

# **ARCHITECTURAL ENGINEERING**

## **EXPERIENCE AMERICAN HIGHER EDUCATION AND RESEARCH IN ATHENS THE ANCIENT CAPITAL OF EUROPE**

The American University of Athens, founded in 1991, is a non-profit, independent, coeducational, teaching and research University formed and operating as an American model.

AUA integrates professional education, liberal studies and postgraduate programs and research. AUA started its operation as Southeastern College in affiliation with Boston University, College of Engineering (1982-1990) now offers Bachelor's, Master's and Doctorate degrees in more than 45 specializations.

### **Architectural Engineering**

Architectural Engineering is a building-oriented discipline, which offers students an opportunity to obtain an engineering education specializing in building architecture, building-system integration, and structural and computer-aided design.

Professional architectural engineers are concerned with the structural integrity of buildings; the performance of mechanical, acoustic, electrical and sanitation systems; lighting; systems and energy conservation; and the management of construction resources and schedules. Graduates of the Architectural Engineering program will be well prepared for careers as consulting engineers, building contractors, construction managers, structural engineers and knowledgeable specialists in related areas of building design and analysis.

Architectural Engineering shares much in common with Civil and Mechanical Engineering but is distinct in its exclusive concentration on building projects. Architectural Engineering students should have an aptitude in and an appreciation of the following areas of knowledge: basic principles of mathematics; physics and chemistry; manual and computer-aided drafting and design; surveying; construction materials; engineering mechanics; structural analysis and design; building-system integration; and professional practice and ethics.

## **MASTER OF SCIENCE**

### **ARCHITECTURAL ENGINEERING OPTION**

The AUA Master of Science – Architectural Engineering Option aims to offer:

Graduate training for Architectural Engineering graduates as well as a specialization in one or more of the following areas:

- a) Sustainable Design and Technologies or Bioclimatic Structures
- b) Computational Design
- c) System and Project Management
- d) Architectural Design Material Essence

A 40-credit graduate degree requires a 12-credit research portfolio and at least 2 courses from the following:

EK 5445, EK 5401, EK 5405, SE 5000, SE 5010, SE 6000

And three courses from:

EK 6483, EK 6420, EK 6491, EK 6436, EK 6432, EK 6431

**MASTER OF SCIENCE  
ARCHITECTURAL ENGINEERING OPTION**

|         |   |
|---------|---|
| EK 5445 | Selected Topics in Architecture from 1800 to the Present.   |
| EK 5401 | Drawings and Numbers, Five Centuries of Digital Design.     |
| EK 5465 | Contemporary Architecture and Critical Debate.              |
| EK 6483 | Sustainable Design and Technology Workshop                  |
| EK 6420 | Computational Design<br>Theory and Applications             |
| EK 6491 | Building Structural Systems                                 |
| EK 6436 | System and Project Management                               |
| EK 6432 | Architectural Design<br>Material Essence<br>The Glass House |
| EK 6431 | Architectural Design<br>Perception and Processes            |
| SE 5000 | Systems Engineering I                                       |
| SE 5010 | General Engineering I                                       |
| SE 6000 | Systems Engineering II                                      |

**Courses for the Master of Science  
Engineering Applied Sciences  
Architectural Engineering Specialization**

**EK 5445 Selected Topics in Architecture from 1800 to the Present.**

This class is a general study of modern architecture as a response to important technological, cultural, environmental, aesthetic, and theoretical challenges, the main highlight after the European Enlightenment. It focuses on the theoretical, historiographic, and design approaches to architectural problems encountered in the age of industrial and post-industrial expansion across the globe, with specific attention to the dominance of European modernism in setting the agenda for the discourse of a global modernity at large. It explores modern architectural history through thematic exposition rather than as a simple chronological succession of ideas.

**EK 5401 Drawings and Numbers  
Five Centuries of Digital Design**

The aim of this course is to highlight some technical aspects of the classical tradition in architecture that have so far received only sporadic attention. It is well known that quantification has always been an essential component of classical design: proportional systems in particular have been keenly investigated. But the actual technical tools whereby quantitative precision was conceived, represented, transmitted, and implemented in pre-modern relationship between architectural theory and data-processing technologies was as crucial in the past as it is today. This course hopes to promote a more historically aware understanding of the current computer-induced transformations in architectural design.

**EK 5465 Contemporary Architecture and Critical Debate**

This course presents a critical review of works, theories, and polemics in architecture in the aftermath of World War II. The aim is to present a historical understanding of the period, and to develop a meaningful framework to assess contemporary issues in architecture. Special attention will be paid to historiographic questions of how architects construe the terms of their “present”.

**EK 6491 Building Structural Systems**

This course serves as an introduction to the history, theory, and construction of basic structural systems with an introduction to energy issues in buildings. Emphasis is placed on developing an understanding of basic systematic and elemental behavior; principles of structural behavior and analysis of individual structural elements and strategies for load carrying. The subject introduces fundamental energy topics including thermodynamics, psychometrics, and comfort, as they relate to building design and construction.

**EK 6420      Computational Design: Theory and Applications**

This class introduces design as a computational enterprise in which rules are developed to compose and describe architectural and other designs. The class covers topics such as shapes, shape arithmetic, symmetry, spatial relations, shape computations, and shape grammars. It focuses on the application of shape grammars in creative design, and teaches shape grammar fundamentals through in-class, hands-on exercises with abstract shape grammars. The class discusses issues related to practical applications of shape grammars.

**EK 6483      Sustainable Design and Technology Research Workshop**

This workshop investigates the current state of sustainability in regards to architecture, from the level of the tectonic detail to the urban environment. Current research and case studies will be investigated, and students will propose their own solutions as part of the final project. Cases in “Intelligent Buildings” are also examined.

**EK 6436      System and Project Management**

This course is designed for students in the System Design and Management (SDM) program and therefore assumes that you already have a basic knowledge of project management. The objective is to introduce advanced methods and tools of project management in a realistic context such that they can be taken back to the workplace to improve management of development projects. In contrast to traditional courses on the subject we will emphasize scenarios that cannot be fully predicted such as task iterations, unplanned rework, perceived versus actual progress and misalignments between tasks, product architectures and organizations.

**EK 6432      Architectural Design  
Material Essence  
The Glass House**

The theme that unites the design is a focus upon the ‘making of architecture and built form’ as a tectonic, technical and materially driven endeavor. It is a design investigation that is rooted in a larger culture of materiality and the associated phenomena, but a study of the language and production of built form as an integrated response to the conceptual proposition of the project. The studio will look to works of architecture where the material tectonic and its resultant technology or fabrication become instrumental to the realization of the ideas, in whatever form they may take. This becomes the “art of technology”— suggesting a level of innovation and creative manipulation as part of the design process to transform material into a composition of beauty and poetry as well as environmental control.

**EK 6431 Architectural Design Perceptions and Processes**

This course explores the notion of in-between by engaging several relationships; the relationship between intervention and perception, between representation and notation and between the fixed and the temporal.

**SE 5000 Systems Engineering I (4)**

The Systems Point of View, definitions, methodological frameworks. Systems Engineering processes: logical steps, life cycle phases, a two dimensional framework, processes, other methodologies. Formulation of issues: situation assessment, problem/issue identification, value system design examples, requirements statement, generation of alternative or system synthesis, feasibility studies. Analysis of systems with uncertain and/or imperfect information, structural modeling trees, causal loops and influence diagrams, systems dynamic models, economic models and economic systems. Analysis reliability, availability, maintainability and supportability models, discrete events models, networks and graphs, evaluation of large-scale models. Alternative courses of action and decision making: formal decisions, group decisions and voting, Systems Engineering Management.

**SE 5010 General Engineering I (4)**

Mechanics: Statics, kinematics, dynamics, vibrations, hydrostatics, hydrodynamics and aerodynamics. Strength of Materials: stress and strain, stresses in bars and beams, theory of elasticity, plates and shells, rotating components, stability problem building. Thermodynamics: definitions, first law, second law, processes. Heat transfer: conduction, convection, radiation, heat exchangers. Materials: properties, testing, plastics and tribology. Engineering design-Mechanical machine components: connections, springs, couplings, clutches and brakes, bearings, gears, drives, kinematics. Machine dynamics: forces and moments of inertia, vibrations. Manufacturing processes: shaping and forming, cutting, assembly. Manufacturing systems: machine tool components, control systems, shearing and blanking machines, processor and harnesses for metal forging, metal cutting, welding and soldering, robotics.

**SE 6000 Systems Engineering II (4)**

Views of systems approach, systems, computer based systems, modeling, specific tasks, systems development activity, development life cycle, configuration management, project management, quality, non-functional aspects, systems performance, evaluators, selected methods, formal theory, quality, quality activity levels, total quality management, development and monitoring of processes.



**THE AMERICAN UNIVERSITY  
OF ATHENS**

**ARCI**

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| <u>Fall Semester</u>                      |   | <u>first year</u>          |                | <u>Spring Semester</u>                |                            |
|---|---|----------------------------|----------------|---------------------------------------|----------------------------|
| <u>Course</u>                             | <u>Title</u>                            | <u>Credits</u>             | <u>Course</u>  | <u>Title</u>                          | <u>Credits</u>             |
| EN 1100                                   | English Composition & Rhetoric I        | 3 <input type="checkbox"/> | EN 1102        | English Composition & Rhetoric II*    | 3 <input type="checkbox"/> |
| MA 1123                                   | Calculus I                              | 4 <input type="checkbox"/> | MA 1124        | Calculus II                           | 4 <input type="checkbox"/> |
| CH 1101                                   | General Chemistry I+Lab                 | 4 <input type="checkbox"/> | PY 1211+PY1221 | General Physics I+Lab                 | 4 <input type="checkbox"/> |
| ME 1105                                   | Technical Drawing                       | 2 <input type="checkbox"/> | EK 1103        | Introduction to Architectural Design  | 3 <input type="checkbox"/> |
|   | Humanities I                            | 3 <input type="checkbox"/> | EK 1106        | Freehand Perspective Drawings         | 3 <input type="checkbox"/> |
| TOTAL OF 33 SEMESTER CREDIT HOURS         |   |                            |                |                                       |                            |
| <b>Second Year</b>                        |   |                            |                |                                       |                            |
| EN 2012                                   | Language in Literature                  | 3 <input type="checkbox"/> | MA 2226        | Differential Equations                | 4 <input type="checkbox"/> |
| MA 2225                                   | Multivariate Calculus                   | 4 <input type="checkbox"/> | PY 2253        | Vibrations & Waves                    | 3 <input type="checkbox"/> |
| PY 2212+PY 2222                           | General Physics II+Lab                  | 4 <input type="checkbox"/> | CS 1122        | Pascal II                             | 3 <input type="checkbox"/> |
| CS 1121                                   | Pascal I                                | 3 <input type="checkbox"/> | ME 3302        | Engineering Mechanics II: Dynamics    | 4 <input type="checkbox"/> |
| ME 2301                                   | Engineering Mechanics I: Statics        | 4 <input type="checkbox"/> | EK 2107        | Architectural Design                  | 3 <input type="checkbox"/> |
|   | Humanities II                           | 3 <input type="checkbox"/> |                | Social Sciences I                     | 3 <input type="checkbox"/> |
|   |   |                            |                | Humanities III                        | 3 <input type="checkbox"/> |
| TOTAL OF 44a SEMESTER CREDIT HOURS        |   |                            |                |                                       |                            |
| <b>Third Year</b>                         |   |                            |                |                                       |                            |
| EK 3121                                   | Engineering Systems Analysis            | 3 <input type="checkbox"/> | EK 4011        | Building Systems Integration Studio I | 3 <input type="checkbox"/> |
| EK 3151                                   | Materials of Construction               | 3 <input type="checkbox"/> | EK 3071        | Structural Design II                  | 4 <input type="checkbox"/> |
| EE 3307                                   | Electric Circuit Theory I               | 4 <input type="checkbox"/> | EK 4243        | Advanced Architectural Graphics       | 4 <input type="checkbox"/> |
| EK 3031                                   | Structural Design I                     | 3 <input type="checkbox"/> | EK 4234        | Seminar in Urban Design I             | 3 <input type="checkbox"/> |
|   | Social Sciences II                      | 3 <input type="checkbox"/> |                | Social Sciences III                   | 3 <input type="checkbox"/> |
| TOTAL OF 33 SEMESTER CREDIT HOURS         |   |                            |                |                                       |                            |
| <b>Fourth Year</b>                        |   |                            |                |                                       |                            |
| EK 4021                                   | Building Systems Integrations Studio II | 3 <input type="checkbox"/> | EK 4235        | Seminar in Urban Design II            | 3 <input type="checkbox"/> |
| EK 4217                                   | Architectural Materials                 | 3 <input type="checkbox"/> | EK 4248        | Computer Graphics                     | 3 <input type="checkbox"/> |
| EK 4221                                   | Seminar in Architecture                 | 3 <input type="checkbox"/> | EK 4214        | Environmental Controls                | 3 <input type="checkbox"/> |
| EK 4303                                   | Architectural Design II                 | 3 <input type="checkbox"/> | EK 4218        | Construction Methods                  | 3 <input type="checkbox"/> |
|   |   |                            | EK 4304        | Architectural Design III              | 3 <input type="checkbox"/> |
|   |   |                            | EK 4711        | Construction Planning and Scheduling  | 3 <input type="checkbox"/> |
| TOTAL OF 30 SEMESTER CREDIT HOURS         |   |                            |                |                                       |                            |
| <b>TOTAL OF 140 SEMESTER CREDIT HOURS</b> |   |                            |                |                                       |                            |

Student's Signature: \_\_\_\_\_ Provost's Signature: \_\_\_\_\_

Chairperson's Signature: \_\_\_\_\_ President's  
Signature: \_\_\_\_\_

School Head's Signature: \_\_\_\_\_

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**Humanities III and Social Sciences I may be taken during the Winter and the Summer Intersessions**

## Major Courses for Architectural Engineering

|         |  |
|---------|--|
| EK 1103 | Introduction to Architectural Design   |
| EK 1106 | Freehand Perspective Drawings          |
| ME 2301 | Engineering Mechanics I: Statics       |
| ME 2302 |  |
| EK 2107 | Architectural Design                   |
| EK 3121 | Engineering Systems Analysis           |
| EK 3151 | Materials of Construction              |
| EK 3031 | Structural Design I                    |
| EK 4011 | Building Systems Integration Studio I  |
| EK 3307 | Electric Circuit Theory I              |
| EK 3071 | Structural Design II                   |
| EK 4243 | Advanced Architectural Graphics        |
| EK 4234 | Seminar in Urban Design I              |
| EK 4021 | Building Systems Integration Studio II |
| EK 4217 | Architectural Materials                |
| EK 4221 | Seminar in Architectural Philosophy    |
| EK4303  | Architectural Design II                |
| EK 4235 | Seminar in Urban Design II             |
| EK 4223 |  |
| EK 4219 |  |
| EK 4215 |  |
| EK 4314 | Environmental Controls                 |
| EK 4218 | Construction Methods                   |
| EK 4304 | Architectural Design III               |
| EK 4711 | Construction Planning and Scheduling   |

## COURSE DESCRIPTIONS

### Engineering (EK)

#### **EK 1103 INTRODUCTION TO ARCHITECTURAL DESIGN (3)**

**No prerequisite.** Introductory course for architecture and civil engineering students. Covers basics in architectural history, essentials of architectural synthesis, primary design considerations, financing; structural; components, construction methods, electrical-mechanical systems, energy conservation and lighting, presentation methods, etc. 3 lecture hours.

#### **EK 1106 FREEHAND PERSPECTIVE DRAWINGS (3)**

**Prerequisite:** EK 1103. Introductory course in presentational perspective drawing aimed mainly at architecture and interior design students who have no drawing experience. Covers freehand sketching and rendering; light and shade; two point perspective; quick visual presentation of objects and concepts. 3 lecture hours.

#### **ME 2301 ENGINEERING MECHANICS I: STATICS (4)**

**Prerequisites:** MA 1124, PY 1211; **corequisite:** MA 2225. Fundamentals of engineering statics. The concept of force and the moment of the force. Equilibrium of rigid bodies equilibrium and analysis of structures. Friction. First and second moments of inertia. 4 lecture hours.

### **EK 2107 ARCHITECTURAL DESIGN I (3)**

**Prerequisite:** EK 1103. This course is addressed to students having already followed EK 1103 or having an adequate knowledge of architectural drawing fundamentals. 3 lecture hours.

### **EK 3031 STRUCTURAL DESIGN I (3)**

**Prerequisites:** ME 2301, ME 3302. Design loads; factors of safety; load and resistance factors for steel and timber structures. Experimental and analytical study of steel and timber materials subjected to various states of stress. Failure theories, yield and post-yield criteria are treated. Fatigue and fracture mechanics phenomena are related to design practice. The design of tension timber, beams and columns in steel and timber. 3 lecture hours.

### **EK 3071 STRUCTURAL DESIGN II (4)**

**Prerequisite:** EK 3031. Design loads, factor of safety; load and resistance factors for concrete structure. Properties of concrete-making materials and the proportioning of concrete mixtures. Experimental and analytical study of plain and reinforced concrete subjected to various states of stress. Failure theories and the ultimate strength of plain and reinforced concrete structural components. The design of beams, columns and slabs in reinforced concrete. 3 lecture hours.

### **EK 3121 ENGINEERING SYSTEMS ANALYSIS (3)**

**Prerequisites:** ME 2301, ME 3302. Applications of engineering and economic concepts and analysis to civil engineering systems; practical applications of elementary probability and statistics, operations research and economics in civil engineering. 3 lecture hours.

### **EK 3151 MATERIALS OF CONSTRUCTION (3)**

**Prerequisites:** ME 2301, ME 3302. Physical principles of elastic and plastic deformation of construction. Mechanical testing methods including tensile, compressive, toughness, creep and fatigue. Properties of aggregates, concrete, masonry, wood, bituminous material, iron and steel, and other construction materials. The emphasis is on concepts from solid mechanics which explain the behavior of materials to the extent needed in the design of load-bearing constructs. 3 lecture hours.

### **EK 4011 BUILDING SYSTEMS INTEGRATION STUDIO I (3)**

**Prerequisite:** EK 3151. Principles and elements of design; synthesis of structural, mechanical, electrical, sanitary and construction, considering interrelationship in performance and economics. Emphasis will be given to system identification, typical usage and manner or means of integration. 3 lecture hours.

### **EK 4021 BUILDING SYSTEMS INTEGRATION STUDIO II (3)**

**Prerequisite:** EK 4011. Continuation of EK 4011. An in-depth review of interference design. Design and detailed development of major architectural project integrating all aspects of architecture and related disciplines in a professional manner and milieu. 3 lecture hours.

### **EK 4214 ENVIRONMENTAL CONTROLS (3)**

**Prerequisite:** EK 3212. Mechanical and electrical systems design with emphasis on the building envelope, energy codes, and the design, of energy-efficient buildings. Systems studied include typical heating and air conditioning systems, heat pumps, active solar systems, and architectural lighting and electrical distribution systems. 3 lecture hours.

### **EK 4216 ENVIRONMENTAL CONTROLS SEMINAR (3)**

**Prerequisite:** EK 3212. A study of recent installation in lighting and electrical distribution systems, heating, ventilating, and air conditioning systems, domestic hot and cold water supply and distribution systems, sanitary and storm drainage, fire protection, vertical transportation, and communications systems within buildings. Emphasis is placed on the investigation of energy-efficient systems. 3 lecture hours.

**EK 4217 ARCHITECTURAL MATERIALS (3)**

**Prerequisites:** EK 4211, EK 4212. Introduction to materials and the criteria for selection in architectural structures. 3 lecture hours.

**EK 4218 CONSTRUCTION METHODS (3)**

**Prerequisite:** EK 3151. A systematic approach to construction. Investigation of systems, concepts, and systems building. Open to majors only. 3 lecture hours.

**EK 4221 SEMINAR IN ARCHITECTURAL PHILOSOPHY (3)**

**Prerequisite:** senior status. In-depth explorations into 20th century architectural philosophy. Important philosophical trends, socio-cultural forces, and personalities will be examined. 3 lecture hours.

**EK 4234 SEMINAR IN URBAN DESIGN (3)**

**Prerequisites:** EK 3201, EK 3202. Detailed analysis of urban design as influenced by technology, socio-cultural factors, and economics. Offered infrequently. 3 lecture hours.

**EK 4243 ADVANCED ARCHITECTURAL GRAPHICS (3)**

**Prerequisite:** senior status. Development of advanced skills in delineation and drawing supportive in architectural design. 3 lecture hours.

**EK 4303 ARCHITECTURAL DESIGN II (3)**

**Prerequisites:** EK 1103, EK 2107. This course is a continuation of Introduction to Architectural Design (EK 1103) and Architectural Design I (EK 2107) and is intended to move the student from broad and general design considerations into more specific and complex design problems. 3 lecture hours.

**EK 4304 ARCHITECTURAL DESIGN III (3)**

**Prerequisites:** EK 1103, EK 2107, EK 4303. This course is a continuation of Introduction to Architectural Design (EK 1103), Architectural Design I (EK 2107) and Architectural Design II (EK 4303) and is intended to move the student from broad and general design considerations into more specific and complex design problems. 3 lecture hours.

**EK 4711 CONSTRUCTION PLANNING AND SCHEDULING (3)**

**Prerequisite:** EK 3151. Planning, scheduling and progress control of construction operations. Critical Path Method and PERT. Resource leveling of personnel, equipment and materials. Financial control/ hauling of construction projects. Impact delay on precedence networks. Construction contract administration. Computer applications. Two hours lecture, two hours lab per week.

## Routes into Civil Engineering

University  
MEng  
(4.5 years)



Work  
Experience and  
Training



Apply for  
Chartered  
Engineer  
Status  
(CEng)

The American University of Athens has been offering since 1982 excellent academic and career preparation for many courses including Architectural Engineering.

A four-year 140-credit hour, Bachelor's degree is awarded, followed by a 40-credit Master of Science degree in Architectural Engineering.

A total period of five years is required for both the Bachelor's and Master's degrees.

The Master's degree requires 11 months intensive study or 18 months full-time study.