Scheme of Studies & Syllabus

Master of Technology
Civil Engineering
2022-23

Department of Civil & Environmental Engineering
SCHOOL OF ENGINEERING & TECHNOLOGY
THE NORTHCAP UNIVERSITY, GURGAON
(Established under Haryana Govt. Notification No. Leg. 32/2006-HARYANA ACT No.25 of 2009)
The department of Civil & Environmental Engineering offers the following programmes during the academic year 2022-23.

- Master of Technology (M.Tech.) in Civil Engineering with specialization in
  - Structural Engineering
  - Construction Engineering & Management and
  - Environmental Engineering

M.Tech. in Civil Engineering programme for regular students and for working professionals will impart research-based knowledge in the selected disciplines of civil engineering. The Full-Time M.Tech. programme will be of 2 years with 4 semesters and the Part-Time M.Tech. programme will be of 3 years with 6 semesters for working professional. The programme has total credits of 70. Also, the student can exit after 1 year of Full-Time M.Tech. programme with a PG diploma in respective specialization completing 50 credits in total. The curriculum is designed in such a way that there are core subjects relevant to overall civil engineering and program electives specific to the respective specializations. Specialization based seminar, minor project, and dissertation in structural engineering, Construction engineering and Management, and Environmental engineering completes the requirement of a Masters’ degree in Civil Engineering domain.
# M.Tech. Full-Time with 2 years exit

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<th>Sem</th>
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<td>I</td>
<td>CEL501 Safety &amp; Reliability Analysis 3-0-0 (3)</td>
<td>PE-1 3-0-2 (4)</td>
<td>PE-2 3-0-2 (4)</td>
<td>PE-3 3-0-2 (4)</td>
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**TOTAL CREDITS OF THE M.TECH. DEGREE PROGRAMME = 70**

*Students can utilize the summer/winter break period to complete the remaining 140 Community Service hours every year*
## PG Diploma with 1 year exit

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**EXIT OPTION: PG DIPLOMA in respective specialization; TOTAL CREDITS = 50**

*Students can utilize the summer/winter break period to complete the remaining 140 Community Service hours every year*
# M.Tech Part-Time with 3 years exit

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Department of Civil and Environmental Engineering

Master of Technology in Civil Engineering
Specialization in

1. Structural Engineering
2. Construction Engineering and Management
3. Environmental Engineering

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<th>Program Core</th>
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Brief Syllabus

**STRUCTURAL ENGINEERING**

**CEL501 Safety and Reliability Analysis**
Fundamentals of set theory and probability, probability distribution, regression analysis, hypothesis testing. Stochastic process and its moments and distributions, Concepts of safety factors, Safety, reliability and risk analysis, first order and second order reliability methods, simulation-based methods, confidence limits and bayesian revision of reliability, reliability based design, examples of reliability analysis of structures.

**CEL502 Optimization Techniques in Civil Engineering**

**MAL 616 Research Methodology**

**CEL503 Advanced Concrete Technology**

**CEL506 Sustainable Built Environment**
Background terms; Smart Growth, smart city and New Urbanism and the Resistance to Change; Green Building Assessment; Green Building Index; Life Cycle Costing; The Setting/Green Roofs, Case Study; Energy and Buildings; Energy and Hydrologic Systems; Materials/Specifications; Interior Environments (lighting, air), GRIHA, LEEDs rating system, BEE Standards and guidelines.
CEL507 Design of Industrial structures

Elementary Plastic Analysis and Design: Introduction, Scope of plastic analysis, ultimate load carrying capacity of tension members and compression members, flexural members, and simple portal frames and design Industrial Buildings- Loads, general arrangement and stability, design considerations, design of roof trusses, industrial building frames, Design of Water Tanks, Stacks and Towers.

CEL 508 Prestressed Concrete Structures

Theory and behavior – basic concept, methods of pre stressing, loss of pre stress, Analysis of prestress, calculations of deflections, crack width; design concepts – procedures as per codes, stress distributions, limit state design criteria; design of pre stressed concrete, Analysis and design of indeterminate prestress members, tanks, pipes and composites construction and elementary idea of pre stressed concrete bridge.

CEL509 Finite Element Analysis


CEL510 Structural Dynamics

Free and forced vibration of single degree of freedom (SDOF) system, response to harmonic, periodic, impulsive and general dynamic loading, response of SDOF to earthquake, Free vibration of lumped multidegree of freedom system, Approximate methods for obtaining natural frequencies and mode shapes, Frequency domain analysis of lumped multi-degree of freedom system using normal mode theory, Time domain analysis using numerical integration scheme, Free and forced vibration of continuous systems, Introduction to the dynamics of soil structure interaction problems.

CEL511 Advanced Design of Foundations

CEL512 Principles of Bridge Engineering

Introduction- Definition, components of bridge, classification of bridges, selection of site, economical span, aesthetics consideration, necessary investigations and essential design data; Standard specifications for roads and railways bridges: Indian Road Congress Bridge Code for specifications and loads; Various types of R.C.C. bridges (brief description of each type), Design Consideration for R.C.C. Bridges and culverts; Design of Tee beam bridge, Various types of steel bridges (brief description of each), Design Consideration for Steel Bridges design of plate girder bridges. Hydraulic & Structural Design of piers, abutments, wing wall and approaches: Brief descriptions of bearings, joints, articulation and other details. Bridge foundation-Various types, necessary investigations and design criteria of well foundation.

CEL518 Earthquake Resistant Design of Structures

Characteristics of earthquake, measurement of earthquake, dynamics of single degree of freedom system, earthquake response to single degree of freedom system, response spectrum, earthquake resistant desing concepts, response reduction factor, stiffness and building configuration, lateral loads, IS 1893 provisions for buildings, active and passive vibration control, dampers.

CEL 601 Theory of Elasticity and Plasticity


CEL602 Matrix Methods of Structural Analysis


CEL603 Prefabricated Structures

Types of prefabrication, prefabrication systems and structural schemes- Disuniting of structures- Structural behaviour of precast structures. Handling and erection stresses - Application of prestressing of roof members; floor systems two way load bearing slabs, Wall
panels, hipped plate and shell structures. Dimensioning and detailing of joints for different structural connections; construction and expansion joints. Production, Transportation & erection- Shuttering and mould design Dimensional tolerances- Erection of R.C. Structures, Total prefabricated buildings. Designing and detailing prefabricated units for 1) industrial structures 2) Multistorey buildings and 3) Water tanks, silos bunkers etc.,4) Application of prestressed concrete in prefabrication

**CEL604 Theory of Plates and Shells**

Bending theory of flat plates: thin plates, Kirchoff theory - strain displacement relations, stresses and stress resultants, constitutive equations, equilibrium equations, boundary conditions, derivation of theory from principle of virtual work, rectangular plates-solution by double Fourier series, circular plates Classical theory of shells – Membrane theory of shells: equilibrium equations, applications to shells of revolution under axisymmetric loads, applications to cylindrical shells under asymmetric loads, strain-displacement relations , application in calculation of displacements; Bending theory of shells: kinematic assumptions and strain-displacement relations, stress measures and equilibrium

**CEL605 Design of Tall Structures**

Design philosophy – Loading - Sequential loading, materials. High risk behaviour, Rigid frames, braced frames, infilled frames, shear walls, coupled shear walls, wall – frames, tubulars, cores, futrigger - braced and hybrid mega system. Approximate Analysis, Accurate Analysis and Reduction Techniques - Analysis of building for member forces - drift and twist - Computerised general three-dimensional analysis. Structural elements- design, deflection, cracking, prestressing, shear flow, Design for differential movements, creep and shrinkage effects, temperature effects and fire. Overall buckling analysis of frames, wall – frames–second order effects of gravity of loading– simultaneous first order and P-delta analysis Translational - torsional instability, out of plum effects

**CEL617 Advanced Design of RCC Structures**

Determination of deflection and crack width of RCC beams and slabs, moment redistribution in RCC beams, moment curvature relationship for RCC sections, design and analysis of deep beams and voided slabs as per IS 456, design of plane concrete walls and shear walls, analysis of frames under horizontal and vertical loads, drift analysis for tall buildings, introduction to design loads other than the earthquake loads such as wind loads and cyclone loads.

**CEL618 Repair and Rehabilitation of Structures**

CEL619 Structural Health Monitoring-NDT

Introduction to structural health monitoring (SHM), necessity of SHM, components of SHM, challenges in SHM, advantages and components of SHM, SHM issues applied to concrete structures, uncertainties in SHM process, short term and long term SHM, local and global health monitoring, estimation of structural health using static SHM, SHM planning and management, SHM methods, damage identification using lumped mass and element modal stiffness, visual inspection method, NDT evaluation, sensor technologies, fiber optic sensors, acquisition system and networking for SHM, Artificial Neural Network (ANN) in the SHM process, damage detection, application of SHM in Infrastructure engineering.

CEC501 Seminar

Independent study on any recent research area in the domain of Civil Engineering as per the specialization chosen by the student. Research papers on specialized topics will be collected from journals and presented. A report shall be submitted showing the literature reviewed by the student.

CED502 Minor project

The minor project will be a design project (hardware/software) on a topic suggested by the course coordinator to be completed during the designated duration. It may be of practical and theoretical interest. It has to be done under the guidance of a faculty and students are expected to complete literature survey, feasibility testing, develop or implement the research work.

CED 601 Dissertation Phase - I

Part-I of the dissertation will cover the problem identification followed by literature review, data collections and data generations and identification of the tool of analysis, simulation and modeling and hypothesis for the problem solving, some basic trail studies.

CED 602 Dissertation Phase – II

Part-II of the dissertation will cover the actual detailed experimentation, simulation, modeling, result generation and reaching to the desired goal set in Part-I. Report writing and publication.
CEL501 Safety and Reliability Analysis
Fundamentals of set theory and probability, probability distribution, regression analysis, hypothesis testing. Stochastic process and its moments and distributions, Concepts of safety factors, Safety, reliability and risk analysis, first order and second order reliability methods, simulation-based methods, confidence limits and bayesian revision of reliability, reliability based design, examples of reliability analysis of structures.

CEL502 Optimization Techniques in Civil Engineering

MAL 616 Research Methodology

CEL503 Advanced Concrete Technology

CEL504 Shoring, Scaffolding and Formwork
Planning of construction work, site equipment required, Calculation of labour constants - Formwork hours - Labour Requirement - Overall programme - Detailed programme – Costing. Materials accessories proprietary products – finish materials, scaffolding material, design of forms – analysis of forces, building and erection of formwork, formwork for domes, tunnels etc.

CEL513 Construction and Contract Management
and Conciliation Act 1996, Arbitration case studies, Professional ethics, Duties and responsibilities of parties. Management Information systems

**CEL514 Infrastructure Development and Management**

**CEL515 Resource Management and Control in Construction**

**CEL516 Construction Economics & Finance**

**CEL517 Strategic Technology Management**

**CEL527 Quality and Safety in Construction**
manuals. Safety legislation, standards/codes with regard to construction. Quality vs Safety. Case Studies

**CEL528 Functional Planning, Building Services & Maintenance Management**
Domestic Water Supply- House connection, water services to multistory buildings, Pipe materials, Jointing, Valves and taps; Building Drainage and Refuse Handling- Building drainage systems, drainage pipe materials, Jointing and testing, types of fixtures and fittings; Collection of refuse from buildings, refuse bins and sacks; Air Conditioning, Heating & Ventilation- Mechanical Ventilation, Air-Conditioning units & their working principles, Different types of heating materials; Lifts- Classification & Types of lifts, lift codes and rules, traffic analysis and selection of lifts, car speed, fire safety, arrangement of lifts; Acoustics-noise reduction, classification & selection of acoustical materials, acoustics of auditorium, schools etc.; Functional Planning & Maintenance Management- Planning of Services, Maintenance of lifts, water supply system, sewerage system

**CEL529 Construction Planning and Management**
Introduction- importance of construction management, tenders and contracts- network techniques -quality and safety in construction; General overview of civil engineering projects, Procurement and contract management, Estimation and rate analysis, Project planning and its implementation, Construction Technology, Use of IT in construction, Software Application

**CEL606 Flexible Systems Management**

**CEL607 Project Planning and Control**
Work study, work break down structure, time estimates, application of CPM/PERT, statitical concepts, Man-Material-Machinery-Money optimization, scheduling, monitoring, updating. Cost function, time-cost trade off, resource planning-levelling and allocation. Resources – based network, crashing, master network, interface activities, and dependencies, line of balancing techniques, application of digital computer. Material management- purchase management and inventory control, ABC analysis. Human resource management

**CEL608 Advanced Methods for management research**
Problem conceptualization and definition. Hypothesis formulation. Selection of Research Methods, Flexible Systems Methodology for preparing research design, Scaling, sampling methods, Managing oral evidence, Questionnaire design, validation and pretesting. Interview design, Case study, Field experiments, Quasi experiments. Qualitative research methods. Statistical techniques and implementation of research plan using statistical packages.
**CEL609 Organization Management**
Manpower planning, organizing, staffing, directing. Organization -span of control, organization chart, development and operation of human resource, managerial staffing, recruitment, selection, placement, training. Human behavior – basic individual psychology, managing groups at work, leadership, behavioural aspects of decision making and communication for people management. Welfare measures – compensation, safety and health, GPF, EPF, group insurance. Management and development methods

**CEL617 Contract Laws and Regulations**

**CEC501 Seminar**
Independent study on any recent research area in the domain of Civil Engineering as per the specialization chosen by the student. Research papers on specialized topics will be collected from journals and presented. A report shall be submitted showing the literature reviewed by the student.

**CED502 Minor project**
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**CED 601 Dissertation Phase - I**
Part-I of the dissertation will cover the problem identification followed by literature review, data collections and data generations and identification of the tool of analysis, simulation and modeling and hypothesis for the problem solving, some basic trail studies.

**CED 602 Dissertation Phase – II**
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ENVIRONMENTAL ENGINEERING

CEL501 Safety and Reliability Analysis
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CEL502 Optimization Techniques in Civil Engineering

MAL616 Research Methodology

CEL519 Environmental Impact & Risk Assessment

CEL520 Environmental Chemistry
Aquatic Chemistry: Chemical equilibria and kinetics fundamentals; Acids and bases; Titrations; Acidity; Alkalinity; Buffers and buffer intensity; Chemical equilibrium calculations; pC-pH diagram. Precipitation and dissolution; Water softening and water conditioning; Langelier index; Solubility diagram; Coexistence of phases in equilibrium; Complexation of metal ions and organic complexes in natural water. Oxidation and reduction reactions stoichiometry; Redox couples; pE-pH diagrams; Redox control in natural systems; Basic concepts of organic and colloid chemistry. Soil Chemistry : Weathering reactions; Structure and surface reactions of clays and oxides; Forces at soil-water interfaces. Atmospheric Chemistry : Chemical equilibria and kinetics; Photo-dissociation and free radical reactions; Chemistry of precipitation; Acid rain

CEL521 Water Supply Engineering
Review of public water supply requirements. Sources of water-Surface and subsurface water sources Quality of water-I: physico-chemical parameters of water Quality of water-II: Water microbiology and biology Quality of water-III: water quality standards for chemical, physical
and microbiological parameters, processes of treatment, Flow measurement devices - Venturi, Orifice meters, weirs, flumes and gates. Pipeline distribution system analysis and design.

CEL522 Industrial Waste Management

CEL523 Geo-Environmental Engineering
Sources and effects of subsurface contamination; Physical, chemical and biological characteristics of solid wastes; Soil waste interaction; Contaminant transport; Laboratory and field evaluation of permeability; Factors affecting permeability; Waste disposal on land case study; Landfills and impoundments types; Silting criteria; Waste containment principles; Types of barrier materials; Planning and design aspects relating to waste disposal in landfills; Soil exploration at contaminated site; Vertical cutoff walls; Cover system; Recovery well system; Bioremediation of soil ; In situ Bioremediation of ground water; Soil washing; Monitoring around landfills; Detection, control and remediation of subsurface contamination; Reclamation of old waste dumps; Regulations; Case studies; Engineering properties and geotechnical reuse of waste materials.

CEL524 Global Climate Change Adaptation and Mitigation
Introduction to global climate; Global climatic models; Methods of reconstructing climate; Quaternary climates, sea level changes, glacial/interglacial cycles; Geological records of climate change, sedimentology, stable isotopes, geochemistry; Geochronology – relative and numerical methods; Vegetation dynamics, migration history, response of vegetation to climatic reversals

CEL525 Waste Water Engineering

CEL526 Environmental Policy and Legislation
Introduction: Economics and Environmental Policy Theory of externalities: Relevance. Externalities: definitions, significant types, and optimal pricing conditions, formal analysis Uncertainty and choice of policy instruments: price or quantity controls. Market imperfections and the number of participants. Detrimental externalities, and nonconvexities in the production set, optimal pricing of exhaustible resources Introduction to design of Environmental policy. Efficiency without optimality: the charges and standard approaches Marketable emission permits for the protection of the environment. Stochastic influences, direct controls, and taxes.
Taxes vs subsidies: a partial analysis. Environment protection and the distribution of income
International environmental issues, National and local standards for environmental quality

**CEL610 Advanced Wastewater Treatment**
Microbiological concepts; cells, classification and characteristics of living organisms, characterization techniques, reproduction, metabolism, microbial growth kinetics and kinetics of biochemical operations; Modeling of suspended growth systems, techniques for evaluation of kinetic and stoichiometric parameters. Optimal selection of water and waste water treatment chain, engineered systems, concepts and principles of carbon oxidation, nitrification, denitrification, methanogenasis. Biological nutrient removal; Anaerobic treatment (process options, components of anaerobic reactions that influence process design); Attached growth reactors (process description, design and applications). Decentralized wastewater treatment systems; Low cost options, constructed wetlands. Reliability and cost effectiveness of wastewater systems.

**CEL611 Air Pollution and Control**
Sources & Classification of Air Pollutants, Global effects, Sampling of Pollutants in ambient air, Meteorology and Air Pollution, Control of Particulate Pollutants, Design and operation of settling chambers, cyclones, wet dust scrubbers, fabric filters & ESP, Control of Gaseous Pollutants, Automobile Pollution and Control, Other Management controls, AP Legislation.

**CEL612 Solid and Hazardous Waste Management**

**CEL613 Environmental Hydraulics and Hydrology**

**CEL614 Environmental Modeling and Simulation**
Sources and effects of water pollutants, introduction to principles of water quality modeling, distribution of water quality in rivers, estuaries and lakes, contaminant transport in groundwater, water quality modeling applications and discussion of case studies. Sources and effects of air pollutants, air quality standards, and emission inventory, meteorological aspects related to air pollution, air quality modeling and its application, trans-boundary air pollution.
CEL615 Environmental Remediation of Contaminated Sites

The course details the usual remediation techniques practiced worldwide and provide an understanding of the relevant theoretical concepts. Hazardous waste law and risk assessment approaches-deterministic and stochastic, remediation of contaminated ground water by different techniques with relevant case studies – plume contaminants, Javendel et al approach, pump and treat, permeable reactive barrier. Natural attenuation mechanism with case studies, factors affecting the process, soil/ sediment contamination and remediation techniques – solidification and stabilization, TCLP approach, chemical treatment methods– insitu and ex-situ, phytoremediation techniques.

CEL616 Environment & Ecology


CEC501 Seminar

Independent study on any recent research area in the domain of Civil Engineering as per the specialization chosen by the student. Research papers on specialized topics will be collected from journals and presented. A report shall be submitted showing the literature reviewed by the student.

CED502 Minor project

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CED601 Dissertation Phase - I

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CED602 Dissertation Phase – II

Part-II of the dissertation will cover the actual detailed experimentation, simulation, modeling, result generation and reaching to the desired goal set in Part-I. Report writing and publication.