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
3 units

48-026 First Year Seminar: Architecture Edition II
3 units

48-095 Spatial Concepts for Non-Architects I
Fall and Spring: 10 units
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). Projects will explore the design and experience of spatial environments through a series of creative investigations. The first half of the semester will focus on short projects, with each design investigation progressively building upon the previous exploration; these early projects will consist of both individual and group work. The second half of the semester will consist of one long term project to be created individually, incorporating students’ personal theories of architecture. Studio work will be supported by group discussion based upon critical review of student work, readings, slide presentations, videos and films. 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
This is the first course in the design studio sequence. As such, it establishes the foundation of exploration into the design process and provides the fundamental abilities required to represent the students’ inductive and deductive ideas as it pertains to spatial thinking. The semester is divided into two halves: The first half of the semester is devoted to teaching fundamental skills which involve collaboration, experimentation, working at full size, testing, ecological research and basic architectural fundamentals such as drawing and making as they pertain to small scale design projects. These projects focus on teaching fundamentals such as point, line, plane and volume as well as fundamental drawing skills such as line types, plan, section, elevation, volumetric and analytical drawing. The design process then shifts to projects, which introduce the student to spatial thinking. Students are asked to explore the fundamental issues of space through geometry, spatial definition, spatial transparency, overlap and articulation. These projects are explored in both the studio setting as well as through a woodshop project. By the end of the semester students are given an elementary program, which is to adapt the students’ spatial strategy to a specific landscape environment. By developing a relationship between the spatial enclosure, landscape, and the natural environment, the student is to show a basic understanding in spatial thinking through graphic, mock-up, physical and digital modeling.

48-105 Architecture Design Studio: Foundation II
Spring: 12 units
The spring semester, Methods and Transformations in Space of the first year architecture program extends from experiences in the fall semester Methods and Transformations in Form. Architecture as a spatial practice is introduced. Design projects evolve from previous studies of structure surface and volume in plant and landscape paradigms. Systems and sequences previously explored in nature are developed in cultural contexts through a progressive series of projects. Mapping human behavior and studying architectural precedents create spatial temporal experiences and narratives. Architectural and interdisciplinary analyses launch each project as a vehicle for generative design strategies. Fluid connections between drawing (freehand and drafted) and modeling (physical, computer, and wood shop) are continued. The semester is divided into three primary design projects: WOODSHOP: The studios explicit relationship to the woodshop is expanded in this course. ROOM (Private) INTERIOR: This project introduces a group research project of architectural precedents as its analytical catalyst. The study of an interior space focuses the transition form to that of space. PLACE (Public) BUILDING: This project uses, interdisciplinary, cultural research as its analytical formal catalyst. The study of a public infill building establishes architecture within an urban context and requires ability to create spatial sequences of public / private programmatic function. The process involves freehand drawing, model building, shade and shadow, digital modeling, and drafting. Prerequisite: 48-100.

48-115 Physics for Architects
Spring: 9 units
Physics is a basic science, typically taught by the College of Science. Physics for Architecture was introduced in Spring, 2005 to best address the academic needs of students in the School of Architecture. It is taught as a science course that provides an emphasis on the physics topics most essential to architecture. The course covers units, vectors, motion in 2D and 3D, Newton’s Laws of Motion, Applying Newton’s Laws, work, energy, conservation of energy, momentum, impulse, collisions, rotation, equilibrium, gravitation, periodic motion, fluids, temperature, heat, thermal properties, and the first law of thermodynamics. The course is very similar to those offered by the physics department, but it is modified to place heavier emphasis on those topics pertinent to architecture, specifically: forces, reactions, equilibrium, dynamics, vibration, thermal properties of matter, heat transfer, and insulation.

48-116 Building Physics
All Semesters: 9 units
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. Autodesk Ecotect and Radiance software programs will be used for lighting and thermal performance simulation.

48-120 Introduction to 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.
48-125 Introduction to 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 course content 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.

48-130 Architectural Drawing I: A Tactile Foundation
Fall: 9 units
Introductory course in a sequence of three drawing courses required by the school of architecture for its professional degree program. It consists of in and out of class exercises in free-hand perspective and general life-drawing. Coursework is built around exercises in the required course text: Drawing and Perceiving, John Wiley and Sons. Part 1 focuses on contour, Part 2 on volume, and Part 3 on mass, a structure that parallels, in some respects, the on-going work in 48-100. Part 3 provides a review of the earlier work of the course as well as a direct application to an on-going studio projects. Topics are introduced through figure drawing and lecture demonstrations and subsequently applied to architectural subjects. The approach of each of these parts is based on the work of Kimon Nicolaides as presented in his landmark book, the Natural Way to Draw. Work is submitted in three portfolio submissions of three to four weeks each.

48-135 Architectural Drawing II: Appearance
Spring: 9 units
“Understanding Appearance” builds knowledge of the order of appearance and drawing as a reasoned response to same. Coursework covers three subjects: 1) free-hand and constructed perspective 2) shade and shadow projection, 3) chiaroscuro drawing and color drawing in pastel, each of 3-4 weeks duration. Work of each is submitted in 3 portfolio submissions.
Prerequisite: 48-130.

48-200 Architecture Design Studio: Composition
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 ground up, to the resultant conceptual, to the physical 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.

48-205 Architecture Design Studio: Materials
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.
Prerequisites: 48-200 and 48-210
Corequisite: 48-215.

48-210 Statics
Fall: 9 units
Topics: Vector mechanics; forces and moments; equilibrium of rigid bodies; reactions; sections and internal forces on free-bodies; analysis of simple beams and trusses; stress and strain; elasticity; bending stress; shear stress; beam design. Material is taken directly from the required texts, presenting the scientific background of each concept together with numerous application examples. Students master the material by completing weekly problem sets. The lectures, text readings, problem sets, and examinations form a consistent treatment of the material.
Prerequisites: 33-106 or 48-116.

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. This is the fourth lecture course of the technology sequence and focuses on the principles of building construction utilizing contemporary systems. Materials and Assembly, taught in parallel with the design studio and Structures I, allows in-depth exploration of the fundamentals of contemporary construction, while the studio provides a simultaneous setting for the application and synthesis of this knowledge. The materials science content of the course examines construction materials with regard to their process of manufacture, their physical properties, their environmental performance and their methods of selection and specification. The assembly content of this course examines the selection, design, preliminary sizing and methodology of construction systems in wood, masonry, steel, sitecast concrete and precast concrete.
This class introduces the fundamentals of enclosure systems.
Prerequisites: 48-210 or 12-235.

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.
Prerequisites: 48-210 or 12-207.

48-240 Historical Survey of World Architecture and Urbanism I
Fall: 9 units
Reflecting the inseparable relation between building and human needs, this lecture course is not only a history of architecture, but also a history through architecture. This course 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 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 ancient to present times. 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.

48-241 Survey of Architectural History II
All Semesters: 9 units
This architectural history lecture course continues the survey from 48-240. It focuses attention on the 20th-century by investigating the web of 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 through Post-Modernism. The emphasis throughout is on the art of architecture, studying how architecture is part of, and has influenced culture through experimentation and provocative thinking, even when the primary intent was functional, technological, social, political, etc.
Architecture Design Studio: Environment
Fall: 18 units
Design Studio I: 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
Prerequisites: 48-217 and 48-205.

Architecture Design Studio: Advanced Construction
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 studio and 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.
Prerequisites: 48-300 and 48-312.

Site Engineering and Foundations
Fall: 6 units
Site Engineering and Foundations is a required course taught in the third year. It is a companion course to the Studio (48-300) and covers materials related to the issues of surface and its manipulation (grading, road alignment and stormwater), soils (fundamentals of soil mechanics) and structures (fundamentals of foundation design). Students are introduced to the conceptual fundamentals, exposed to applications in the field, and develop skills which are demonstrated in this class and in their studio work. The course syllabus is broader than found in any existing text treatment, but is supported by one required textbook, two recommended texts and excerpts from other sources.
Prerequisite: 48-217.

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 are expected to combine an understanding of the basic laws of comfort and heat flow with the variables of local climate to create regionally appropriate energy design guidelines for their design projects. The state of the art in building energy conservation and passive heating and cooling technologies, as well as the emerging field of sustainable design are 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 hand calculations are completed individually by each student for a residential-scale building. Students 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 is challenged by lectures on building energy conservation successes and competitive challenges of sustainability. The course ends 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.
Prerequisite: 48-116.

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.

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 History of Theory
Intermittent: 9 units
Architecture is not only building, technology, drawings, etc., but also discourse, meaning, communication, and concept: or theory. This architectural history seminar will study in roughly chronological order some of the major theories and theoreticians of architecture from Vitruvius through the Renaissance, the Enlightenment, the 19th-century, up to the modern era. Throughout the seminar we will chart the changing definitions of what constitutes "theory" in architecture, and how it relates to other writings such as criticism and history. We will study in-depth how (if at all) the individual theory relates to the intellectual context and built works before and after. Students will discover how ideas recouperate, and even the oldest theories have a historical reference in the development of architecture. The seminar will involve extensive readings, active class discussions, and a term paper on pre-20th-century theory.
Prerequisite: 48-240.

48-343 American Built Environment Since 1860
Intermittent: 9 units
The American built environment of today is dominated by the city and the suburb. Although cities and homes are hardly 19th century inventions, the landscape we inherit today is deeply affected by the architectural and cultural practices of the preceding centuries. In this course we will study a century of radical change in American architecture, ranging from the rise of skyscrapers to the sprawl of suburbia. We will look at architecture as both a designed object and as a cultural landscape shaped by class, gender, race, economics, politics, and fashion. Through the use of field trips, we will use Pittsburgh as a touchstone for understanding broader national trends in American architectural and urban design between circa 1850 and 1950.
Prerequisite: 48-240.

48-344 Architecture of Henry Hornbostel
Intermittent: 9 units
This course addresses the architectural career of Henry Hornbostel (1867-1961) from the beginning of his architectural education at Columbia University in the late 1880s through his retirement from the profession in 1939 until the revival of interest in his work in the 1980s. Hornbostel studied at the Ecole des Beaux-Arts in Paris, which is reflected in his early work. Later designs incorporate the abstracting tendencies of the Streamline Moderne or Art Deco. Throughout his career, Hornbostel was consistently innovative, eclectic and not necessarily easy to classify, even though the Beaux-Arts label provides an easy way to pigeon-hole (some of) his work. Interest in Hornbostel often begins with his buildings on campus. Many consider the CFA building Hornbostel's masterpiece. Nearby, Hornbostel designed the Rodef Shalom Synagogue, the Soldiers' and Sailors' Memorial, the Schenley Apartments, Webster Hall and a number of buildings for the University of Pittsburgh in Oakland alone. Downtown, the City County Building, the Grant Building and the German Evangelical Protestant (now Smithfield United) Church are also prominent elements in his corpus. Not simply a "Pittsburgh architect," Hornbostel enjoyed national prominence in the profession during his career. He consistently won design competitions for prestigious commissions throughout his career. New York, West Virginia, Georgia, Illinois and California. Hornbostel died in 1961, Modernism's heyday, so he was largely forgotten. There is only a single monograph on Hornbostel and a comparatively small bibliography of recent publications. The excitement of this dearth of secondary literature is the presence of many nearby significant built works and major archives of original drawings and other documents at CMU. These play a role in the course.
Prerequisite: 48-240.

48-345 The Cultural Landscape of Northern Italy: Land, City, Architecture
All Semesters: 9 units
The course proposes to plunge into the richness of the cultural landscape of Northern Italy, to examine through its architecture and its culture the relationship of man with land over time. The layers of different cultural and artistic traditions, superimposed and entwined by the passing of time, will start from the cities and territory that we see today, to learn to unearth the layers of their history, their geographic, economical and cultural connections, and to understand the challenge underlying the need to select and preserve part of this incredibly rich and complex memory.
Prerequisite: 48-240.

48-348 Architectural History of Mexico & Guatemala
Intermittent: 9 units
This course surveys the architecture and urbanism of Mexico and Guatemala during three critical periods of their 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 modernism. When the Spanish conquistador Hernán Cortés landed in 1519 in what is now Mexico, he entered 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 impacts can be seen as 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.
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 reignited 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.
Prerequisite: 48-240.

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 it in the context of the individual and the group 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 it in the context of the individual and the group and subsequently, how we apply this knowledge to our own design work.
Prerequisite: 48-205.

48-352 Islamic Architecture
Intermittent: 9 units
The course explores selected episodes of the history of preservation, defining in the historical context the respective fields of conservation theory, restoration practices and preservation policies. A first part of the course will focus on the early history of the debate on heritage conservation, early restoration practices and the underlying progressive creation of administrative structures and official policies regarding preservation and heritage listing. (mainly in Europe, from the French revolution to the First World War). The second part will focus on the main features of modern-day approaches and problematic aspects, the broadening of the field of preservation (including urban areas and landscape preservation) and the different sensibilities involved in both decision-making and implementation practices.
Prerequisite: 48-240.
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 Kilm Nicolas. It is aligned 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 ongoing design work for subject material. Work is submitted in 3 portfolio submissions of 3-4 weeks duration each.
Prerequisites: 48-135 and 48-130.

48-356 Color Drawing
Intermittent: 9 units
The course will use three media, pastels, colored pencils and watercolor 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 $150.
Prerequisites: 48-130 and 48-135.

48-368 Rediscovering Antiquity: Travelers, Archeologists & Architects in Mediterranean
All Semesters: 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 Costantinople/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.
The Prerequisite: 48-240.

48-371 American House and Housing
Intermittent: 9 units
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. And yet, however powerful and durable that image is, the history of house and home in America is a far more complex tale and it is a story with many different twists and turns. This architectural history course examines the development of American house and housing choices between 1850-1975. 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 additional time slot on Thursday afternoons will be used only when field trips are scheduled. The course is organized as a lecture course supplemented with field trips and discussions based on field trips and primary source readings. Student work will include a research paper and several shorter written assignments throughout the semester.
Prerequisite: 48-240.

48-400 Architecture Design Studio: Occupancy
Fall: 18 units
The Occupancy Studio raises a designer’s involvement with human needs, functional and space programming, building planning and schematic design with its focus on the relationship of the building user (owner/client, occupant or visitor) to the built environment. At the crux is how an architect develops a methodology to understand the individual or aggregated occupant and assemble decoded, distilled and articulated criteria for the design of space. Studios may emphasize intellectual or theoretical approaches to user-based design, in-depth study of client needs resulting in a detailed program, or participatory design with a real or surrogate client such as a community group. Each semester offers a range of such ideas. Studio faculty varies building typeology, conceptual approach, programming studies or development and historical precedent. Studios share information and project knowledge with each other. This healthy mix enlivens design process and class participation. An important aspect of the Occupancy studio and the following Systems Integration studio is understanding the application of codes and zoning requirements, which students research themselves after attending lectures on the basics of life safety, egress and the intrinsic order of code applications. Students are encouraged to work both in teams and as individuals.
Prerequisite: 48-305.

48-405 Architecture Design Studio: Systems Integration
Spring: 18 units
In today’s climate of complex clients and large-scale architecture, design students research and discuss broad political, economic, infrastructure, management and operational systems. Following this theme, the students’ quest of building integration, they examine the complex interrelationships between performance criteria, building subsystems and their integration, specification, and evaluation. This studio is concerned with the detailed design development relating to the spatial, visual, acoustic and thermal performance of complex buildings as well as the long-term integrity of the integrated systems. Students achieve design integration of at least two building systems and their interdisciplinary objectives - structure, enclosure, interior, mechanical, communications and information, and the safety systems—addressing issues of constructability and technical innovation while combined with suitability to the user, studied in the previous semester of Occupancy.
Prerequisites: 48-412 and 48-400
Corequisite: 48-415.

48-410 Environment II: Light
Fall: 6 units
This course introduces fundamental lighting principles in the context of performance-based architectural design and diagnostics. The course will cover relevant aspects of building physics 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.
Prerequisites: 33-106 or 48-115.

48-412 Environment II: Mechanical Systems
Fall: 9 units
Mechanical Equipment is a study of the mechanical systems required to heat, cool, ventilate, wire and plumb a building. Students will focus on energy usage and savings for buildings along with a look at the various system types and equipment used – past, present, and future. The course parallels the AIA review class for the professional license examination, and should become a future study guide for the exam.
Prerequisite: 48-105.

48-413 Building Acoustics
Fall: 6 units
This course introduces theoretical foundations, computational approaches, and design methods in architectural acoustics (building and room acoustics). Topics include a review of physiological and psychological response to the acoustical environment, prediction of indoor and outdoor air-borne sound propagation, sound transmission between rooms, design methods in room acoustics, and applications of computer-aided simulation tools for room acoustical design.
48-415 Advanced Building Systems
Spring: 6 units
Advanced Building Systems is a required course taught in the fourth year with a direct connection to the studios emphasizing system integrations. This course introduces the concept of Total Building Performance, delineating the full range of performance mandates required for today's architecture, including building integrity. Advanced Building Systems highlights the state-of-the-art and major challenges and innovations in building technologies for structure, enclosure, mechanical, telecommunications, lighting, and interior systems. The course explores the relationships, opportunities, and conflicts of the performance mandates, and the integration of building systems necessary to achieve total building performance.
Prerequisite: 48-305.

48-420 City as Landscape: Geography as Method and Metaphor
Intermittent: 9 units
This design theory seminar will explore the emergence of landscape, ecology, and infrastructure as new conceptual, aesthetic, and methodological organizers for architectural and urban form. Over the first decade of the twenty-first century it has become clear that the form of urban settlement is driven by complex interacting systems, ecologies, and economies resulting in a physical form that has surpassed our traditional notions of "city" or "landscape," while producing highly unsustainable patterns of development with both ecological and cultural impacts. At the same time contemporary culture has evolved into a hyper-mediated, networked and globalized state which appears increasing unstable, creating both positive negative potentials. During this period the design professions have successfully integrated sustainability at the scale of buildings and products, however, the question of how best to do this at the urban scale remains open for debate. For those working at the scale of the city, one of the most promising recent attempts to reformulate design has been the conceptual merging of landscape and urbanism in a hybrid practice of landscape, infrastructural or ecological urbanism which draws on analytical tools from sources such as geography and ecology to understand material, spatial and cultural flows. Over the first 10 weeks of the semester this seminar will explore this approach through readings, lectures and case studies. We will read from cultural geography, critical theory, sociology, anthropology, landscape ecology, architecture and landscape. Moving from theory to action, the final 5 weeks of class will be devoted to a speculative project exploring how the large scale systems of the urban landscape might be re-calibrated to create more dynamic or productive possibilities for the future of the city that could influence its future from and from function.
Prerequisite: 48-205.

48-431 Bio Logic Responsive Building Technology
Intermittent
The intent of this course is to transfer knowledge from biology and ecology to the field of architecture and thereby better understand the porous boundaries between living and non-living systems. Through the lens of responsive material sets and digital fabrication technologies, students work in multidisciplinary teams to develop responsive building technologies that operate in accordance with the biologic condition of homeostasis — the ability for an organism to maintain equilibrium in response to fluctuating environmental conditions. The outcomes are working models that demonstrate responsive behavior to environmental fluctuations. Once groups are formed, I work with each team to structure a design-research project based on their skill sets. The course is a creative and intensive open-source collaborative workshop where models are constructed and tested during class time. Open to students of any discipline, no previous design experience is required, simply a sustained commitment to transferring your knowledge stream to the design of the built environment. Please contact me if you are curious to see if your skill sets apply. dalec@cmu.edu
Prerequisite: 48-420.

48-440 American Regionalism
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 models 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 region's 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.

48-441 Frank Lloyd Wright
Intermittent: 9 units
This architectural history course investigates the career and legacy of the famous American architect Frank Lloyd Wright within the context of modern architecture. We will attempt to understand the great variety of work and ideas produced by Wright over seventeen decades, as well as the context which stimulated and fed off of his ideas. We will focus on issues including: 1) Wright's buildings and projects; 2) the concept of organic architecture; 3) the historical and intellectual climate that gave rise to FLW's work, including the work of Richardson and Sullivan, the Shingle Style and International Style, Japanese and European modern architecture; 4) investigations of Wright's progressive clients, innovative use of building materials, changing design theories, invented building systems, radical social & political theories, broad urban experiments, and publishing prowess; 5) the influences Wright had on modern architecture worldwide, especially the tremendous influence he had in America through his own buildings, writings and lectures, as well as some 1200 disciples he trained through his Taliesin Fellowship. Work for the course involves extensive reading and a major research paper.
Prerequisite: 48-240.

48-447 History and Preservation
This seminar investigates issues in historic preservation from a variety of historical, theoretical, and practical view points. Through intensive reading, class discussion, invited speakers, and field trips, we will explore, discuss, and write about such topics as the history of historic preservation in Europe and America, preservation philosophies and types of intervention, designating and documenting historic structures, historic house and village museums as preservers and interpreters of history, the relationship between urban revitalization and historic preservation, historic preservation as a tool of urban revitalization and cultural tourism, preservation professions. The course is generally organized by a weekly theme, with one class dedicated to discussing the history and theory of a particular aspect of preservation, and the other class dedicated to its actual practice through guest speakers or field trips.
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 aesthetic 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 exam questions 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, Plato, 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.
Prerequisite: 48-240.
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 thematic ideas and methodologies are examined. Assignments include readings from seminal texts, quizzes, and a final examination.  
Prerequisite: 48-305  
Corequisite: 48-500.

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 included introduce 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  
Corequisite: 48-500.

48-470 Exploring Pattern Through Lamination  
Fall: 6 units  
The course, Experimenting with Lamination, Clamping and Cutting, will review standard shop process and expand upon initial instructions the students have already received. Topics will be demonstrated in class and assignments relating to the demonstrations will be issued. Demonstrations may not take the entire class time in which case the students will work under the instructor’s supervision. Multiple assignments will be given throughout the course. Several demonstration topics may be incorporated into one assignment. While assignments are process driven, thoughtful, well crafted execution reflecting good design will be essential. Projects will be idea statements rather than finalized (functional) objects. Each exercise will present a series of basic wood working operations, which, when repeated and recombined will become products of compelling visual character. As visual idea statements you will be asked to experiment, invent and explore and take these standard operations in new directions.  
Prerequisite: 48-105.

48-473 Hand and Machine Joinery, New Directions  
Fall: 6 units  
Hand and Machine Joinery, New Directions will be offered in the second half of the semester and, like Experimenting With Lamination, Clamping and Cutting, will be considered fulfillment of the prerequisite for. Furniture Design and Construction. It will distill the broad array of wood joints that have been used in furniture through centuries into a collection appropriate to contemporary woodworking and modern style. The collection will include perpendicular and angled joints with two, three, and more intersecting members. Different methods for interlocking these members will be demonstrated using machine and hand tools. Students will be given assignments which require the adaption of these interlocking methods to different design circumstances.  
Prerequisite: 48-105.

48-477 Undergraduate Making things Interactive  
Intermittent: 9 units  
Learn to design and build interactive projects that combine physical form, mechanical behavior, electronic sensing and actuation, and computational control. Making Things Interactive is intended for people with no previous technical background but an appetite for hacking, tinkering, and creative play with materials, transgressing disciplinary boundaries. The first half of the course is a series of short exercises leading to a term project of your choice, carried out in the second half of the semesters. The class has attracted students a cross campus, including both graduate and undergraduates at all levels. It’s a combination of programming, robotics, materials, conceptual design, and construction; and where you take it is up to you. The only firm requirement is that you learn the technical material through the exercises and apply it in a term project. For previous editions, see class blogs at http://mti09fall.wordpress.com/ http://mti08fall.wordpress.com/ 

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.

48-497 Thesis I  
6 units  

48-500 Architecture Design Studio: The Urban Laboratory  
Fall: 18 units  
The Urban Lab studio at Carnegie Mellon seeks to educate architects to be leaders for vision-based change at the scales of neighborhood, city and region. It is intended to both introduce students to urban design and inform their understanding of building design in relation to existing neighborhoods. Our approach to urban design engages the city as an integrated design problem that is best solved through a participatory design process. Each year, teams of students and faculty seek to catalyze the revitalization of Pittsburgh urban neighborhoods by working with Mayors and elected officials, public agencies, private investors, and citizens of communities to collectively envision physical change within their neighborhoods and communities. Without being direct providers of technical assistance for communities, the Urban Laboratory has used the educational qualities of the urban design studio to build long-term university-community partnerships and ultimately build the capacities of communities to be their own drivers of change. Equally important to introducing the participatory process in urban design, the Urban Lab also emphasizes the importance of collaborative, multi-disciplinary design and decision-making. Students expand architectural design skills and gain new skills in urban design, planning and community leadership. In short, the Urban Lab represents the culmination of the architectural educational experience, by expanding existing skill sets, dramatically increasing the scale of intervention, and introducing a real client – the community.  
Prerequisite: 48-405.
**48-505 Architecture Design Studio: Thesis**

Spring: 18 units

This project-based thesis studio offers the opportunity for creative understanding, spatial experimentation and architectural consolidation. The thesis is to be enriched by a dynamic process of discovery during the development of the project. The thesis project grows out of this exploration and does not precede it. A well researched, clearly articulated thesis project develops the student’s individual architectural voice. Working from one’s own comprehensive knowledge in architecture to date, theory, humanities, history, cultural criticism, philosophy, music, art, etc., the successful thesis project challenges us to question our convictions about architecture and urban design. The goal of the architectural thesis is to demonstrate such creative understanding and be able to sustain critique at various levels of interpretation, project resolution and enquiry. *Students can also fulfill Studio X via a School of Architecture approved Study Abroad Experience.*

Prerequisite: 48-105.

**48-512 Contemporary Architectural Theory II**

Intermittent: 9 units

This is the second course in a sequence on Contemporary Architectural Theory, but the first is not a prerequisite. As a counterpart to the first course which considered philosophical, literary and cultural theory as broader interpretive frameworks, this course will emphasize textual texts which document and contextualize the specific conceptual and physical processes of generating space, form, and detail in contemporary architectural design, in structures whether real or virtual, built or represented. Authors will include but not be limited to Herzog & de Meuron, Toshiko Mori, Kenneth Frampton, Greg Lynn, Winy Maas, Michael Hall, Zaha Hadid, and Daniel Libeskind. This course will operate as a seminar and depend significantly on student participation in discussions and presentations. It will include a significant section of student-suggested readings.

**48-531 Fabricating Customization**

Intermittent: 9 units

This course will explore the tectonic, material and organizational opportunities afforded through automated fabrication and assembly. Particular attention will be directed to the opportunities for mass customization at the building component scale. Emergent topics of digital craft, performative architectures and responsiveness will be explored in relationship to culture, economy and technology. To this end, focus will move beyond formal novelty to meaningful architectural impact. Specific attention will be focused on robotic fabrication. Given the process / task flexibility inherent with robotics, attention will be paid to a range of processes and scales. Through a series of design and fabrication investigations student groups will develop a comprehensive understanding of the robotic fabrication workflow relating to various digital design processes. The recently acquired 7 axis robotic milling machine and 6 axis robotic gripper will serve as the principal instruments of the exploration; however all tools within the lab will be utilized. In an effort to leverage the equipment available, particular focus will be directed to a critical understanding of the distinctions between analog fabrication, traditional digital fabrication and robotic fabrication. To this end, both additive and subtractive processes will be explored. Technical proficiency and critical engagement of the processes will occur through a structured sequence of fabrication projects. These results will provide a basis to inform student group projects. As an advanced digital fabrication course, students should be proficient with CNC routing and high fidelity digital modeling.

Prerequisite: 48-125

Corequisite: 48-400.

**48-539 Performance Driven Composite Surfaces**

Intermittent: 9 units

Through design and fabrication processes that are informed by how various surfaces can perform, students in this class will develop a large scale architectural installation that speculates upon the potential found within combinations of standard materials. The material relationships will provide the framework to transform the traditional assumptions of a material and produce hybrids. Particular focus will be devoted to structural, acoustic and visual performance as they relate to the creation of space. The installation from this class will be a collaborative project. As such, all participants will be required to work closely through all stages of the project. Given the design build nature of the class, students should expect to physically produce a significant body of work. This class will rely upon the DFab within the SOA and therefore requires digital modeling proficiency. Students will learn the fundamentals of a select number of CAD/CAM processes but will be expected to build upon these skills outside of the context of formal lectures. Since the SOA will provide a material budget for the class, students should not expect to incur significant material costs.

Prerequisite: 48-125.

**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.

**48-564 Furniture Design & Construction**

Spring: 9 units

The spring elective is for students who want to build furniture of their own design. The instructor will assign the type of furniture to be built. The course is for students with knowledge of basic wood working techniques, the operation of standard woodworking machines, and specifically the array of the machines we have in the SOARCH shop. For this reason there are prerequisites including the first year shop training offered in the “Introduction to Architecture” course and one of the fall mini shop electives. In lieu of the prerequisites the instructor will review photographic documentation of a student’s work which demonstrate comparable experience. The instructor will determine if the projects represent sufficient experience to qualify for the class. One project will be assigned, designed and built during the semester by each student. Exercises relating to design and construction will be assigned as well. Wood will be the primary material, however additional materials may be incorporated. Equipment and procedures beyond those covered in the prerequisites will be introduced as necessary throughout the course. The project deadline, and a review, will be scheduled during the final exam period at a time determined by the class.

Prerequisites: 48-105, 48.470 OR 48.473

Prerequisites: 48-473 and 48-470 and 48-105.

**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.
Prerequisites: 48-205 and 48-120.

48-576 Mapping Urbanism
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. Weekly lectures introduce world cities and their typologies – e.g. the quintessential city, the shrinking city, the growing city and the megalopolis. Readings, films, presentations, and class discussions focus on global issues and the built environment. Parallel to these urban explorations, students learn to employ a diverse set of representational techniques to create inventive mappings. All upper-level (300 and 400 level undergraduate and graduate) students with working knowledge of Adobe Illustrator and/or InDesign are encouraged to register.

48-577 Contemporary Middle Eastern Cities
Intermittent: 9 units
As the capital of Qatar, Doha is a city on the precipice of immense change. The numerous cranes, the vast infrastructural investments, and the alterations to the natural landscape merely mark the beginning of an enormous nation-wide project that has chosen to focus on education, culture and sports. Amidst our enthusiasm for this progressive policy, the following issues inevitably arise: the environmental impact of rapid urbanization, the changes to the local culture, and the long-term effects on the next generation. These issues will be examined by looking at both cultural context and physical form. Students will investigate the large scale, regional effects of urbanization as well as smaller interventions within a given neighborhood, and will explore interrelations between the two scales. The course includes a field research trip in early September to gather data, document sites, and interview key decision-makers in the city. The final project will culminate in a final project that represents a synthesis of their research. It is expected that students will respond in both writing and drawing, utilizing information design as a means of expressing their findings.

48-579 Middle Eastern Cities: Case Studies from Two Centuries of Urban History
Intermittent: 9 units
The Middle East is home to some of today’s most dynamic metropolitan areas, sharing with growing urban conglomerations in other areas of the world the need to address issues like burgeoning populations, the environmental impact of rapid urbanization, and post-disaster reconstruction, both natural and man-made. At the same time, the history of Middle Eastern cities is a finely woven tangle of cultural specificity and reactions to international models, presenting similar challenges towards preservation of urban fabric, integration of historical buildings in the growing urban body, and choices regarding the visual identity of the city. We will be looking at both the cultural and physical form of the contemporary city, and then apply the methods of urban history to gain deeper understanding of one specific aspect of urban culture. Students will be encouraged to look at large scale, regional effects of urbanization as well as smaller interventions within a given neighborhood, and to search for the interrelation between the two scales, while they consider continuity and change in the historical fabric of the city. The course will examine several of the region’s significant cities in a case study model. Students will present to their peers their research findings for a given city and will prepare work that will culminate in a final project that represents a synthesis of their research. It is expected that students will respond in both writing and drawing, utilizing information design as a means of expressing their findings. Prerequisite: 48-105.

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: & 61599: Role of the architectural lighting designer in the collaboration process & 61599: Establishing design goals and a point of view & 61599: Communicating design ideas & 61599: Lighting interiors (retail, restaurants, offices, museums, hotels) & 61599: Lighting exteriors (landscape, buildings, bridges) & 61599: 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.

48-588 Contemporary Architectural Theory I
Intermittent: 9 units
Contemporary Architectural Theory is less of a description than a collection of three contentious terms. Current architectural discourse can search for innovative form or the mechanisms of meaning. More crucially, it can seek critical assessments of political, economic, and environmental forces. It may use the language of philosophy, literary and cultural criticism, economic and political analysis, popular culture or social activism. The purpose of this course is to read from the literature of the numerous methodological and disciplinary approaches that fit under the loose rubric of contemporary architectural theory to develop students’ skills in critical thinking about and clear communication of the complexities of current architectural discourse. Authors will include but not be limited to Jean Baudrillard, Jean-Francois Lyotard, Michel Foucault, Fredric Jameson, David Harvey, Saskia Sassen, Diane Ghirardo, Keller Easterling, Michael Bell, Sanford Kwinter, Jeffrey Kipnis, Manuel de Landa, Paul Virilio, Sylvia Lavin, and Saskia Sassen.. It will include a significant section of student-suggested readings. Prerequisite: 48-105.

48-595 Under the Influence: Architecture & Art I
Intermittent: 9 units
Under the Influence: Architecture and Art is an elective course taught in the spring semester. Many of the world’s leading architects cite art and cinema and other cross disciplinary factors among their most significant inspirations. Rather than basing their successful architectural practices on narrowly focused foundations, these architects boldly cross borders into the worlds of music, fashion, photography, film, art. New York architects Scofidio & Diller reference Marcel Duchamp, Rem Koolhaas and Herzog & de Meuron design for Prada, Peter Eisenman acknowledges the writings of Robert Morris among other artists, and Bernard Tschumi has based buildings on the editing principles of Sergei Eisenstein ‘The light of reason’. At the same time, many contemporary filmmakers look to architecture for their conceptual framework. Why are these artists and architects looking outside of their disciplines to cross over into each others worlds for inspiration and direction? What are they learning and how are they applying these discoveries? What can we learn from these leading figures and how can we ourselves begin to cross borders to develop new working methods and approaches that will advance our own professional and creative processes? These are some of the questions that the course addresses. 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 (LEED™) 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 background knowledge 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.

48-711 Paradigms of Research in Architecture
Fall: 9 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 respects 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 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-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.
Prerequisite: 33-106.

48-724 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 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.
Prerequisites: 48-624 and 48-300.

48-725 Real Estate Design and Development
Fall: 9 units
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 pro formas, 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.

48-728 Special Topics in BPD: Redesigning Our Built Environment
Intermittent
The course includes an overview of various real life concepts to implement "Value Added Propositions" for buildings. The goals are to: 1. Provide energy efficient and sustainable designs and processes for existing residential, educational and office buildings. 2. Gain a basic understanding of building science, renovation technologies, and techniques used in today’s construction industry. 3. Learn how a scope of work is developed for a Green Building through building diagnostic techniques and energy modeling. 4. Examine energy efficiency financing opportunities. Students will work with industry, manufacturers, and government to help identify the challenges and barriers facing the industry and provide new efficient solutions and strategies.
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 new building investment decision support tool – BIDS™ – has been developed by the NSF/UCRC Center for Building Performance 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, and well-being. The course will engage students in the literature relating 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. Instructor(s): Vivian Loftness Prerequisite: 48-305.

48-739 Making Things Interactive (Graduate)
Fall: 9 units
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. Through weekly exercises and a term project the class will introduce basic analog electronics and microcontroller programming, as well as exploration into using kinetics and materials to make the things you design perform. Emphasis will be on creating innovative experiences using simple robotic technologies. 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 2011, 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’ll 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’ll examine the results of those requirements. At the outset, we’ll 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’ll examine how a net-zero building is achieved, including the use of renewable energy to achieve the net-zero balance. We’ll 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’ll 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. Prerequisites: (48-315 and 48-412) or 12-748.