



Master of Architectural Engineering – Course Descriptions

Compulsory Courses

Code	Course Title	Prerequisite	CR.H
ARE 601	Advanced Research Methodology	-	3 credits Hours

Course Description:

This course provides students with a comprehensive practical experience of the research process, encompassing advanced research strategies, methods, and techniques. The course delves into the challenges and intricacies of data collection methods, correlation, analysis, and interpretation. Students gain hands-on experience in designing a research plan, including identifying research problems, proposing research objectives, developing research questions, and creating and testing research hypotheses. Additionally, the course cultivates students' skills in developing surveys, testing survey questions, and validating collected survey data. The practical component of the course immerses students in conducting comprehensive research to address a specified design problem and develop a publishable paper. Students undertake the process of gathering necessary information, theories, data, and case studies, while also interpreting alternative solutions that reflect social, economic, environmental contexts, user profiles and needs, standards, regulations, codes, and materials and construction. To gather primary and secondary data, students employ a variety of research approaches, including literature reviews, interviews, questionnaires, and observations. Quantitative and qualitative analysis methods are employed in the discussion and analysis section, with descriptive research methods serving as the primary tool for interpreting research results.

Code	Course Title	Prerequisite	CR.H
ARE 602	Spatial and Urban Planning	-	3 credits Hours

Course Description:

This course provides advanced knowledge and experience of history of spatial and urban planning, its evolution and territorial and urban problems generated from the industrial revolution. The students study urban paradigms including the urban phenomenon of the twentieth century, urban expansion and suburbanization versus compactness, crisis and decadence of urban centres, the monocentric city and polycentric models, the evolution of the current city "post-Fordism", the economy and the city of knowledge, The environmental, economic and social sustainability of urban structures, Immigration and social segregation, closed neighbourhoods, metropolitanization, megalopolis, intermediate cities, among others. The course also introduces the regional strategy of urban development, Bahrain Urban law and regulation, Bahrain urban pattern and systems, and Bahrain future urban plan.

Code	Course Title	Prerequisite	CR.H
ARE 603	Artificial intelligence For Built Environment	-	3 credits Hours

Course Description:



This course delves into the three pillars of smart cities: Smart People, Smart Living, and Smart Governance. It provides an introduction to the application of artificial intelligence (AI) in various aspects of urban life, including energy, mobility, public safety, water and waste management, project management, healthcare, urban planning, and city governance. Students will explore AI applications in cities and buildings, examining how AI can be used to generate design, planning, and decision-making. The course also covers AI in interior design, including the use of sensors and devices to control lighting, water, air conditioning, heating, and doors.

Code	Course Title	Prerequisite	CR.H
ARE 604	Sustainable Built environment	-	3 credits Hours

Course Description:

The course introduces advanced knowledge of ecological foundations of environmental science, Urban Ecology Evolution of environmental awareness, the concept of sustainability, Matter cycles, energy flows, diversity and information, and Information and entropy. The students study the city and the territory as ecosystems, ecological cycles (the cycle of water, carbon, ...) and the effect that human action has on them, especially urban development, the metabolism of the city and the ecological footprint, renewable and non-renewable natural resources, and Soil as a non-renewable resource. Moreover, understanding the ecological matrix of the territory: territorial systems of free spaces, the conservation of biological diversity and ecological connectivity. The rural space. Planning and sustainable management of the landscape. Approach of ecological urbanism is discussed in this course including the origin and evolution of sustainability in the territory and the city, the principles of Ecological Urbanism, Ecocity, Smart Growth, New Urbanism, and the certifications for sustainable development such as Leadership in Energy & Environmental Design (LEED for ND) and BREEAM Communities. Students review and analysis the sustainability indicators in terms of main international references, resilience of cities in the face of climate change, Strategies, and sustainable territorial models: land consumption; compactness, containment, and urban renewal; diversity and mixture; social cohesion; sustainable mobility; energy autonomy, waste management. Students practice on the analysis of emissions generation, land consumption and case studies from the evaluation of neighbourhoods with the help of LEED guidelines for ND or BREEAM Communities.

Code	Course Title	Prerequisite	CR.H
ARE 670	Thesis	24 Cr. H.	9 credits Hours

Course Description:

This is an independent research study which addresses a question or topic relevant to one of the following tracks in Architectural Parametric Design, Sustainable Urban Design, Urban Planning and smart Cities, Real-estate Development & Management, Green buildings, or Construction Management. There are two parts to this course. Students must submit a research proposal related to the chosen track with the following information: research problem, research questions, objectives, methodology, reference list, and a detailed budget if a grant is required. Second, the student will conduct the



research, collect data, analyse the data and submit the final dissertation. The dissertation will include the following sections: an abstract, an introduction, an analysis, a discussion, a result, and a conclusion. It is mandatory that the thesis be written in accordance with the policies of teaching, learning, and assessment, as well as the policy against plagiarism. The thesis will be assessed based on a report and through a viva presentation, which will be reviewed by a committee consisting of an internal examiner, an external examiner, and the supervisor.

Elective Courses

Code	Course Title	Prerequisite	CR.H
ARE 611	Digital Fabrication	12 Cr.H.	3 credits Hours

Course Description:

This course focuses on geometry rationalization, in which the students build advanced knowledge of architecture and industrial materials are planar in addition to studying different rationalization techniques for reparameterization the surfaces and double curvature into planar pieces. The course focuses on subtractive 3D manufacturing where instead of designing an object to be milled, students are encouraged to design the milling process that will define the object. In the first part of this course, students study the 2D machining including Planar subtractive operations with 2d cutting tools; Remeshing strategies; Implementation of processing techniques on complex surfaces; Metrics extraction, evaluation, and statistical analysis; and Constructability and detailing. In the second part of this course, the students study 3D Machining including Superficial and volumetric subtractive operations with a Computer Numerical Control (CNC) milling machine; General CNC and hardware instruction; Toolpath coding; and Analysis, experimentation and research based on a milling project with small and large machines. Application on CNC machine in the workshop is a part of practicing the digital fabrication subject.

Code	Course Title	Prerequisite	CR.H
ARE 612	Parametric Geometry	12 Cr.H.	3 credits Hours

Course Description:

This course introduces the main concepts of architectural geometry or constructive geometry which concerns with a specific branch of geometry that address the needs of architecture in terms of theoretical and numerical tools. The course focus on architectural geometry on curved objects. The goal is to give students a working knowledge of common geometrical analysis and design techniques, and a solid geometrical base in order to tackle new geometrical problems. Students study two main subjects, the first is analytical geometry including analysis of curves, Generation of curves, Description and analysis of surfaces, Generation of surfaces, Description and analysis of meshes, Generation of meshes, Elementary geometrical algorithms, Transformation that conserve particular properties. While the second subject is Synthetic geometry including Coordinate Systems, Data structures and points, Lines, curves, vectors, Surfaces, solids, planes, Meshes. Mesh operations. Mesh tools. Dynamic meshes.



Code	Course Title	Prerequisite	CR.H
ARE 621	Conservation and Urbanism	12 Cr.H.	3 credits Hours

Course Description:

This course introduces advanced knowledge in urban conservation principles. Students gain experience with conservation strategies and methods, including reuse, rehabilitation, transformation, adaptive reuse, and maintenance of urban elements. To achieve the course objective, students study elements of urban design, urban structure, urban density and mix, urban height and massing, urban streetscape and landscape, urban façade and interface, space details and materials, public realm, topography and landscape development, social and economic fabric, scale of urban space, urban forms, and shapes. Additionally, students apply SWOT analysis to urban space to identify opportunities for implementing conservation strategies. Accordingly, students apply a conservation strategy to develop sustainable urban space.

Code	Course Title	Prerequisite	CR.H
ARE 622	Eco-Systemic of networks & Urbanism	12 Cr.H.	3 credits Hours

Course Description:

This course introduces two subjects, the first subject is a focused view of the relationship between two concepts (urban infrastructure and planning) on an urban scale. This course proposes systematizing characteristic problems from each type of infrastructure according to re-modelled planning where issues and flows (communication, energy, mobility), logistics, environmental infrastructures, public transportation, together with other relatively traditional layouts of streets and urban services constitute fundamental themes. The second subject is environmental principles on an urban scale, integrating them into the urban landscape. New concepts, parameters and techniques following the environmental paradigm are incorporated into this course with the aim of improving the integration of natural and urban environments.

Code	Course Title	Prerequisite	CR.H
ARE 631	Management, Governance and Urban Policies	12 Cr.H.	3 credits Hours

Course Description:

This course introduces the students to analysis of the various policies on land and housing, with emphasis on the review of good practices of local, regional, and international housing policies, as well as from the point of view of their historical evolution and in the analysis and achievement of their objectives. The students study relations between land policy and the urban planning. They also learn about factors that from urban planning can influence the normalization of the land uses, among other objectives. The students develop the main elements of urban policy (analysis of the supply and demand of land and housing, accessibility to the market, financing, taxation, etc.). in this course the students analyze the basic management instruments, such as expropriation, equitable distribution of benefits and



charges, land reserves for social housing, public land assets, intervention in the market, rental policy, etc.

Code	Course Title	Prerequisite	CR.H
ARE 632	Planning Environmental Assessment	12 Cr.H.	3 credits Hours

Course Description:

The course introduces advanced knowledge of Environmental control instruments; Instruments for protection and management of natural heritage; Networks of protected natural spaces, planning and management for protection of geological heritage and principles of the management of unique habitats. The students apply various assessment instruments in plans and projects, such as: instruments of environmental control for evaluating environmental impacts; and instruments of organization and management for working with renewable natural resources. The course also presents a subject of environmental integration in the various types of projects and for their subsequent verification, both the strategic assessment of the models and management alternatives and the consideration of the different environmental vectors. The students develop various environmental assessment documents and criteria for their preparation, with special attention to Environmental Sustainability Reports (ISA) and environmental reports.

Code	Course Title	Prerequisite	CR.H
ARE 641	Land Development Process	12 Cr.H.	3 credits Hours

Course Description:

This course focuses on the property development sector, providing students with an excellent macro understanding of the field's land development processes and management. Students gain a comprehensive understanding of property developer assumptions by studying methods of finding land, evaluating site selection criteria and feasibility studies, financing strategies, planning permission procedures, and property marketing skills. Additionally, the course explores the automation of property development through data, website, and software applications. In the context of the built environment, this course enables students to appreciate the role of real estate development and investment in a market-led economy. Students are exposed to the principles, strengths, and weaknesses of professionally recognized techniques used for appraising development opportunities and valuing real estate investment assets.

Code	Course Title	Prerequisite	CR.H
ARE 642	Real Estate Market Analysis	12 Cr.H.	3 credits Hours

Course Description:

This course explores the sources of data used in economic studies and provides an in-depth analysis of trends, market activity, sales, lending, leasing, and how research studies are conducted. Other topics include land-use studies and city planning, traffic studies, population behavior and mobility, and consumer spending and trade area. Students learn through case studies, demonstrations, and class



participation in the analysis of shopping center development, tract development (sales, projections, and surveys), service station location, population projections, employment trends, urban renewal projects, and community reuse studies. Property professionals representing investors, developers, businesses, resident occupiers or others require a thorough knowledge of the way real property markets operates. Managing property effectively maintains and adds value to property assets. Practitioners need to be aware of the relationship between legal, financial and taxation issues in this context. Property asset managers require a detailed understanding of a number of disciplines, including property taxation, valuation, land law and the landlord and tenant relationship.

Code	Course Title	Prerequisite	CR.H
ARE 651	Active Systems and Material Resources Management	12 Cr.H.	3 credits Hours

This course focuses on two area of studies, namely active systems and waste material resource management in relation to building performance and management. This course aims to develop an in-depth understanding of influence of the building active systems such as HVAC (Cooling & Heating system), Electrical Installations, Water supply system and water recycle systems, Sewage disposal systems, Vertical Transportation systems and Active firefighting systems on building performance in complex and high-rise buildings. The course also aims to develop a critical awareness of construction waste and building waste management as a means of sustainable development.

Code	Course Title	Prerequisite	CR.H
ARE 652	Green building assessments and Certification	12 Cr.H.	3 credits Hours

Course Description:

This course aims to expose the students to different building environmental performance assessment methods and certification tools. The building environmental performance analysis will cover methods of evaluating the building performance such as measuring environmental data in actual buildings, measuring environmental data using scale models, and post occupancy evaluation methods. The students also will be exposed to reviewing different green building certification [(Regional: ESTIDEMA) & (International: LEEDS, BREEAM, European & Asian Green Rating Tools)] and their evaluation categories. In this process students will review the different assessment variables under each category using case studies. The learning outcomes of the course will be evaluated using assignments, examinations and project reports.

Code	Course Title	Prerequisite	CR.H
ARE 661	Construction Cost Analysis and control	12 Cr.H.	3 credits Hours

Course Description:

This course introduces the types of cost estimation from the conceptual design phase through the more detailed design phase of a construction project. The students are expected to learn about Design in the Construction Industry; Types of Cost Estimates; Methods of Construction Cost control; Quantity Take-



Off and Measurement; Pricing; Building the Estimation; Procurement process; Post Contract and Cost Estimation within a Project; Earned Value Method (EVM); Close Out Period; Cost Estimation in Practice; Project Cash Flow; Technology Trends in Cost Estimating and Cost Control; and Program Cost Estimating. In addition, the course highlights the importance of controlling costs and how to monitor project cash flow. Students work on a break-even analysis of construction tasks in a project.

Code	Course Title	Prerequisite	CR.H
ARE 662	Construction Risk management	12 Cr.H.	3 credits Hours

Course Description:

This course introduces advanced knowledge about concepts of construction risks, Types of Risk in Construction Projects (Safety Risk, Financial Risk, Legal Risk, Project Risk and Environmental Risk); methods of recognizing the potential risks, impacts of risk to construction project, risk management processes (Identification, Assessment, Mitigation, Monitoring, Reporting), Risk Mitigation methods and strategy; standard form of construction contacts (JCT, NEC and FIDIC). The course is also an opportunity to practice Project management software to develop risk register and mitigation plan of construction project.