

# School of Architecture Courses

## Note on Course Numbers

Each Carnegie Mellon course number begins with a two-digit prefix which designates the department offering the course (76-xxx courses are offered by the Department of English, etc.). Although each department maintains its own course numbering practices, typically the first digit after the prefix indicates the class level: xx-1xx courses are freshmen-level, xx-2xx courses are sophomore level, etc. xx-6xx courses may be either undergraduate senior-level or graduate-level, depending on the department. xx-7xx courses and higher are graduate-level. Please consult the Schedule of Classes (<https://enr-apps.as.cmu.edu/open/SOC/SOCServlet>) each semester for course offerings and for any necessary pre-requisites or co-requisites.

### 48-025 First Year Seminar: Architecture Edition I

Fall: 3 units

In this course, students will learn about effective strategies for teaching architecture and the built environment. Topics include the cognitive differences between novices and experts, instructional techniques, and goal alignment. As part of the coursework, each student will implement these teaching strategies to design and teach a lesson. Elements of developmental psychology, learning theories, and classroom practices will inform the architectural education lesson. Teaching and learning techniques can be generalized for communication with clients, practice, and the community.

### 48-026 First Year Seminar: Architecture Edition II

Spring: 3 units

The first year seminar (part 2) introduces students to opportunities at Carnegie Mellon University and beyond. The goal of this course is to encourage students to pursue their interests inside and outside of the School of Architecture by introducing a range of opportunities, including study abroad experiences, internships, academic minors/additional majors, and graduate study. The introduction of the study abroad process and travel options will encourage students to consider a study away experience into their academic curriculum. Students will explore their additional academic interests by identifying their psychological preferences through the Myers-Briggs Type Indicator and matching these preferences with academic minors/additional majors at CMU. The presentation of the Intern Development Program (IDP) will engage students in considering future plans for earning IDP hours and understanding the process of securing an architectural internship. Students will be introduced to the process of developing an independent research project. Additional topical areas to be covered in the seminar will include an evaluation of the previous semester, scholarship/academic funding opportunities, graduate studies, and schedule planning for upcoming semesters.

### 48-065 Architectural Rapid Prototyping for Non-Architects

Intermittent: 9 units

The continuing development of rapid prototyping technologies has expanded the range of applications and their accessibility. The ubiquity of the three dimensional printer is only a matter of time: today's availability of the desktop 3D printer has made it conceivable that they will soon become as common as their two-dimensional counterparts. This course will test the current capabilities of the desktop 3D printer, and explore the ways in which it can be used to develop architectural massings and details. Through the iterative process, we will test your original designs at a number of scales, from site context to the building to the component. While there is no prerequisite for this course per se, it is expected that students understand the basic fundamentals of architectural drawing conventions (plans, sections, elevations), and/or are conversant in 3-D modeling programs (Sketchup, Revit, Rhino, etc.). Preference will be given to those intending to graduate with a minor in Architecture.

### 48-095 Spatial Concepts for Non-Architects I

Fall and Spring

This course serves as an introduction to the spatial concepts of architecture for students from other disciplines. The course is focused entirely on project design work (this is not an historical survey, technical or lecture course). This course is very hands-on. Projects will explore the design and experience of spatial environments through a series of creative investigations. The semester will be broken in to 3 parts: Intro/Exploration and a long term project. In Intro/Exploration, students will have many hands on opportunities to start to build a common language to describe spacial investigations as well as creating them. This will consist of short projects, with each design investigation progressively building upon the previous exploration; these early projects will consist of both individual and group work. They will focus on Making. The second half of the semester will consist of one long term project to be created individually, incorporating students' personal theories of architecture based on an overarching question. Studio work will be supported by group discussion based upon critical review of student work, readings, slide presentations, videos and films. There will also be a few field trips. Students are encouraged to explore their own areas of interest with respect to their work in class. Self-motivation, class attendance and an open mind is mandatory, however, no prior architectural, engineering or artistic experience is required. Students are expected to perform work both inside and outside of class. Students should be prepared to purchase various supplies throughout the course. This course is in partial fulfillment of requirements for an Architecture Minor.

### 48-100 Architecture Design Studio: Foundation I

Fall: 12 units

As the first architectural design studio course, the Foundation I studio establishes a fundamental understanding of representation and abstraction to which more of your own thoughts and ideas about spatial thinking can be added. This will involve, by means of the architectural studio, a reiterative investigation into the relationship of technique, form, and meaning through study, invention, testing, and evaluation. During this semester a series of short problems will be given to expose you to the complexities of visual communication and the design act; to develop skills of spatial manipulation; to give you the self-confidence in making valid decisions within set time limits; to develop the skills of graphic presentation necessary for interpreting and communicating your architectural intentions; and above all, to instill the ability to combine insight with the rigorous analytical study in a design process that is efficient, personally effective, and which becomes second nature to you as a working process.

### 48-105 Architecture Design Studio: Foundation II

Spring: 12 units

The 48-105 studio, called Foundation II, is the second studio in CMU's professional B.Arch program. It builds on the lessons from 48-100 about clear architectural communication and abstract spatial-definition, but adds a greater emphasis on the material and experiential understanding of how architecture is made and used. We continue to emphasize architectural drawing and models (both analog and digital) as the primary means of architectural communication, but also as a method of creatively exploring and rigorously testing fundamental architectural ideas. We investigate, research, analyze, diagram, and apply lessons from local architecture, and great architecture of the past, in studio, and in the parallel survey of architectural history. We introduce the use of systems, computational thinking, and rules in the design process to create order, deal with a range of parameters, and satisfy specific performance criteria. Beginning with more abstract formal design exercises, and ending with the design of a small building, we explore how tectonics, joinery, materials, as well as site, orientation, context, and human use can be harnessed to inspire great design. The design process is still carefully controlled, but students are encouraged to begin to speculate and take careful risks.

Prerequisite: 48-100 Min. grade C

**48-116 Building Physics**

All Semesters: 9 units

This course is composed of two parts related to fundamental building physics concepts, namely, the lighting performance of buildings (first part) and the thermal performance of buildings (second part). In the first part, the course will introduce fundamental lighting principles in the context of performance-based architectural design and diagnostics. The course will cover relevant aspects of lighting environment that affect the physiological and psychological experience of buildings, performance metrics, design and benchmarking methods, and contemporary simulation tools. Topics include a review of physiological and psychological response to the visual environment, analytical and numeric methods for the prediction of lighting conditions in interior spaces, lighting engineering and design methods, and application of computer-aided lighting simulation tools in architectural design. In the second part, the course will introduce fundamental thermal principles in the context of performance-based architectural design and diagnostics. The course will cover relevant aspects of thermal environment that affect the physiological and psychological experience of buildings, performance metrics, design and benchmarking methods, and contemporary simulation tools. Topics include a review of basic theory of heat transfer, thermal dynamics, thermal comfort, analytical and numeric methods for the prediction of building thermal load and energy consumption, and application of computer-aided thermal simulation tools for building thermal design. Demonstration of a set of environmental measurement and sensing devices will also be included in the thermal part of this lecture. DIVA-for-Rhino and ArchSim-for-Grasshopper/Rhino software platforms will be used for lighting and thermal performance simulations

**48-120 Digital Media I**

Fall: 6 units

IDM is a required course for all first year architecture students. The course introduces students to a wide range of digital methods and concepts available to architects for design, representation, and documentation. The coursework is directly coordinated with Studio assignments providing the students with the opportunity to master their digital skills in a meaningful manner. Due to the amount of content covered there is no single text for this course, but the course is supported by materials created by the instructor. IDM addresses topics such as digital image editing, vector illustration, HTML coding, and 3D modeling.

**48-121 Drawing I**

Fall: 6 units

Architects draw and build models for a variety of reasons: to record and reference; to analyze and reveal order, intent, and relationships; to speculate; and to visualize new propositions. The study of architecture requires the connection between the mind, the eye and the hand, so that the nature of ideas and their relationship to physical form can be investigated. The connection of the mind, hand and drawing skills requires considerable time and effort. This course introduces why architects use these forms of representation. Students are introduced to how to do basic academic research as well direct assignments that apply the fundamentals of freehand drawings and drafting techniques as it pertains to plans, sections, elevations and parallel drawing, analytical diagramming and model making.

**48-125 Digital Media II**

Spring: 6 units

IDM2 is a required course for all first year architecture students. This course is the continuation of IDM. IDM2 introduces students to measured drafting and the process of creating a construction drawing set. The coursework is directly coordinated with Studio assignments providing the students with the opportunity to master their digital skills in a meaningful manner. Due to the amount of content covered there is no single text for this course, but the course is supported by materials created by the instructor. IDM2 addresses topics such as digital drafting, construction drawings, advanced 3D modeling and HTML programming.  
Prerequisite: 48-120

**48-126 Drawing II**

Spring: 6 units

Drawing and Appearance? is a traditional course in free-hand architectural drawing. Its central learning objective is building a capacity for visualizing three-dimensional space through the making of hand-made drawings. Two secondary objectives foster visual literacy: the ability to use line, tonal values and color to represent architectural space and the ability to use drawing to represent architectural proposals at various levels of abstraction. Coursework includes free-hand and constructed perspective, shade and shadow projection, chiaroscuro drawing in colored pencil and color drawing in pastel. Work is submitted in three portfolio submissions of two weeks duration each. Coursework is built around exercises in the required course text: *Drawing and Perceiving*, John Wiley and Sons.

**48-175 Descriptive Geometry**

Spring: 9 units

This course is offered only at Carnegie Mellon's campus in Qatar. This is a manual construction course for solving problems in three-dimensional geometry through working with two-dimensional planes using basic mechanical drawing tools. The course covers basic concepts of descriptive geometry; solving problems involving lines and planes in space and their spatial relationships; rotations in three dimensions; locating points and tangents on solids and surfaces; intersection of solids; shades and shadows; perspectives; and development of surfaces.

**48-200 Architecture Design Studio: Elaboration I**

Fall: 18 units

This studio is an introduction to architectural design stressing concept generation and the development of a rich design process to create evocative spatial experiences through architecture. Building on the explorations of form and space in the 1st year, we investigate in greater depth the role that program, context, and the physical "elements of architecture" play in creating meaningful architecture. We seek to understand design principles underlying the buildings of the past and present, from the broadly theoretical and conceptual, to the real implications of tectonics and sustainability, and apply these ideas with intent and significance. We will focus on developing challenging architectural ideas, profound building details, and effective ways of communicating them in order to explore architecture's potential for creating poetic expressions, appropriate shelter, or exalted experiences, as well as its ability to embody ideas and impart meaning to the world around us.  
Prerequisite: 48-105 Min. grade C

**48-205 Architecture Design Studio: Elaboration II**

Spring: 18 units

Building on the fall studio, the spring semester is concerned with more in-depth understanding and development of designs for small-scale buildings, now informed by greater knowledge related to materials, fabrication, and the act of construction. Following the "New Materiality" evident in architecture today, and acknowledging the importance of materials and assembly techniques for sustainable design, we seek to explore the aesthetic and experiential meaning of materials (WHY?), and the technical knowledge related to the use of materials and the processes of construction (HOW?). The creative opportunities and design implications of using varied materials, structural systems, fabrication and assembly techniques—both analogue and digital—are elaborated, especially as they determine the artistic, conceptual, poetic, creative, spatial, and experiential aspects of architecture. The studio projects, lectures, and the required building study will focus on the application and integration of knowledge acquired in a parallel "Materials & Assembly" course 48-215.  
Prerequisite: 48-200

**48-215 Materials and Assembly**

Spring: 9 units

The fourth semester of architectural studies at Carnegie Mellon University is concerned with the detailed development and refinement of architectural design as informed by the meaning, aesthetics and techniques related to the usage of materials and the process of construction. As part of the technology sequence, 48-215 introduces and examines the fundamentals between design intent and construction materials, the science of materials (performance) and their assemblies. Learning how materials and techniques inform spatial and form making decisions will be a central theme to the semester. Lectures and discussions will focus on the meaning, aesthetics and techniques related to the use of materials and the process of construction. Field trips will provide further depth into these topics. A basic understanding of essential, well-known systems of building construction will be our base line. Discussions and case studies of contemporary systems that extend, experiment and question these known systems will introduce you to the great depth to which this basic knowledge can lead you. Joint assignments with the second year design studio will provide you with an opportunity for an in-depth exploration of these fundamentals of construction through a direct application and synthesis of this new knowledge to your studio project. This course will introduce a basic understanding, selection, design, preliminary sizing and methodology of construction systems organized by the 16 divisions of construction, as defined by the Construction Specifications Institute (CSI) as well as an introduction to the International Building Code (IBC) with special attention due to fire protection, types of construction, and means of egress.

**48-217 Structures**

Spring: 9 units

Structures is a required course taught in the second year. It is a successor course to Statics, complementing that previous course by emphasizing structural member design in wood, steel, and reinforced concrete; spatial synthesis of hierarchical one-way systems for gravity load; structural types for lateral load including braced frames, shear walls, and rigid frames; introduction to geometric structures such as cable nets, domes, shells, and air-supported structures.

**48-240 Historical Survey of World Architecture and Urbanism I**

Fall: 9 units

This course cuts a broad swath through time, geography and cultures, surveying critical episodes in the built environment of Europe, the Middle East, Asia, and the Americas from antiquity through the 19th century. Reflecting the inseparable relation between building and human needs, this course is not only a history of architecture, but also a history through architecture. It examines architectural and urban design as a form of cultural expression unique to its time and place. The design, use, meaning and legacy of a building is conditioned not only by the architect's will or the patron's desire, but also by a web of technological, religious, social, cultural, economic, and political factors of the time. This foundation course is the first in the architectural history sequence, and introduces students to the subject and skills of world architectural history. It is a prerequisite for all subsequent architectural history courses. Student work will include several exams and a final.

**48-241 Modern Architecture**

Fall: 9 units

This survey of modern architectural history lecture course picks up where the historical survey 48-240 leaves off. It focuses attention on the 20th-century, and investigates the web of interwoven ideas and issues that characterize the modern age and modernism. We begin with a look at the "crisis of modernity" that plagued most of western civilization in the late 19th-century, and then survey the major movements of the avant-garde and other responses to modernity, and end with what came to be known as Post-Modernism. We will look more closely at the increasing divide between the disciplinary edge of architecture, and architecture's increasing professionalization in the last century, focusing on how architecture has influenced culture through experimentation and provocative thinking, even when the primary intent was functional, technological, social, political, etc. Emphasis will be placed on the relationship of buildings to the more general cultural, intellectual, and historical circumstances in which they were created. Special attention will be devoted to the important manifestoes, theoretical, and critical writings that so determined the project of modern architecture.

**48-250 Case Studies in Architecture and Cities**

Fall: 9 units

To be determined by the department

**48-300 Architecture Design Studio: Integration I**

Fall: 18 units

Design Studio III: Building and Site is a required course taught in the third year. The subjects of the Third Year Fall Semester are the reciprocal orders of buildings and landscapes and the development of the building site. The work builds on knowledge gained in prerequisite and co-requisite courses including 48-312 Site Engineering. This course asks students to continue their investigations into the formal and spatial composition and enquiries of previous semesters with a focus on the following concepts: Occupancy: Social and cultural phenomena, dimension/measurement and cycles of time relating to human and non-human occupancy Site assessment: site inventory at many scales Grading and surface manipulation: compatibility of grading with related technical considerations for water management, ground structures, surfacing, plants, and maintenance Road alignment: design of roads and parking to support construction, service and the anticipated occupancies, design of roads to connect to other roads with appropriate sight lines, stack spaces, and turning requirements, layout and sizing of parking spaces for vehicles Stormwater: volume and direction of runoff water on both the undisturbed and developed areas, storm water surface system, Plants: selection of plants and plant communities with consideration for regional, local, and site-specific factors Prerequisite: 48-205 Min. grade C

**48-305 Architecture Design Studio: Integration II**

Spring: 18 units

The basis for the CMU studio course sequence is the expectation that the student retains and applies knowledge gained each semester to the current studio. The spring semester of the third year of architectural studies at Carnegie Mellon University is concerned with the detailed development and refinement of an architectural design as informed by the technical knowledge of structural systems, enclosure systems and the process of construction. The student is expected to articulate concepts and develop designs with more precision and in greater detail than done in previous studios and courses. In addition to criteria related to the development of design skills appropriate to one's sixth semester of the studio sequence, the following criteria are an explicit part of the evaluation of the student work: Aesthetics: The degree to which the design responds to formal issues as articulated in prior design studios. Structural System: The degree to which the proposed building is presented as a statically stable structure which defines the spatial order and satisfies the architectural intentions made explicit in the project. Enclosure System: The degree to which the proposed enclosure system satisfies the design requirements and responds to the physical phenomena of the environment into which it is placed. Material Selection: The degree to which the selected building materials and their implementation are appropriate to the occupancy, articulate the architectural order, and satisfy the physical design requirements. Constructability: The degree to which the proposed building is developed in response to an understanding of the processes of construction. Presentation: The clarity, craft and completeness of the presentation. Prerequisite: 48-300

**48-315 Environment I: Climate & Energy**

Fall: 9 units

This course introduces architectural design responses for energy conservation, human comfort, and the site-specific dynamics of climate. Students will be expected to combine an understanding of the basic laws of comfort and heat flow with the variables of local climate to create energy design guidelines for their own work. The state of the art in building energy conservation and passive heating and cooling technologies will be presented, with take-home readings and assignments. To stress the significance of architectural design decision-making on energy consumption and comfort, full design specifications and calculations will be completed for a residential-scale building. Students will compile a professional energy consultant's report, designing the most viable energy conservation retrofit measures for their client from siting, massing, organization, enclosure detailing, opening control, to passive system integration and management. An overview of world energy consumption in buildings and energy design standards will be challenged by lectures on building energy conservation successes, and emerging demands for a broader definition of sustainability. The course will end with a focus on the design integration of natural conditioning systems and the potentially dynamic interface of mechanical systems in small- and large-scale buildings.

**48-324 Structures/Statics**

Fall: 9 units

To be provided by department

**48-332 Teaching and Learning**

Intermittent: 6 units

In this course, students will learn about effective strategies for teaching architecture and the built environment. Topics include the cognitive differences between novices and experts, instructional techniques, and goal alignment. As part of the coursework, each student will implement these teaching strategies to design and teach a lesson. Elements of developmental psychology, learning theories, and classroom practices will inform the architectural education lesson. Teaching and learning techniques can be generalized for communication with clients, practice, and the community.

**48-338 European Cities in the XIX Century: Planning, Architecture, Preservation**

All Semesters: 9 units

The history of the main cities of Europe during the XIX century is a history of change and transformation. The physical environment and the political, financial and administrative structures adapt to the needs of new masses of population and to the challenges of metropolitan life. In some cases, cities even acquire new representative functions, as they become a national capital. This course traditionally offers an overview of the urban culture of XIX century Europe, reconstructing aspects of the broader historical context and then focusing on reading the effects of the XIX century transformations on the physical appearance, structures and image of present-day European cities, such as Paris, London, Berlin, Barcelona, Vienna and Rome. This semester we will add to this analysis, acquired by learning and applying a set of essential questions about XIX century urban transformations, a second look at the image of the city - the issue of how the city is represented and described in the various moments of its Nineteenth century transformation (from historical maps, to paintings, from postcards to literary descriptions). We will try to consider its changing visual representation and the different perception of its character and peculiarities over time, finally discussing how the Nineteenth century image of each city still affects how it is viewed today. We will rely, along with the usual reading materials (articles, book excerpts) also on visual documentation, such as photography and film. The course is based on lectures and discussions and requires personal elaboration, as well as a fair amount of reading and writing.

Prerequisite: 48-240

**48-340 Modern Architecture and Theory 1900-1945**

Intermittent: 9 units

This architectural history lecture course surveys the modern buildings and literature of the first half of the twentieth century, focusing primarily on Europe but extending also to non-western countries. We begin with a look at the "crisis of modernity" that plagued most of western civilization in the late 19th-century, and then focus on the major movements of both the avant-garde and other responses to modernity from 1900-1945. The course includes lectures, readings, and discussions about a broad range of issues, including 1) Formal tendencies; 2) Theoretical issues; 3) National traditions; 4) Biographical sketches; 5) Significant technologies and materials; 6) Political motivations; 7) Social & cultural influences. Emphasis will be placed on the relationship of buildings to the more general cultural, intellectual, and historical circumstances in which they were created, especially the important manifestoes, theoretical and critical writings that so determined the project of modern architecture. Work for the course involves extensive reading and a major research paper.

Prerequisite: 48-240

**48-341 Expression in Architecture**

Intermittent: 9 units

This architectural history seminar will explore expression in architecture in its many forms, particularly in written works of architectural theory through the ages. We start with the premise that architecture is not merely pragmatic, technical, or functional: it can express or communicate like a language, it can represent and inspire like many of the arts, it can shape behavior and emote, it can trigger memories, emotions, or meanings. As Isozaki put it: "Architecture is a machine for the production of meaning." We'll investigate many ways that architects have theorized the design process, as well as the forms, materials, and contexts of architecture, to express a myriad of ideas and sensibilities. We'll also look at the ways that buildings can communicate and have meaning, often beyond the intent of the architect, and usually changing over time. Some of the topics to be explored include the classical orders, gothic geometry and mystical light, the theatrical space of the Baroque, architecture parlante, character, and style in the Enlightenment, tectonics as structural expression, political architecture and morality, the aesthetics of functionalism, Expressionism, key terms such as ornament, representation, linguistics, and semiotics, as well as more recent theoretical constructs such as embodiment, materiality, atmosphere, and affect. The work of the seminar will include intensive weekly readings, especially of primary sources by the architects seeking to express ideas, weekly presentations and discussions about the sources, and a term paper on an important theory of expression in architecture of your choice.

Prerequisite: 48-240

**48-347 ImPrint. Writing for Creatives**

Spring: 9 units

Experience the impact of writing and publishing on your design process. In this hands-on workshop for a small group, the raw material is your completed and in-progress studio work. See your design thinking evolve and develop under the lens of a thoughtful, design-oriented writing practice. Learn to use writing and editing to clarify and refine your thought process and decision-making. Explore how text, images and layout come together to help you meaningfully adjust your communication strategy. The weekly three-hour session is a dedicated time to reflect on your studio work, do hands-on writing, share and discuss. You will create effective, evocative, intriguing presentations, respond to feedback from a panel of guest readers and finally see your work published in a SoA sponsored book at the end of the term.

**48-348 Architectural History of Mexico & Guatemala**

Intermittent: 9 units

This course surveys the architecture and urbanism of Mexico and Guatemala from prehistory to the 20th century, focusing on three critical periods of their cultural history and architectural development: (1) the Pre-Columbian development of Mesoamerica, primarily Maya and Aztec, (2) the Spanish colonial architecture and urbanism of the 16th-18th centuries, and (3) the 20th-century search for an appropriate regional and national modernism. When the Spanish conquistador Hernán Cortés landed in 1519 in what is now Mexico, he encountered one of the world's largest and most spectacular civilizations. The Aztec empire, however, was only the latest urban civilizations in a Mesoamerican tradition that stretched back more than 2,000 years. The ensuing European architectural and urban imprints can be seen as both a victory of colonialism's political, social, and architectural ideals, and as a fusion combining European practices with indigenous conditions and traditions. Centuries later, as 20th-century Latin Americans grappled with the challenges of industrialization, economic swings, and political and social revolutions, architects, planners, and clients again sought to reconcile competing visions of national and modern identities. Student work will include a research paper and several shorter written assignments throughout the semester.

Prerequisite: 48-240

**48-350 Postwar Modern Architecture and Theory**

Intermittent: 9 units

This architectural history lecture course surveys the modern buildings and architectural theory of the post-World War II period. It begins with the cataclysm of WWII and the fundamental shifts it caused on the conception of modernism, technology, cities, and geo-politics. It proceeds to investigate themes such as rebuilding and reconstruction, grand modern masters such as Mies, Kahn, and Le Corbusier, the fascination with technology, megastructures and utopian thought, the need for monumentality, meaning, and regional identity, and the dissemination of modernism from corporate America to the third world. It ends with the rupture in modernism associated with the social revolutions and the rise of a post-modern architecture in the late 1960s and early 1970s. The course includes lectures, readings, and discussions to define the unique character of the postwar period, as modernism both reigned supreme, and began to be questioned. Emphasis will be placed on the relationship of buildings to the more general cultural, intellectual, and historical circumstances in which they were created. Special attention will be devoted throughout the course to the important manifestoes, theoretical and critical writings that so determined the project of modern architecture. Work for the course involves extensive reading, preparing for class discussions, and a major research paper.

Prerequisites: 48-240 or 48-241

**48-351 Human Factors in Architecture**

Spring: 9 units

Required course Human Factors is an investigation of what makes buildings tick for people: the internal spaces, transitional spaces, transactional spaces, defensible space, owned space, shared space, public space, and most importantly, occupied space. We move up in scale from the individual and group to the community to consider our designers' biases in how we analyze the human needs, how we judge the quality of space and subsequently, how we apply this knowledge to our own design work. Students develop a research question and test it in field research using observation, interviews and surveys. They draw conclusions about the quality of a space and place and how to improve it. Students should leave this class with the ability to discern a problem, experience in applying their understanding of behavioral settings and the human condition to specific research foci, and the ability to use their knowledge and skills deftly in practice, where time and resources are limited. Assignments will be a mix of individual and group work, with emphasis on the latter. There will be an emphasis on reading relevant literature, field investigations and understanding research methods and collaboration for applications in practice.

**48-355 Perspective**

Intermittent: 9 units

Course addresses perspective on the basis of three distinct understandings of perceptual psychology: 1) A Kinesthetic Basis for Perspective, which is built on the drawing pedagogy of Kimon Nicolaides. It aligns with the transactionalist understanding of perception and considers perspective as partly invented and partly discovered truth. 2)The Order of Appearance, which is built on the early work of the perceptual psychologist, J.J. Gibson, and aligns with the ecological position of Gibson and his followers It considers perspective as an absolute truth of the visual field. 3)Perspective Imposed, which aligns implicitly with the position of Gestalt psychology. It treats perspective as an imposed schema. Along the way some use is made of on-going design work for subject material. Work is submitted in 3 portfolio submissions of 3-4 weeks duration each.

Prerequisite: 48-105

**48-356 Color Drawing**

Intermittent: 9 units

The course will use three media, pastels, colored pencils and water color to address the representation of architectural space. Early work will focus on interiors; later work will extend into landscapes. Topics covered in each will be, value, color temperature and use of complementary palettes. Work will be submitted in three portfolios of 3-4 weeks duration. Work will consist of in-class exercises and out of class assignments using subjects of the students' choice. Including in-class work, students should anticipate 9 hours of work per week. Students should anticipate material costs for taking the course of ca. \$150.

Prerequisites: (48-121 and 48-126) or (48-130 and 48-135)

**48-368 Rediscovering Antiquity: Travelers, Archeologists & Architects in Mediterranean**

Spring: 9 units

The course proposes a journey in the Mediterranean, with special focus on Greece and Turkey, but also travel through time. In fact ancient cities and archeological sites, from the hills of Troy to the archeological sites of Pergamon and Ephesus, to the cities of Athens and Constantinople/Istanbul, will be studied not so much as signs of the important Greek and Roman past of the region, but as the object of late Eighteenth and Nineteenth century rediscovery. The rich vestiges of the mythical past of this region were then brought to the light, in the frame of complex and adventurous missions. The eyes of scholars, travelers and artists filtered and transformed the reality of the ancient objects and places, adding to their fascination and vitality and changing the way we perceive this legacy today. At the same time though, a new political agenda, new biases and new aims were connected with the rediscovery. These in turn influenced not only the way the past of the region was explored and the way the finds were studied and exposed, but also the cultural debate in the rest of Europe, with important effects on the architecture of the main European cities.

Prerequisite: 48-205

**48-371 American House and Housing, 1850-1975**

Intermittent: 9 units

This architectural history course examines the development of American house and housing choices during the period 1850-1975. A recurring picture of the "American Dream" has typically included the image of a single-family, detached dwelling set within its own green yard in the suburbs. However powerful and durable that image is, the history of house and home in America is actually a far more complex story with many different twists and turns. In the course we will look at both urban and suburban housing choices and cultures, ranging from single family detached dwellings to multi-unit housing, and across a social spectrum income, class, race, and gender. Through the use of occasional field trips, we will use Pittsburgh as a touchstone for understanding broader national trends in the history of American urban and suburban housing. The course is organized as a lecture course supplemented with field trips and discussions based on field trips and primary source readings. The additional time slot on Thursday afternoons will be used only when field trips are scheduled. Student work will include a research paper and several shorter written assignments throughout the semester.

Prerequisite: 48-240

**48-374 History of Architecture in the Islamic World- A Primer**

Fall: 9 units

This course serves as an introduction to the architecture that developed in the Islamic lands over the centuries. The aim of the course is to provide a basic understanding of major epochs and regional variations, examining the social and historical context within which Islamic art and architecture developed. Through lectures, discussion and guided research activities, the students will learn the function and meaning of the most important building types, examine how these types changed over time to adapt to the needs of changing societies, and consider influences and exchanges with other traditions. While the main geographical focus of the course will be on the Mediterranean area, from Moorish Spain to the modern Middle East, the students will have the opportunity to develop independent research projects on other areas of the Islamic world.

Prerequisite: 48-240

**48-380 Real Estate Design and Development**

Spring: 6 units

This course will provide an overview of the real estate development process and explore the interdependence of real estate development and design. The course will introduce real estate development team members, processes, and phases, including feasibility, predevelopment, construction, and marketing. The course will include a substantial financial component that will introduce students to the basic techniques of property valuation, project budgeting, pro forma analysis, sourcing of financing, and investment analysis. Students will study how market demand, tenant requirements, site constraints, zoning restrictions, and available capital affect design solutions. Course work includes classroom learning, independent reading and exercises, guest lectures, and examination of case studies. The semester's effort culminates in the execution of a team development project based on a current Pittsburgh development project. Teams will complete a basic market analysis, program evaluation, schematic design creation, project cost estimation, pro forma analysis, and evaluation of financial feasibility. Development practitioners will provide a critique of each team's project to offer "real world" guidance on student schematic designs and feasibility analysis prior to the final completion of the project.

**48-381 Ethics and Practice**

Spring: 12 units

Course description coming soon.

**48-383 Ethics and Decision Making in Architecture**

Spring: 6 units

Course description coming soon.

**48-390 Physical Computing Studio**

Spring: 10 units

This collaborative studio course will allow interdisciplinary teams to develop wearables with a focus on assistive technology. The ubiquitous nature of mobile devices coupled with low-cost and easily integrated sensors and actuators make this a good time to approach real problems for a range of users from the physically disabled to athletes. Teams will learn skills in hardware, software, fabrication, and design communication in order to effectively develop and share their ideas.

Prerequisites: 60-223 Min. grade C or 16-223 Min. grade C

Course Website: <http://ideate.cmu.edu/>**48-400 Advanced Synthesis Options Studio I**

Fall: 18 units

Having proven competency in the spectrum of skills determined necessary for tomorrow's architect during the first three years of the program, students in their fourth and fifth year are permitted to select from a variety of studio options, each providing the opportunity to build upon or augment some of those skills with new or more nuanced perspectives. All advanced synthesis studios are open to both years, the vertical integration offering enhanced learning opportunities. The content and focus of each studio is governed by faculty interests, which run the spectrum of architectural pursuits, ranging in scale from the design of a piece of furniture to a city and in approach from a comprehensive and complex building program to a critically-driven speculation. They may also be interdisciplinary in nature, taking advantage of the unique juxtapositions made possible at Carnegie Mellon.

Prerequisite: 48-305

**48-405 Advanced Synthesis Options Studio II**

Spring: 18 units

Having proven competency in the spectrum of skills determined necessary for tomorrow's architect during the first three years of the program, students in their fourth and fifth year are permitted to select from a variety of studio options, each providing the opportunity to build upon or augment some of those skills with new or more nuanced perspectives. All advanced synthesis studios are open to both years, the vertical integration offering enhanced learning opportunities. The content and focus of each studio is governed by faculty interests, which run the spectrum of architectural pursuits, ranging in scale from the design of a piece of furniture to a city and in approach from a comprehensive and complex building program to a critically-driven speculation. They may also be interdisciplinary in nature, taking advantage of the unique juxtapositions made possible at Carnegie Mellon.

Prerequisites: 48-400 and 48-412

**48-432 Environment II: Design Integration of Active Building Systems**

Fall: 9 units

High performing buildings can only be achieved with designs that effectively integrate passive and active systems. Having been introduced to passive systems in prior semesters, students will now be introduced to the range of active systems typically included in commercial buildings and strategies for their successful integration with passive components. The goal of the Design Integration of Active Building Systems course is to familiarize students with active building systems and integrative design strategies that should result in high levels of occupant comfort in commercial buildings that approach net zero energy and net zero carbon emissions. Active systems introduced in this class include: electrical lighting; mechanical ventilation; active heating and cooling; water systems for interior and exterior use and water heating, including solar; onsite electricity generation with renewable energy; building transportation systems; and active fire protection & smoke control. Because of the breadth of this subject area, the course will be future-focused, concentrating on design approaches and technologies that appear to be well-suited to a net zero energy and net zero carbon future. Prerequisites: successful completion of 48-116, 48-215 and 48-315 or their equivalent is expected. No prior knowledge of active commercial systems and systems integration is assumed, but students are expected to understand heating and cooling load calculations, to be able to identify factors in building design that affect those loads, and to quantify their impact. A basic understanding of daylighting and electric lighting principles as covered in 48-116 and 48-315 is also assumed.

**48-440 American Regions & Regionalism: An Architectural History of Place, Time, and Cul**

Intermittent: 9 units

Despite the leveling forces of mass culture and globalization, the geographic and social diversity of the U.S. has created distinctive regional mosaics of landscape and architecture. Say New England and images of English Pilgrims, town greens with white framed churches, and industrial mill villages may come to mind. The Southwest conjures different images, perhaps of adobe pueblos, Spanish friars, arid ranches, and the color turquoise. The built environment of the Midwest, the California coast, the Mississippi Delta, and many places in between reflect particular regional identities that have been both unconsciously and consciously created over time. This course examines the historical development of regional patterns in the American built environment. It investigates how and why a regions architectural identity evolved in the ways that it did. To what degree is place something to respond to, to interact with, and to what degree is place something that is created? Our focus will be primarily pre-20th century when the forces of vernacular traditions were stronger, we will also examine more recent trends of regionalism as an aesthetic choice and a theoretical stance.

Prerequisite: 48-240

**48-448 History of Sustainable Architecture**

Intermittent: 9 units

The History of Sustainable Architecture investigates themes of nature, ecology, pollution and conservation in the built environment and visual arts. The term "sustainable architecture" is a comparatively recent one, arising in reaction to the destructive and toxic nature of the industrial era and its strident ambassador, Modern architecture. Yet, an esthetic and philosophical view of harmony with nature accompanies many forms of historical human activity in the built environment. Similarly, issues of waste removal, mechanical systems and natural materials that characterize current concerns have illustrative historical roots in numerous civilizations going back centuries and even millennia in pre-Industrial or non-industrial cultures. This course will engage texts and examples relating not simply architecture, landscape and urban history, but also art, philosophy and popular culture as a means to understand the many precedents for today's interest in sustainable architecture and planning. The course will examine texts and works by figures including Vitruvius, Pliny, Leon Battista Alberti, Thomas Cole, Frederic Law Olmsted, Buckminster Fuller, Reyner Banham, Ebenezer Howard, Hassan Fathy, Bernard Rudofsky, Norman Foster, Robert Smithson, Andy Goldsworthy and more. Students will be encouraged to apply principles from the class to understanding and execution of work in their own discipline.

**48-452 Real Estate Design and Development**

Fall: 6 units

This course will introduce the Real Estate development process and explore the interdependence of development drivers and the design process. Classroom learning, exercises and guest-lectures will introduce students to the concepts of market and financial analysis, as well as the basic techniques of budgeting, proforma development, and valuation. Parallel to this investigation, students will evaluate real world developments and interface with the development professionals that executed them to learn how development drivers shaped the development process and decision making. Students will study how market demand, tenant requirements, site constraints, and available capital affect feasibility, and through this the ultimate design solution. The semester's effort culminates in the execution of a mini-development project. Students will work in teams to complete a basic market analysis, program evaluation, schematic design, construction and development cost estimate, proforma analysis, and a determination of financial feasibility. Development practitioners will interface with student teams during this mini-project to offer "real world" guidance on student schematic designs and feasibility analysis.

Prerequisite: 48-305

**48-453 Urban Design Methods**

Fall: 6 units

This undergraduate lecture course introduces urban design history, theory and methods. It is a required supporting course for the Urban Laboratory design studio, and similarly examines urban design at multiple scales: city form and networks, neighborhoods and block structures, streets, public spaces, and urban building typologies. Key issues introduced include the emergence and evolution of urban design as a discipline, economic, social and political factors affecting the contemporary city, and environmental sustainability at the urban scale. A wide variety of cities, projects, proposals and methodologies are examined. Assignments include readings from seminal texts, quizzes, and a final examination.

Prerequisite: 48-305

**48-454 Futures of the City/Cities of the Future**

Intermittent: 9 units

If all design can be read as attempts to predict and to shape the future, then no one looks further into the future than the urban designer and the urban planner. The work in which they are involved often does not materialize in their lifetimes; in fact, the duration of the projects are so long twenty, thirty, fifty and hundred year timeframes, it is more than likely that he or she will pass on before the project reaches fruition. The trouble with predicting the future is that it is so uncertain, so undecided, so unknowable. A brief look backwards reveals that we are not the first generation to consider the future. History is replete with predictions, some of which were actualized, the vast majority of which were not. Today's forecasts for tomorrow vary wildly. A handful of optimists view the future through rose colored glasses, whereby humanity is delivered to salvation via technological wonders and the widespread adoption of common social values. A larger group predicts the end of the world as we now know it, but even they cannot agree on the cause of our demise, with those arguing that climate change will kill us clashing with those convinced that we will be destroyed when robots achieve technological singularity. Shy of total extinction, however, any vision of the future requires designers, and will likely occur in urban (or formerly urban) locations. As of this decade, for the first time in history, more than half of the world's population, almost three and a half billion people, live in towns and cities. Estimates suggest that by 2030 this number will swell to almost five billion.

Prerequisite: 48-205

**48-470 Exploring Pattern Through Lamination**

Fall: 6 units

In the Fall 2017 and Spring 2018 there will be some changes to the shop electives offered. First the Spring Furniture Design and Construction course # 48564 will no longer be offered because that content is incorporated within the Furniture Studio in the fall. Next, the two shop mini courses previously offered in the fall will each be expanded to become full electives, one in the fall and one in the spring. The prerequisite for both of these classes is documentable experience with the band saw, table saw (ripping and crosscut), drill press and the belt and disk sander. Exploring Pattern Through Lamination, 48470 is scheduled Tuesday and Thursday mornings 10:30 am to 11:50 in the fall, and will be a 9 unit elective running the entire semester. Historically this course has explored patterns generated both as square tiles arranged like quilts, and as a series of rectangular, angular, and curved shape patterns generated by edge gluing. Next fall 2017 both methods of pattern generation will be utilized, however the presentation these products will take the form of doors. The tiles and shapes will be arranged to form an encompassing pattern spanning two door panels, using prescribed detailing.

**48-473 Hand and Machine Joinery, New Directions**

Fall: 6 units

In the Fall 2017 and Spring 2018 there will be some changes to the shop electives offered. First the Spring Furniture Design and Construction course # 48564 will no longer be offered because that content is incorporated within the Furniture Studio in the fall. Next, the two shop mini courses previously offered in the fall will each be expanded to become full electives, one in the fall and one in the spring. The prerequisite for both of these classes is documentable experience with the band saw, table saw (ripping and crosscut), drill press and the belt and disk sander. The Hand and Machine Joinery, New Directions, is scheduled Tuesday and Thursday mornings 10:30 am to 11:50 in the spring 2018, and will be a 9 unit elective running the entire semester. The elective will focus on building a free standing (or hung) cabinet with doors. If enrolled students have taken the Exploring Pattern course in the fall the doors made in that class will be mounted on the cabinet. If students have not taken that course then a pair of simple doors will be made instead. The primary goal of this course will be to learn the steps of making a simple cabinet using hand and machine joinery. Quality of craft will be of great importance. Uniqueness of design will not be emphasized, however individualization of the cabinet will still be possible throughout the construction, starting with choices between a wall mounted or free standing (with legs) cabinet, the selection of hardwoods, the specific size of parts, and the selection of particular detail options. The construction process will be carefully staged with demonstrations continuing throughout the semester. The cabinet will be perpendicular and rectangular. Students will use standard mortise and tenons of various sizes, bridal joints, floating tenons, tongue and groove, spline and dovetail joints.

**48-478 Digital Tooling**

All Semesters: 6 units

This course serves as an immersive analysis of the available technologies located in the Digital Fabrication Lab at Carnegie Mellon and beyond. Students begin to understand equipment limits/boundaries, purposes and concepts; and the possibilities that arise from thoroughly comprehending how these tools work. During your Digital Experience, students begin to understand more systematically how to use these tools to their advantage. A better understanding of the equipment proves very useful towards a SoArch Student's 3rd, 4th and 5th years at Carnegie Mellon; but more importantly provides a fundamental understanding of a leading edge technology that will certainly prove itself as an integral tool for any Designer throughout their professional career. It is based on the idea that pushing the limits of design fabrication; comes from knowing the limits of your tools. The course operates by discovering tooling extremes; thus indicating limits, and then incorporating these boundaries (and/or breaking them) with Digital Fabrication methods and tooling; ultimately providing a platform in which students begin to understand and incorporate project efficiency. Prerequisites: Imagination, Laser Cutting, Milling and 3D-Modeling Experience required. (Rhinoceros 3D Preferred)  
Prerequisite: 48-205

**48-493 Representing Activism**

Intermittent: 9 units

Efforts to promote social, political, economic and environmental change can range in form from written word to direct action. Sources of injustice are multi-dimensional and complex. Effective forms of activism are fueled by creativity that synthesize and distill complex constellations of information and foster understanding. REPRESENTING ACTIVISM explores the role of multi-media graphic representation as a lens through which to effect change and social justice. Modes of representation explored will span four dimensions, 1) Social Media, 2) Film, 3) Graphic Design, and 4) Technical Delineation.

**48-494 Beyond Patronage**

Intermittent: 9 units

TBD

**48-497 Thesis Prep**

Spring: 3 units

The primary goal of this mini is to help students formulate a robust proposal for the 5th year Thesis, but it could be used to create a proposal for any grant, scholarship or academic research project. A series of weekly workshops, readings, discussions, and guest lectures will help students move from wide-open initial ideas about issues they are curious about and seek to explore, to the development of a rigorous research process that builds on existing knowledge and attempts to develop new ideas and advances the discipline. The class will explore the difference between design and research in architecture, how different research methods and modes of representation can be leveraged, and how concepts of disciplinary and "project" can focus a topic. Students will begin to identify precedents, key readings and a research bibliography, an overview of the general topic they will research in depth, a detailed plan for a years worth of independent thesis work, and a well-defined end-product, likely a design proposal. An important task will be to identify advisors who can support, guide, and critique your work, who can act as intellectual collaborators as much as evaluators. This course (or an equivalent approved by the Thesis coordinator) is a pre-requisite for doing a year-long Thesis or semester-long Independent Project in 5th year studio.

**48-500 Advanced Synthesis Options Studio III**

Fall: 18 units

Having proven competency in the spectrum of skills determined necessary for tomorrow's architect during the first three years of the program, students in their fourth and fifth year are permitted to select from a variety of studio options, each providing the opportunity to build upon or augment some of those skills with new or more nuanced perspectives. All advanced synthesis studios are open to both years, the vertical integration offering enhanced learning opportunities. The content and focus of each studio is governed by faculty interests, which run the spectrum of architectural pursuits, ranging in scale from the design of a piece of furniture to a city and in approach from a comprehensive and complex building program to a critically-driven speculation. They may also be interdisciplinary in nature, taking advantage of the unique juxtapositions made possible at Carnegie Mellon.

Prerequisite: 48-410

**48-505 Advanced Synthesis Options Studio III**

Spring: 18 units

Having proven competency in the spectrum of skills determined necessary for tomorrow's architect during the first three years of the program, students in their fourth and fifth year are permitted to select from a variety of studio options, each providing the opportunity to build upon or augment some of those skills with new or more nuanced perspectives. All advanced synthesis studios are open to both years, the vertical integration offering enhanced learning opportunities. The content and focus of each studio is governed by faculty interests, which run the spectrum of architectural pursuits, ranging in scale from the design of a piece of furniture to a city and in approach from a comprehensive and complex building program to a critically-driven speculation. They may also be interdisciplinary in nature, taking advantage of the unique juxtapositions made possible at Carnegie Mellon.

Prerequisite: 48-105

**48-509 Architecture Design Studio: Thesis I/ Independent Project**

Spring: 18 units

This is a year-long, independently defined research and design project that takes the place of upper level option studios. Thesis is an opportunity to develop skills, thoughts, and habits essential for future success, including mental discipline; independence of mind and judgment; working with advisors; the capacity to focus and pursue a subject in depth and over an extended time; the ability to design and execute a complex project; the skills of analysis, synthesis, and clear writing; and the self-confidence that grows from mastering a difficult challenge. Thesis topics and research agendas are generated by the student, but must be determined in collaboration with an advising team, and approved by a Thesis Coordinator. The School seeks to encourage an expansive range of rigorous and provocative inquiry as a culminating experience for the B.Arch education, including work that speculates, invents, or improves on existing ideas, practices, or systems through research and design; work that challenges the boundaries of the discipline and the profession, and moves beyond mere practice or solution-based work; work that engages with open-ended and generalizable ideas, as much as with specific situations; work that projects or imagines a better future and an improved world; work that leads to the new knowledge, ideas, understanding, or paradigms. Acceptance into Thesis is dependent on passing the 48-497 ?Thesis Prep? course or its pre-approved equivalent, and submitting a rigorous thesis proposal to the Thesis Coordinator in late August, before the begin of classes. Approval for the 2nd semester is contingent upon successful completion of the 1st.

**48-519 Architecture Design Studio: Thesis II/ Independent Project**

Spring: 18 units

This is a year-long, independently defined research and design project that takes the place of upper level option studios. Thesis is an opportunity to develop skills, thoughts, and habits essential for future success, including mental discipline; independence of mind and judgment; working with advisors; the capacity to focus and pursue a subject in depth and over an extended time; the ability to design and execute a complex project; the skills of analysis, synthesis, and clear writing; and the self-confidence that grows from mastering a difficult challenge. Thesis topics and research agendas are generated by the student, but must be determined in collaboration with an advising team, and approved by a Thesis Coordinator. The School seeks to encourage an expansive range of rigorous and provocative inquiry as a culminating experience for the B.Arch education, including work that speculates, invents, or improves on existing ideas, practices, or systems through research and design; work that challenges the boundaries of the discipline and the profession, and moves beyond mere practice or solution-based work; work that engages with open-ended and generalizable ideas, as much as with specific situations; work that projects or imagines a better future and an improved world; work that leads to the new knowledge, ideas, understanding, or paradigms. Acceptance into Thesis is dependent on passing the 48-497 ?Thesis Prep? course or its pre-approved equivalent, and submitting a rigorous thesis proposal to the Thesis Coordinator in late August, before the begin of classes.

**48-530 Human-Machine Virtuosity**

Spring: 12 units

Human dexterous skill embodies a wealth of physical understanding which complements computer-based design and machine fabrication. This project-oriented course explores the duality between hand and machine through the practical development of innovative design and fabrication systems. These systems fluidly combine the expressivity and intuition of physical tools with the scalability and precision of the digital realm. Students will develop novel hybrid design and production workflows combining analog and digital processes to support the design and fabrication of their chosen projects. Specific skills covered include 3D scanning, 3D modeling (CAD), 3D printing (additive manufacturing), computer based sensing, and human-robot interaction design. Areas of interest include architecture, art, and product design.

Prerequisites: 16-223 Min. grade C or 60-223 Min. grade C

**48-531 Fabricating Customization**

Intermittent: 9 units

This course relocates the design process from the studio to the lab-workshop, moving design decisions upstream to include considerations of tooling and material processing as inputs for design experimentation. Students in this course will work in partnerships to explore novel methods of robotic metal sheet forming that are borne out of direct experimentation with industrial robotic arms and customized metal forming tools. We will operate in response to two primary motivations: 1. Explore novel methods of customizable robotic metal sheet forming. 2. Speculate upon the potential application of the results at the building scale. Our work will leverage the robustness and precision of industrial robotic arms in conjunction with rule-based, computationally generated geometry to explore highly customizable alternatives to long-standing massproduction metal forming techniques. In situating this as an open-ended series of design experiments, rather than product designs, we seek to produce artifacts that reveal the methods of their production and uniqueness of their material character, while suggesting potential applications at the building scale.

Prerequisite: 48-305

**48-550 Issues of Practice**

Fall: 9 units

Issues of Practice is a required course taught in the fifth year. It consists of three modules: Personal Promotion, Emerging Professional's Companion, and Excursions. The Personal Promotion module provides the students with a framework to create a resume, cover letter, and portfolio. The EPC (Emerging Professional's Companion) provides concentrated study in different aspects of professional practice. The Excursions require students to see how architecture relates to the wider world with architecturally related events that can include volunteer opportunities, lectures, mentorship, or teaching.

Prerequisite: 48-305

**48-551 Ethics and Decision Making in Architecture**

Spring: 9 units

Ethical Decision Making in Architecture is a required course in the fifth year of the Bachelor of Architecture Degree. It is part of a sequence dealing with professional aspects of the field of architecture, alongside courses like Human Factors, Real Estate Design and Development, and Issues of Practice. It builds on an understanding of the issues of occupancy, economics and practice in design decision making. The course covers basic frameworks of decision making and ethical adjudication through several case studies including Fallingwater, Sydney Opera House, Citicorp Tower, Pruitt-Igoe housing development, Crystal Palace and Kansas City Hyatt. The text for the course is a manuscript by the instructor entitled "Ethical Decision Making in Architecture".

Prerequisite: 48-205

**48-558 Reality Computing**

Fall: 12 units

The Adaptive House is the focus of an advanced design studio based around the collaborative development of reality computing applications within a residential prototype. Reality computing encompasses a constellation of technologies focused around capturing reality (laser scanning, photogrammetry), working with spatial data (CAD, physical modeling, simulation), and using data to interact with and influence the physical world (augmented / virtual reality, projector systems, 3d printing, robotics). This studio will use reality computing to understand existing homes, define modes of augmentation, and influence the design of houses yet to be built through full scale prototyping. The objective of the course will be the production of a house that moves beyond the notion of being "smart", but is actively adapted towards its inhabitants' needs and capabilities. Topics of special focus within the course are residential design (John Folan), augmented reality and robotics (Pyr Matikainen), and indoor flying robots (Manuela Veloso and Nina Barbuto).

**48-564 Furniture Design & Construction**

Spring: 9 units

This course is for students who already have a basic knowledge of hand tools and machines, and standard fabrication methods. Wood is the primary material, although other supplemental materials are permitted. One functional project will be built during the semester. Because all the equipment in the shop is traditional analog, the fabrication will remain analog. All operations will be done with hand tools or machines operated and controlled by hand. The emphasis of the design phases will also be non-digital. However recognizing the versatility of CAD, students will be permitted to advance and refine their ideas using their computer. One full scale orthographic drawing by hand will still be required, including plan, elevations, sections, and dimensions on 1/8" ply or mdf.

Prerequisites: 48-105 and (48-473 or 48-470)



**48-568 Advanced CAD, BIM, and 3D Visualization**

Fall: 9 units

This course is designed to introduce a student to advanced software applications, including AutoCAD 3D, 3D Studio MAX, and Autodesk REVIT. Students will learn how to properly set up and manipulate CAD projects integrating all three software applications, replicating real world projects in leading architectural firms. Building information and parametric modeling, animations, materials, lighting, and rendering concepts will allow students to create integrated projects, 3D video animations, and realistic renderings. At the conclusion of this course, students will have projects and animations created and architectural CAD standards outlined. Students should have some familiarity with basic AutoCAD 2D commands. Those who don't have AutoCAD 2D knowledge can contact the professor to arrange for on-line tutorials that need to be completed before classes begin.

Prerequisite: 48-305

**48-569 GIS/CAFM**

Spring: 9 units

A Geographic Information System (GIS) integrates displays, edits, analyzes, and shares spatial data for informing decision making. Industries benefiting from GIS include architecture, business, city planning, defense and intelligence, education, government, health and human services, natural resources, public safety, transportation, utilities and communications, and urban planning/design. GIS topics include map design and outputs, geodatabases, downloading and importing spatial and attribute data, digitizing, geocoding, and advanced spatial, 3D, and network analysis. Other topics such as raster-vector integration and web-based GIS will also be covered. Facilities management is the practice of coordinating the physical workplace with the people and work of the organization. Computer Aided Facilities Management (CAFM) integrates software tools to streamline operations, boost productivity and develop strategic planning goals for an organization. CAFM topics include space management, asset management, building operations, emergency preparedness, environmental health and safety, telecommunications, and real property and lease management. This course prepares students to understand, maintain, and manipulate spatial and organizational data using world leading software applications. By the end of the course, students will have sufficient background to identify spatial characteristics of diverse application areas enabling them to integrate spatial thinking and analysis into their academic research and careers.

Prerequisite: 48-205

**48-576 Mapping Urbanism**

Intermittent: 9 units

This seminar provides the critical tools necessary to examine the city as both a representation and a reality in flux. Through an interdisciplinary framework, students study urban history, theory, visual thinking and spatial mapping. Contemporary urban issues are introduced through weekly lectures, readings, and class discussions. Parallel to these urban explorations, students learn to employ a diverse set of representational techniques to create inventive mappings. Upper-level (300 and 400 level) undergraduate students and graduate students are encouraged to register.

**48-587 Architecture Lighting Design**

Intermittent: 9 units

Through hands-on exploration in the light lab, lecture and discussion, students will develop a design process for lighting people and architecture. Topics will include: Role of the architectural lighting designer in the collaboration process; Establishing design goals and a point of view; Communicating design ideas; Lighting interiors (retail, restaurants, offices, museums, hotels); Lighting exteriors (landscape, buildings, bridges); Technical tools (luminaires, lamps, control and dimming) A large part of class time will be devoted to hands-on experimentation of light. Students will also spend time in the light lab outside of class preparing realized lighting designs. The final design project will include full-scale lighting mock-ups.

Prerequisite: 48-105

**48-596 LEED Buildings and Green Design**

Spring: 6 units

Green building and sustainable design have been rapidly gaining acceptance in all sectors of the building market. Global issues of energy use, emissions, resource depletion, and land use are forcing building professionals to re-evaluate standard design and construction processes, and look to more environmentally friendly practices. The U.S. Green Building Council (USGBC) developed green building rating systems entitled Leadership in Energy and Environmental Design (LEEDTM) in order to define "green building" by establishing a common standard of measurement. LEED considers green building methods and technologies in several categories including site, water, energy, materials, and indoor air quality, and awards points towards an overall green building rating of certified, silver, gold or platinum. Currently, LEED registered projects make up 3% of the current U.S. commercial building market, and Pennsylvania is the third leading state with LEED registered projects. There is now a demand for design professionals with knowledge and experience not only in sustainable design but specifically with the LEED rating system as well. This course will provide students with background knowledge of the USGBC, the LEED system, as well as referenced standards related to specific topics. The course will benefit greatly from the large number of LEED projects in the Pittsburgh region, which will serve as case studies. Upon completion of the course, students will be prepared to take the LEED Professional Accreditation Exam, which is quickly becoming the standard of recognition for green building professionals.

Prerequisite: 48-315

**48-630 Masters Studio: Integration I**

Fall: 18 units

TBA

Course Website: <https://soa.cmu.edu/march>**48-631 Fabricating Customization**

Fall

to be created by the department

Prerequisite: 48-205

**48-634 Architectural Theory**

Fall: 9 units

TBA

Course Website: <https://soa.cmu.edu/march>**48-635 Environment I: Climate & Energy**

Fall: 9 units

This course introduces architectural design responses for energy conservation, human comfort, and the site-specific dynamics of climate. Students will be expected to combine an understanding of the basic laws of comfort and heat flow with the variables of local climate to create energy design guidelines for their own work. The state of the art in building energy conservation and passive heating and cooling technologies will be presented, with take-home readings and assignments. To stress the significance of architectural design decision-making on energy consumption and comfort, full design specifications and calculations will be completed for a residential-scale building. Students will compile a professional energy consultant's report, designing the most viable energy conservation retrofit measures for their client from siting, massing, organization, enclosure detailing, opening control, to passive system integration and management. An overview of world energy consumption in buildings and energy design standards will be challenged by lectures on building energy conservation successes, and emerging demands for a broader definition of sustainability. The course will end with a focus on the design integration of natural conditioning systems and the potentially dynamic interface of mechanical systems in small- and large-scale buildings.

Course Website: <https://soa.cmu.edu/march>**48-711 Paradigms of Research in Architecture**

Fall: 6 units

This course is both an introduction to important models and methods of academic research particularly as they are related to building design issues and a forum for intellectual curiosity. During the initial ten weeks of the semester, the course presents an overview of the field and covers several models of research as they relate to the building design. These will include models of natural sciences, social sciences, sciences of the artificial, engineering and aesthetics in building design. During the final five weeks of the semester faculty both CFA and CIT will be invited to make presentations about their areas of research and the methods they use. These presentations correspond in many respect to those covered in lectures.

**48-721 Building Controls and Diagnostics**

Intermittent: 12 units

This course introduces the concepts and methods of building diagnostics. It focuses on the empirical evaluation of the built environment (building components and systems, interactions between building, occupants and environmental conditions) in view of multiple performance criteria (thermal, visual and acoustic performance). Field measurement and assessment techniques will be introduced. The empirical methods of building analysis are commonly used to: describe/specify building components; study the real-time behavior of buildings; detect the causes of building failures; and gather data for model validation. The course will address these issues, both theoretically and practically, through the application of: field measurement techniques; physical modeling methods; and computer-aided building modeling. Computer-aided data processing techniques will be applied for the analysis and interpretation of the results of model and field studies. The role of building performance simulation in the area of building diagnostics will be investigated.

**48-722 Building Performance Modeling**

Fall: 12 units

This course introduces fundamentals and computational methods in building performance modeling. Topics include: modeling and design, overview of thermal, visual, and acoustical domain knowledge, integration of performance simulation in computer-aided design, introduction to the application of advanced computational building simulation tools, case studies and design assignments on the application of simulation in the evaluation and improvement of building performance.

**48-723 Performance of Advanced Building Systems**

Spring: 9 units

Advanced Building Systems Integration This is a graduate level course that focuses on commercial building performance achieved through systems integration. In lectures, class discussion, and student projects, we will explore the topic of building performance, the design and technical strategies that support sustainable high performance; the design, construction and operation processes that are likely to produce sustainable high(er) performance buildings; and the current state of theory versus practice. The course assumes a basic understanding of buildings' impact on the environment, of building design and materials performance, and the calculation of building heating and cooling loads. On that foundation, we will examine the concept of systems integration and how this approach can sustain the occupants and the environment far better than conventional design, construction and operation. Although US climate, building conventions and codes will be our reference point, we will broaden our discussion by using examples and data from many other countries. An essential aspect of our exploration will be identifying successful built projects and examining the factors that may have allowed those projects to succeed. If this course meets its objectives, students who successfully complete the material will understand and be able to discuss sustainable building performance characteristics, will understand the systems integration approach and how it differs from conventional approaches to building design, and will know how to positively affect architectural and engineering decisions to support the design, construction and operation of sustainable high performance buildings.

**48-724 Scripting and Parametric Design**

Intermittent: 6 units

This is an introductory course to parametric modeling, which can be taken either as a half-semester assignment-based course, or as a full semester course with a parametric design project component. The course will introduce i) fundamental concepts of geometric modeling including such topics as: spatial coordinates, projections, Boolean operations, formal transformations, freeform surface creation, development and deformations; ii) parametric techniques and tools to model designs parametrically, to construct geometrical relationships among complex shapes, and to deal with constraints and their propagation. The lectures will be on computational geometry that can be applied to architectural design. In addition, the lectures will focus on hands-on techniques that can be applied to the design process, to extend the efficiency and productivity of work during the process. For practical reasons, the course will use RhinoCeros, Grasshopper, Rhinoscript, and .NET framework.

Prerequisite: 48-624

**48-725 Real Estate Design and Development**

Fall

This course will study the real estate development process and explore the interdependence of financial investment drivers and the creation of this built environment. Classroom learning, exercises and guest-lectures will introduce students to the concepts of market, location and valuation, as well as the basic techniques of real estate finance including development budgets, operating proformas, return analysis, and lender requirements. Parallel to this investigation, students will have opportunities to study real world developments and interface with the development professionals that executed them to learn how development drivers shaped the development process and decision-making. The semester's effort culminates in a feasibility study of a development site Pittsburgh. Students will complete a basic market analysis, program evaluation, zoning, deeds, liens and a determination of financial feasibility. Students will study how market demand, tenant requirements, site constraints, and available capital affect feasibility, and through this the ultimate design solution. Development practitioners will interface with student teams during this case study to offer "real world" guidance on student proposals.

**48-729 Productivity, Health and the Quality of Buildings**

Intermittent

Given the growing demand for green buildings by federal and private sector clients, professional practices are tooling up? all over the world to deliver high performance, environmentally responsive, green buildings and communities. However, investments in green, high performance building solutions and technologies are still limited by first cost decision-making, and life cycle tools are still largely inaccessible to professionals. A building investment decision support tool? BIDS? - continues to be developed by the Center for Building Performance and Diagnostics at Carnegie Mellon University, with the support of the Advanced Building Systems Integration Consortium. This cost-benefit decision support tool presents the substantial cost-benefits of a range of advanced and innovative building systems designed to deliver? privacy and interaction, air quality, ergonomics, lighting control, thermal control, network flexibility, and access to the natural environment - from field case studies, laboratory studies, simulation studies, and other research efforts. This course will explore the relationship of quality buildings, building systems, and land-use to productivity, health, well-being and the environment. The course will engage students in the literature that relates building design decisions to ten cost/performance impacts: energy, facilities management, organizational change, technological change, attraction/retention (quality of life) of employees, individual productivity, organizational productivity, salvage/waste, tax/ insurance/ litigation, and health.

Prerequisite: 48-305

**48-738 Special Topics: Ecological Footprints**

Fall: 6 units

The Ecological Footprint is a measure of the demand that human activity puts on the biosphere. More precisely, it measures the amount of biologically productive land and water area required to produce all the resources an individual, population, or activity consumes, and to absorb the waste they generate, given prevailing technology and resource management practices (Global Footprint Network 2010). This course will engage students in the metrics and impacts of our collective consumption and waste of: -Energy -Materials (Cradle to Cradle) -Food -Water -Transportation -The Integration of Systems towards Quality of Life Starting at the global context, this course will address challenges/opportunities to advance regenerative practices, improving our relationship to nature. Learning from international best practices, we will continue to explore ecological footprints at the global, national, regional, city, neighborhood, building and individual scale. The course will be based on lectures and readings, with assignments and student presentations to fully explore each of the footprint characteristics. Experts on water, energy, materials, food and other resources have been invited to lecture. By mid semester, an application project will be selected for ecological footprint analysis and the development of design, engineering, and operational guidelines towards reducing that footprint. The potential application projects include: the CMU campus footprint and Donner House retrofit; the Energy Innovation Center and education of the trades in reducing our regions footprint; or a new Net Zero building for Carnegie Mellon University. This will be a collaborative effort.

Prerequisite: 48-305

**48-739 Making Things Interactive (Graduate)**

Fall

In this hands-on design-build class you will learn the skills to embed sensors and actuators (light, sound, touch, motion, etc.) into everyday things (and places etc.) and to program their interactive behavior using a microcontroller. You'll also dive into the fields of VR/AR/MR and experiment with combining these disciplines with physical computing. Through weekly exercises and a term project the class will introduce basic analog electronics, microcontroller programming, projection mapping and virtual reality; as well as exploration into using kinetics and materials to make the things you design perform. Emphasis will be on creating innovative experiences. The graduate edition of this course will require additional work including a paper that can be submitted to a peer-reviewed interaction design conference such as CHI, UIST, or TEI. Students from all disciplines are welcome: but please note that the class demands that you master technical material. Experience in at least one of: programming, electronics, or physical fabrication is strongly recommended. (Participants will provide their own supplies and materials.)

**48-749 Special Topics in CD: Parametric Modeling with BIM**

Intermittent

This course is on modeling with an emphasis of producing designs that meet sustainability standards such as LEED, BREEAM, GreenStar, etc. The course is offered either as a half-semester assignment-based mini course (without prerequisites) or extended to a full semester course with a project component (for those students who meet the necessary requirement at mid-semester). Graduate students in Computational Design are required to register for the full 10 units. In addition, some prior programming experience (Visual Basic or C#) would be beneficial although not essential. Overall, the course will introduce: (i): Fundamental concepts of building information modeling Students will be introduced to parametric sustainable building information modeling to create and experiment with performance evaluations. (ii): Parametric modeling techniques and tools Tools will focus on hands-on techniques that can be applied to the design process, to extend the efficiency and productivity of work during the process. For practical reasons, the course will use Autodesk Revit Architecture, Green Building Studio and .NET framework. Overall, the course will introduce: (i) Fundamental concepts of building information modeling. Students will be introduced to parametric sustainable building information modeling to create and experiment with performance evaluations. (ii) Parametric modeling techniques and tools. Tools will focus on hands-on techniques that can be applied to the design process, to extend the efficiency and productivity of work during the process. For practical reasons, the course will use Autodesk Revit Architecture®, Green Building Studio and .NET framework.

Prerequisite: 48-205

**48-752 Zero Energy Housing**

Fall: 9 units

Net zero energy construction has gone from concept to policy in just a few years, but built examples are still rare. What does it take, technically, to achieve net zero and what else, beyond technical requirements, advances or impedes a net zero future? 48-752 is a graduate level class that explores net zero energy design and construction in the residential sector. Through case studies and applied projects, we will explore what it takes to achieve quantitative net zero in residential buildings while maintaining occupant comfort and satisfaction. In locations where net zero is now required, we will examine the results of those requirements. At the outset, we will discuss specific definitions of a net-zero building and the implications of each definition. Through case studies, lectures, field trips, outside reading and assignments, we will examine how a net-zero building is achieved, including the use of renewable energy to achieve the net-zero balance. We will apply lessons learned from metered examples to real sites and to new design or renovation projects in Pittsburgh and will use simulation software to test and quantify the impact of our design/renovation strategies. We will also compare our strategies to requirements in US codes and rating systems such as IECC-2012 and LEED for Homes to evaluate their impact in moving the US residential sector toward much higher performance buildings. Although our focus is residential, many of the concepts and strategies we cover have parallels in the commercial sector. Students who enroll in the class must know how to calculate without software heat loss and heat gain for a small building. You are also expected to have a fundamental understanding of residential design and construction, plan reading and mechanical systems; US residential materials and construction methods for net zero will be covered in class.

**48-753 Intro to Urban Design Media**

Fall: 6 units

This course introduces urban design history, theory and methods of analysis and representation. Urban design is examined at multiple scales: city form and networks, neighborhood and block structures, streets, public spaces, and urban building typologies. A wide variety of cities, projects, proposals and methodologies are examined with a special focus on urban sustainability in the contemporary city. Assignments include readings from seminal texts, presentations and discussions, graphic assignments and a final project. A required course for Master of Urban Design students, it is also open to fourth and fifth-year architecture undergraduates as well as graduate students in related programs.

**48-783 Generative Modeling (GRAD)**

Fall and Spring: 9 units

This course introduces students to the fundamentals of generative modeling using computer aided design as practiced in the field of architecture. Core competencies will be developed through modeling projects and software intensive labs, while a broader critical framework for conceiving of contemporary and historical parametric practices will be encouraged through weekly lectures. Emphasis will be placed on careful consideration of digital mediums and developing a sense of craft related to digital modeling in the hope that students will become conscientious makers and consumers of digital content. Students will be encouraged to understand and apply algorithmic problem solving to the many design constraints encountered in architecture. The course will explore the relationship of parametric workflows to design thinking and will situate contemporary trends in a broader framework of computational design. The course will also forefront complex form-making as a response to bio-mimicry, systems thinking, and mass-customization. Rather than positioning parametric modeling as a disruption of historical architectural design process, the course will encourage students to consider how new tools might augment the discipline's historical commitments to orthographic projection, perspectival drawing, and physical modeling.

**48-795 LEED, Green Design and Building Rating in Global Context**

Spring: 6 units

LEED, Green Design and Building Rating in Global Context is a graduate level mini-course that examines holistic, integrated strategies for sustainable building design, construction and operation. The course is organized within the framework of the US Green Building Council's Leadership in Energy and Environmental Design (LEED) Rating System: location, site, water, energy, materials, and the interior environment. Within that framework, we explore strategies promoted within LEED and compare/contrast them with strategies in the rating systems of other countries. We also consider additional ways to encourage development of better buildings, e.g., codes and standards, incentives, and project delivery methods. The course focuses on the concepts underlying rating system credits, the national contexts that can produce different rating systems, and substantive improvement in building performance. This course provides the foundation for taking USGBC's LEED Green Associate exam. More importantly, students who successfully complete the course will understand buildings' powerful impact on the environment and equally powerful strategies to address those impacts. There are no prerequisites for this course. However, because the course moves quickly and we are discussing improvements to building practice, a basic knowledge of the vocabulary, design, construction and operation of buildings is assumed.

Prerequisite: 48-315

**48-801 Office Visits**

Fall: 6 units

Each candidate will arrange with their home office a virtual 'visit' for members of the degree program and organize presentations of the projects, methodological challenges, recurring problems, best and worst practices within the context of their office experience. Asynchronous Course Delivery (Fall 2014) -> September 18, through December 7, 2014 Online Synchronous Course Conclusion (Fall 2014) - December 8-11, 2014

**48-802 Principles of Research I**

Fall: 6 units

Candidate's current knowledge of problems, methods and outcomes based on their professional work. Overview of the eight knowledge areas as existing disciplines and their potential place in them. Asynchronous Course Delivery (Fall 2014) -> September 18, through December 7, 2014 Online Synchronous Course Conclusion (Fall 2014) - December 8-11, 2014

**48-803 Areas of Practice**

Fall: 6 units

Candidate presentations of area(s) of expertise summarizing the methods and problems that are prevalent; using case studies to establish a situated approach to research. Asynchronous Course Delivery (Fall 2014) -> September 18, through December 7, 2014 Online Synchronous Course Conclusion (Fall 2014) - December 8-11, 2014

**48-804 International Exchange I**

Fall: 12 units

Conduct workshops for collaborative research and information exchange meetings with EU cohorts visiting from the Université Toulouse III - Paul Sabatier, Doctoral Programs in Architecture. Asynchronous Course Delivery (Fall 2014) -> September 18, through December 7, 2014 Online Synchronous Course Conclusion (Fall 2014) - December 8-11, 2014

**48-805 Directed Study I**

Fall: 6 units

Prepare the first publishable article under the supervision of the advisor, based on the current professional practice record of the candidate. Submitted to a committee of faculty for approval. Asynchronous Course Delivery (Fall 2014) -> September 18, through December 7, 2014 Online Synchronous Course Conclusion (Fall 2014) - December 8-11, 2014

**48-809 International Exchange II**

Spring: 12 units

Visit Université Toulouse III - Paul Sabatier, Doctoral Programs in Architecture and participate in collaborative research and information exchange meetings with EU cohorts, based on the cohorts current knowledge base culled from their practice experience. Asynchronous Course Delivery (Spring 2015) - January 18, through May 13, 2015— Online Synchronous Course Conclusion (Spring 2015) - May 14 through 17, 2015

**48-810 Comparative Analysis of US and EU Practices**

Spring: 6 units

Practices in the building sector vary considerably in the US versus the EU. The instructor will provide a rich collection of national and international initiatives in the AEC domains and include a stimulating series of site visits to important installations in the area. Asynchronous Course Delivery (Spring 2015) - January 18, through May 13, 2015— Online Synchronous Course Conclusion (Spring 2015) - May 14 through 17, 2015