Bearing capacity: theories, allowable bearing pressures, effect of water table, bearing capacity from in-situ tests; Settlement: causes, uniform and differential settlements, permissible settlements, settlement analysis, Design: foundation subjected to eccentrical-inclined load, combined footing, raft foundation. Introduction to soil-structure interaction.	11

Unit-V **Deep Foundations** 08

Types of piles, mechanics of load transfer in piles, Load carrying capacity, Pile load test, Axial capacity of single piles, Axial capacity of pile-groups, Negative skin friction, settlement of single piles and pile-groups, settlement control; Introduction to Piled-raft foundation, Well foundation, Cassion and Cofferdam.

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:

- Das, B. M., *Principles of Foundation Engineering* Nelson Engineering.
- Saran, S., *Analysis and design of Substructure*, Oxford IBH Publishing Co.
- Bowles, J. E., *Foundation Analysis & Design,* McGraw-Hill Companies, Inc.
- Kurian, N. P., *Design of Foundation Systems*, Narosa Publishing House.
- Coduto, D. P., *Foundation Design Principles and Practices*, Pearson, PHI Learning.
- Poulos, H. G. & Davis, E. H., *Pile Foundation Analysis and Design* john wiley & sons inc.
- Tomlinson, M. J., *Foundation Design and Construction* - Prentice Hall.
- Salgado, R., *The Engineering of Foundations,* McGraw-Hill, Boston.

Laboratory work: Laboratory work will be based on the above syllabus with minimum 06 experiments/exercises to be incorporated.

Suggested List of Experiments (not restricted to the following):
(Only for Information)

Sr. No.	Name of Experiments/Exercises	Hours
1.	Permeability and seepage analysis	04
2.	Shear strength of soil	04
3.	Analysis of shallow foundation	06
4.	Design of shallow foundation	06
5.	Settlement analysis	04
6.	Analysis of pile foundation and pile group	06

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. in Civil Engineering**
Course Code:	3CL301ME24
Course Title:	**Traffic Engineering and Road Safety**
Course Type:	**Departmental Elective**
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 traffic stream characteristics and assess its externalities (BL2)
2. estimate traffic parameters to analyse the safety of roads (BL5)
3. identify traffic control systems considering traffic demand and safety (BL3)
4. plan 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

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:

- Roess, R. P., Prassas, E. S. & McShane. W. R., *Traffic Engineering*. Pearson/Prentice Hall.
- Kadiyali, L. R., *Traffic Engineering and Transport Planning*, Khanna Publishers.
- Slinn, M., Matthews, P., Guest, P., *Traffic Engineering Design,* Taylor & Francis.
- Khanna, S. K., Justo, C. E. G., Veeraragavan, A., *Highway Engineering*, Nem Chand Publishers.
- IRC Manuals – IRC 53, IRC 62, IRC 65, IRC 70, IRC 64, IRC 106, IRC 79, IRC 93, IRC 99.

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. Civil Engineering**
Course Code:	3CL701ME24
Course Title:	**Geomatics**
Course Type:	**Departmental Elective**
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. 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. identify the need for navigation satellite systems. (BL3)

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 & 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 & 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** 03

Introduction to multispectral, hyperspectral, microwave remote sensing, LIDAR and drone survey, applications.

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.
- Reddy, M. A., *Remote Sensing and Geographical Information System*, B S Publication.
- 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.

Laboratory work: Laboratory work will be based on the above syllabus with minimum 06 experiments/exercises to be incorporated.

Suggested List of Experiments (not restricted to the following):
(Only for Information)

Sr. No.	Name of Experiment/Exercise	Hours
1.	Study of toposheet & maps	02
2.	Geo-referencing of satellite imagery	04
3.	Digital image processing	08
4.	Layer stacking, mosaicking & digitization of images	06
5.	Preparation of map using ArcGIS/QGIS.	08
6.	Collection of point, line and area features using GPS	02

NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B. Tech. in Civil Engineering**
Course Code:	3CL602ME24
Course Title:	**Disaster Management**
Course Type:	**Departmental Elective**
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. explain various types of disasters, administrative structure and policies (BL2)
2. examine different stages of disaster risk assessment and management (BL4)
3. appraise tools of management for meteorological and geophysical disasters (BL5)
4. evaluate the effect of climate change on biodiversity. (BL5)

Unit	Contents	Teaching hours (Total 45)
Unit-I	**Fundamental to Disaster Management** Concepts, Importance & significance, natural and human induced disasters, disaster management cycle, historical perspective of disasters in India, disaster and development, institutional framework for managing disasters in India, disaster legislation and policy, disaster management act 2005, national guidelines and policy.	10
Unit-II	**Disaster Risk Assessment and Management** Risk, vulnerability, hazard, risk assessment process, hazard mapping, disaster communication, disaster monitoring and early warning system, capacity building, utilisation of resource, training and public awareness in disaster risk reduction. challenges and solutions, disaster safe designs and constructions, structural and non-structural mitigations. Role of Geographical Information System, Global Positioning System and Remote Sensing in disaster management.	14
Unit-III	**Meteorological Disaster** Causes, identification of factors, effects on land and sea, risk assessment, damage assessment, hazard prone area, analysis and management, tools and systems for monitoring and management, case studies.	07

Unit-IV	**Geophysical Disaster** Introduction, causative factors, monitoring instruments, triggering and non-triggering, regional and site-specific risk assessments, hazard zonation maps, analysis and mitigation measure, risk mitigation plans, case studies	07
Unit-VI	**Biodiversity Disasters** Ecological degradation, nuclear disaster and biodiversity loss. Identification of parameters (mapping of forest types, protected areas and natural forests), population extinction, conserving bio-diversity, Soil erosion, coral/mangrove depletion, forest fire, mining. Geomatics tools for preparation of ecological degradation maps, erosion maps, deforestation maps etc., case studies	07

Tutorial Work:
This shall consist of at least 02 tutorials based on the above syllabus.

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:

- Modh, S., *Introduction to Disaster Management*, Macmillan.
- Sinha, P.C., *Disaster Relief: Rehabilitation and Emergency Humanitarian Assistance*, SBS Publishers.
- Piers B, Cannon T., Davis I. & Ben W., *At Risk: Natural hazards, People's Vulnerability and Disasters*, Routledge.
- Singh R.B., *Natural Hazards and Disaster Management Vulnerability Mitigation*, Rawat Publications.
- Robert B., & Edwards K., *Natural Hazards: Earth's processes as hazards disasters and catastrophe*, Pearson Prentice Hall.