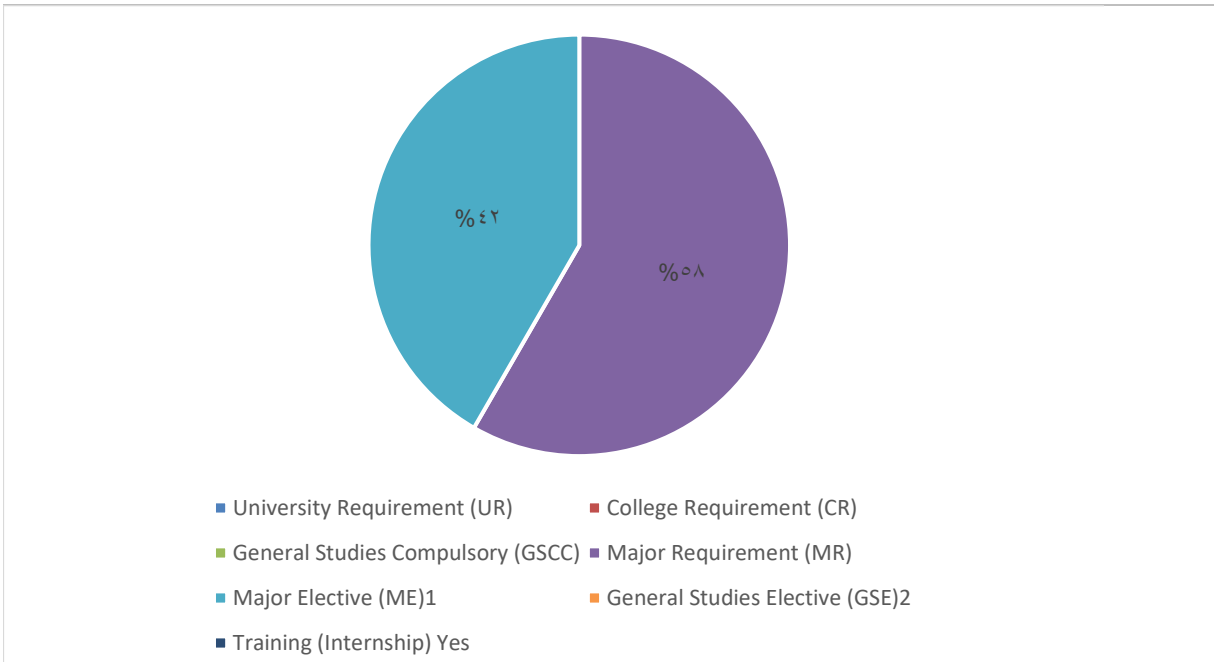
Master of Science in Civil Engineering

Program Components



University Requirement (UR)	**--**
College Requirement (CR)	**--**
General Studies Compulsory (GSCC)	**--**
Major Requirement (MR)	**21**
Major Elective (ME)[1]	**15**
General Studies Elective (GSE)[2]	**--**
Training (Internship) **Yes**	**--**
Total Credit (CRD)	**36**

[1] Student must select five (3XX & 4XX) courses from Major Elective(ME) List. Additional to this, two courses must be selected from ME list as Job Placement Courses. This needs consultation and approval of the department.

[2] Student must select three General Studies Electives, one of them must be from Humanities and Social Science.
Note:

- Free Elective Courses any UOB course excluding:(1) courses offered for special students, (2) courses covered in the B.Sc. curriculum, (3) courses equivalent or lower than those already taken in the curriculum and should not be a science course prepared by College of Science for other colleges.

- HU/SS Courses - Humanities and Social Science Component: Any course from the following:
  Humanities: Fine Arts, History, American Studies, Classics, Communications, English, (Foreign Language) French, Music, Philosophy, Theatre, Literature (Arabic), Religion (comparative).
  Social Science: Anthropology, Economics, Education, Geography, History, Psychology, Sociology, Women's Studies, Political Science.

Detailed Study Plan

Year 1 - Semester 1

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CENG601	Research Methodology	3	0	3	MR	--	Yes
CENG602	Advanced Numerical Analysis	3	0	3	MR	--	Yes
CENG603	Artificial Intelligence Applications in Civil Engineering	3	0	3	MR	--	Yes

Year 1 - Semester 2

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CENGXXX	Elective Course from Field of Specialization	3	0	3	ME	--	Yes
CENGXXX	Elective Course from Field of Specialization	3	0	3	ME	--	Yes
CENGXXX	Elective Course from Field of Specialization	3	0	3	ME	--	Yes

Year 2 - Semester 3

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CENGXXX	Elective Course from Field of Specialization	3	0	3	ME	--	Yes
CENGXXX	Elective Course from Field of Specialization	3	0	3	ME	--	Yes

Year 2 - Semester 4

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CENG699	Masters Thesis	0	36	12	MR	Completion of 21 credit hours	No

Major Elective Courses

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
Structural Engineering Track							
CENG611	Advanced Mechanics of Materials	3	0	3	ME	--	Yes
CENG612	Plates and Shells	3	0	3	ME	--	Yes
CENG613	Matrix Structural Analysis	3	0	3	ME	--	Yes
CENG614	Finite Element Methods	3	0	3	ME	--	Yes
CENG615	Structural Stability	3	0	3	ME	--	Yes
CENG616	Structural Dynamics	3	0	3	ME	--	Yes
CENG617	Advanced Steel Design	3	0	3	ME	--	Yes
CENG618	Pre-Stressed Concrete	3	0	3	ME	--	Yes
CENG619	Shallow and Deep Foundations	3	0	3	ME	--	Yes
CENG620	Bridge Engineering	3	0	3	ME	--	Yes
CENG621	Advanced Reinforced Concrete Design	3	0	3	ME	--	Yes
Water Resources and Environmental Engineering							
CENG631	Advanced Hydrogeology	3	0	3	ME	--	Yes
CENG632	Desalination and Advanced Wastewater Treatment	3	0	3	ME	--	Yes
CENG633	Rainfall-Runoff Modeling	3	0	3	ME	--	Yes
CENG634	Sludge and Solid Waste Management	3	0	3	ME	--	Yes
CENG635	Sustainable Water Resources Management	3	0	3	ME	--	Yes
CENG636	Environmental Fluid Mechanics	3	0	3	ME	--	Yes
CENG637	Groundwater Contamination and Pollutant Transport	3	0	3	ME	--	Yes
CENG638	Stochastic Water Resources Management	3	0	3	ME	--	Yes
CENG639	Irrigation Engineering for Arid Climates	3	0	3	ME	--	Yes
CENG640	Advanced Environmental Engineering	3	0	3	ME	--	Yes
Transportation Engineering Track							

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CENG620	Bridge Engineering	3	0	3	ME	--	Yes
CENG651	Pavement Design	3	0	3	ME	--	Yes
CENG652	Advanced Traffic Engineering	3	0	3	ME	--	Yes
CENG653	Transportation Planning and Modeling	3	0	3	ME	--	Yes
CENG654	Road Safety Analysis	3	0	3	ME	--	Yes
CENG655	Public Mass Transportation Systems	3	0	3	ME	--	Yes
CENG656	Road Traffic Management	3	0	3	ME	--	Yes

Course Description

Course Code: CENG 611 **Course Title:** Advanced Mechanics of Materials
Theory of stress and strain; elastic, plastic, elastic-plastic and viscous-elastic material behavior and failure; energy methods; unsymmetrical bending, nonlinear and elastic-plastic bending; beams on elastic foundation; shear and torsion of thin-walled cross section; curved beams.

Course Code: CENG601 **Course Title:** Research Methodology
Research process, research problems, research design, Variables, Measurement, and Scaling Technique, collection of data, sampling design. Processing and Analysis of Data, Formulation and Testing of Hypothesis, Analysis of Variance and Experimental Designs, Analysis Related to Breeding Researches, Multivariate Analysis, Instrumentation and Computation, Research Proposal and Report Writing.

Course Code: CENG602 **Course Title:** Advanced Numerical Analysis
Ordinary differential equations, Numerical solution of initial value problems, Runga-Kutta methods and multi-step methods, Numerical solution of boundary value problems, shooting method, finite difference method, Nonlinear boundary value problems, Partial differential equations, modern numerical techniques for linear and nonlinear elliptic, parabolic and hyperbolic partial differential equations, Finite Difference and Finite Volume Discretization; Finite Element Discretization; Boundary Element discretization; Direct and Iterative Solution Methods.

Course Code: CENG603 **Course Title:** Artificial Intelligence Applications in Civil Engineering
Genetic algorithm and its applications in problem solving and optimization; neural network and its application in functional mapping, fuzzy logic and its application in decision making, clustering and linear programming, Application of AI and ML Techniques in Building Information Modeling (BIM), detection and assessment of structure damage, structural health monitoring, Groundwater and its quality, flood forecasting, remote sensing, Construction and Risk Management, and Traffic and transportation Management.

Course Code: CENG612 **Course Title:** Plates and Shells
Elements of plate bending theory, circular plates, rectangular plates, plates of various geometrical forms, numerical methods, anisotropic plates, plates under combined lateral and in-plane loads, large deflection of plates, thermal stresses in plates, membrane and bending stresses in shells, application to pipes, tanks and pressure vessels, cylindrical shells under general loads. Crushing and bending strength of cylindrical shells.

Course Code: CENG613 **Course Title:** Matrix Structural Analysis
Definitions and concepts, formation of global analysis equations, stiffness analysis of frames; element stiffness matrix, coordinate transformation, loads between nodal points, initial and thermal strain conditions. Virtual work principles in framework analysis, nonlinear analysis of frames, geometric nonlinear and elastic critical load analysis, material nonlinear analysis, solution of nonlinear equilibrium equations, special analysis procedures.

Course Code: CENG614 **Course Title:** Finite Element Methods
Stiffness method, finite element forms using energy methods, element formulation using assumed displacement fields, isoperimetric formulation, formulation of plane, three dimensional, and plate and shell elements. Use of commercially available programs.

Course Code: CENG615 **Course Title:** Structural Stability
Buckling of columns, linear elastic theory, initial imperfection, large deformation theory, Analytical and numerical methods for the treatment of elastic instability. Approximate methods; buckling problems in beams, columns, and frames; Beam-column buckling. Lateral and torsional instability; energy and numerical methods.

Course Code: CENG616 **Course Title:** Structural Dynamics
Dynamic response of structures modeled as single degree of freedom systems, lumped systems, and multi-degree of freedom systems. Numerical evaluation of system responses due to general loading; blasts, wind, and earthquake loading. Earthquake analysis by response history and response spectrum and structural dynamics in building codes.

Course Code: CENG617 **Course Title:** Advanced Steel Design
Plastic Design of steel frames. Limit state design. Design of single-story industrial buildings; structural framing, three-dimensional stability, gable frames. Flexural torsional stability of hotrolled steel sections. Design of multi-story steel frames. Design of beam column connections. Torsional analysis of thin-walled sections; warping, bi-moment,

Course Code: CENG618 **Course Title:** Pre-Stressed Concrete
Pre-stressed materials, methods, and systems. Behavior and design of members subjected to axial forces, flexure, shear, and torsion; effect of prestressed losses; partial prestressing, load balancing and composite design; anchorage0zobne design; applications to continuous beams, slabs and bridge design. Deflection.

Course Code: CENG631 **Course Title:** Advanced Hydrogeology
This master's course covers groundwater systems, focusing on aquifer characterization, flow modeling, and contaminant transport. Students will integrate field data with computational methods and engage in hands-on projects using modern tools.

Course Code: CENG632 **Course Title:** Desalination and Advanced Wastewater Treatment
This master's course covers groundwater systems, focusing on aquifer characterization, flow modeling, and contaminant transport. Students will integrate field data with computational methods and engage in hands-on projects using modern tools.

Course Code: CENG633 **Course Title:** Rainfall-Runoff Modeling
This course provides in-depth exploration of the principles and methodologies involved in hydrological modeling. Students will study the processes of rainfall interception, infiltration, and runoff generation, applying various modeling techniques and tools to analyze and predict water flow in different landscapes. The course emphasizes the integration of theoretical concepts with practical applications, including the use of software for simulation and data analysis. Through hands-on projects and case studies, students will gain experience in evaluating the impacts of land use changes, climate variability, and extreme weather events on hydrological systems.

Course Code: CENG634 **Course Title:** Sludge and Solid Waste Management
This course focuses on the management of sludge and solid waste generated from various industrial, municipal, and agricultural processes. Emphasis will be placed on the regulatory framework, treatment technologies, disposal methods, and the environmental impact of waste management practices. Students will engage in case studies and practical applications relevant to sustainable waste management.

Course Code: CENG635 **Course Title:** Sustainable Water Resources Management
This course explores sustainable water management through Integrated Water Resources Management (IWRM). Students will examine historical contexts, policies, and global practices, emphasizing stakeholder engagement, ecological sustainability, and equitable distribution. Case studies and practical applications will help develop strategies to manage water amid climate change and population growth. By course end, students will gain analytical tools and collaborative skills to address complex water challenges sustainably and innovatively.

Course Code: CENG636 **Course Title:** Environmental Fluid Mechanics
This course introduces the fundamental principles of fluid mechanics and hydraulics, with a focus on their applications in environmental engineering and hydrology. Topics include fluid properties, hydrostatics, fluid dynamics, open channel flow, pipe flow, flow through porous media, and sediment transport in rivers. The course emphasizes the integration of theoretical concepts with practical applications relevant to river and environmental engineering.

Course Code: CENG619 **Course Title:** Shallow and Deep Foundations
Layered and anisotropic soils, foundations with uplift and tension forces. Foundation on sand deposit, design of mat foundations. Tension piles, laterally loaded piles, pile buckling, wave equation, pile driving stresses.

Course Code: CENG620 **Course Title:** Bridge Engineering
Overview and History of Bridges. Planning of Bridges; traffic studies, hydrotechnical studies, environmental considerations, economic feasibility of a bridge. Factors considered in deciding bridge type, Aesthetics in bridge design, AASHTO Bridge design code. Loadings; gravity, lateral, collision loads, forces due to deformations Geometric design considerations. Selection of suitable bridge type, introduction to bridge design methods. Concrete deck design, Solid slab bridge design, T-beam bridge design, Prestressed concrete girder bridge, concrete box girder bridge, various types of bridge foundation, spread footings, piles, caissons, abutments, design requirements, Types of joints in bridges, types of bearings used in bridges, Bridge inspections and maintenance.

Course Code: CENG651 **Course Title:** Pavement Design
Development of highway construction in Bahrain, pavement types, principles in the conventional and structural design and consideration of highway and airport pavements. Traffic assortment and consideration. Climatic influences on pavements. Economic, design strategies. Materials characterization. Design of asphaltic mixtures. Evaluation and maintenance of pavements.

Course Code: CENG652 **Course Title:** Advanced Traffic Engineering
Review of road users, Traffic control devices, applications of control measures, advanced traffic analysis and prediction, traffic flow theory, traffic signal control, capacity and level of service at signalized intersection, highway capacity for freeways, roundabout capacity models, urban and rural areas, special topic in highway safety.

Course Code: CENG653 **Course Title:** Transportation Planning and Modeling
Review of mathematical prerequisites, system analysis and principles of modeling in transportation, data, space and travel demand, urban transportation planning process, inventory, trip generation, trip distribution, model split, network assignment, transportation evaluation, and equilibrium supply-demand system.

Course Code: CENG654 **Course Title:** Public Mass Transportation Systems
Service characteristics of the principal modes of public mass transportation with emphasis on urban transit (fixed-route bus, light rail, subways, commuter rail, par transit, taxi); legislation and regulations; institutional structures; financing; need and demand studies; planning strategies; management; operations and record keeping; case studies of leading systems.

Course Code: CENG655 **Course Title:** Road Safety Analysis
Safety design and operational practices for streets and highways including safety improvement programs, design of barrier systems, bicycle and pedestrian consideration; access control; safety evaluation; and measures of effectiveness.

Course Code: CENG656 **Course Title:** Road Traffic Management
Objectives of traffic management, Integrated urban traffic management, Bus priority, including bus rapid transit (BRT), Road pricing systems, Pedestrian and shared space measures, Cycling facilities, Rural traffic management, Intelligent Transport Systems, Speed management, Parking management, Motorway management, Variable message signs.

Course Code: CENG640 **Course Title:** Advanced Environmental Engineering
This course delves into advanced topics in environmental engineering, focusing on the design, analysis, and implementation of sustainable technologies for air and water quality management, waste treatment, and remediation strategies. Emphasis will be placed on innovative engineering solutions and policy frameworks supporting environmental sustainability.

Course Code: CENG637 **Course Title:** Groundwater Contamination and Pollutant Transport
This course provides an in-depth analysis of groundwater contamination processes and the mechanisms of pollutant transport within aquifers. Emphasis will be placed on the sources of contaminants, hydrogeologic characteristics influencing transport, remediation strategies, and regulatory frameworks. Through lectures, case studies, and practical applications, students will develop a comprehensive understanding of groundwater protection and management.

Course Code: CENG638 **Course Title:** Stochastic Water Resources Management
This course provides an in-depth exploration of stochastic modeling techniques applied to water resources management. Students will learn to incorporate uncertainty in hydrological processes and resource allocation through statistical methods and simulation models. Students will also learn foundational rainfall modeling techniques.

Course Code: CENG639 **Course Title:** Irrigation Engineering for arid climates
This course explores irrigation engineering principles for arid and semi-arid environments, focusing on designing and managing efficient irrigation systems to optimize water use. Key topics include water resource assessment, soil-water-plant relationships, irrigation methods, water quality, and scheduling. It also covers advanced water conservation techniques, system automation, and the use of remote sensing and GIS. Students will learn to design sustainable irrigation systems that enhance agricultural productivity while reducing environmental impact, with case studies relevant to the Gulf region and other arid areas.

Course Code: CENG621 **Course Title:** Advanced Reinforced Concrete Design
Review of reinforced concrete behavior, material properties for reinforced concrete; stress-strain relationship for confined and unconfined concrete, stiffness of reinforced concrete; moment-curvature relationship in reinforced concrete, computation of the M-Φ relationship, M-Φ relationship for columns, influence of various parameters, minimum reinforcement for flexure, nonlinear behavior of reinforced concrete; ductility, hysteretic behavior, energy absorption and dissipation, inelastic moment redistribution, inelastic analysis of concrete structures, pushover analysis, shear walls, beam-column connections; monolithic joints, behavior in inelastic range, shear effects, shear and torsion of reinforced concrete members, strut and tie approach.

Course Code: CENG699 **Course Title:** Thesis
The Master's Thesis represents the culmination of the research project, carried out by the student as a part of his graduation requirements. The research project and research findings must have some elements of originality either in substance or in approach. The research topic can be either applied or basic in nature.

University Requirements Courses Descriptions

N/A

College Requirement Courses Descriptions

N/A