School of Architecture Courses

About Course Numbers:

Each Carnegie Mellon course number begins with a two-digit prefix that designates the department offering the course (i.e., 76-xxx courses are offered by the Department of English). 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. Depending on the department, xx-6xx courses may be either undergraduate senior-level or graduate-level, and xx-7xx courses and higher are graduate-level. Consult the Schedule of Classes *(*https://enr-apps.as.cmu.edu/open/SOC/SOCServlet*) each semester for course offerings and for any necessary pre-requisites or co-requisites.*

48-025 First Year Seminar: Architecture Edition I

Fall: 3 units
The main objective of this first-year seminar course is on how students learn, develop, and make decisions as they transition into architecture education. The goal of this course is to promote academic success and encourage connections within the SoA and the University at large. Teaching and learning strategies will be introduced to help support the transition into architecture and the development of independent critical thinkers. Students will be introduced to campus resources that support their academic/social/personal integration into the campus community. Topical areas to be covered in the seminar will include academic success strategies in architecture education, academic development, career planning, mentorship, academic and personal support services, and the aspects of professional practice in architecture.

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-095 Spatial Concepts for Non-Architecture Majors

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). This course is very hands-on Projects will explore the design and experience of spatial environments through a series of creative investigations. The semester will be broken in to 3 parts:Intro/Exploration and a long term project. In Intro/Exploration, students will have many hands on opportunities to start to build a common language to describe spacial investigations as well as creating them. This will consist of short projects, with each design investigation progressively building upon the previous exploration; these early projects will consist of both individual and group work. They will focus on Making. The second half of the semester will consist of one long term project to be created individually, incorporating students? personal theories of architecture based on an overarching question. Studio work will be supported by group discussion based upon critical review of student work, readings, slide presentations, videos and films. There will also be a few field trips. Students are encouraged to explore their own areas of interest with respect to their work in class. Self-motivation, class attendance and an open mind is mandatory, however, no prior architectural, engineering or artistic experience is required. Students are expected to perform work both inside and outside of class. Students should be prepared to purchase various supplies throughout the course. This course is in partial fulfillment of requirements for an Architecture Minor.

48-100 Architecture Design Studio: POIESIS STUDIO 1

Fall: 15 units
This studio will investigate the role and process of architectural design as different forms of practice. The studio will practice drawing, making, and building architectural narratives in iterations at various scales of time and space, to establish productive habits and develop essential techniques and skills in architectural design. In learning how architects see in both visible and invisible terms, the studio will analyze design precedents and problems that generate ideas about architectural material, form, and systems. In understanding how architects empathize with whom or what they serve, the studio will rigorously investigate methods of abstraction and critical dimensions relative to human form and experience. In practicing how architects deliver in the professional context, the studio will develop mastery of spatial composition, representation, and narrative as means for an architect to iteratively test, experiment with, and communicate spatial ideas.

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-104 Shop Skills

Fall
This course will introduce basic material assembly methods, and the use of shop machinery, hand and power tools. It prepares students to participate in a wide range of subsequent building and fabrication projects. We will aim to build confidence and safe work habits while demystifying the interactions between tools and physical materials.

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-105 Architecture Design Studio: Poiesis Studio 2

Spring: 15 units
As the second studio within the Poiesis Sequence, this studio will nurture a way of making and thinking in design that aims to cultivate the practice of architecture as an act of creative citizenship. By building an affinity for an approach linking the cross-cultural study of how people perceive and manipulate their environments can push a multimodal understanding of architecture and urban design. We will use a multi-disciplinary approach to become detectives interrogating the contemporary and historical tissue of Pittsburgh through the occupations and working lives, therefore elevating ordinary folks and trades that had and continues to foster the fabric of the city. Grasping the multi-faceted changing environment, this studio will use architectural tools as a base of inquiry to speculate and allow us to transform the way we view our world through multiscale multisystemic perspectives. The structure of the studio will follow one cohesive research driven design project that will explore narrative modalities, by using critical cartography, archival research, storytelling, programming adjacencies and tectonic exploration as a method to produce a hybrid shop-house focused on the historical trades of Pittsburgh. Students in the sequence will be introduced to critical proficiencies, learn new techniques of representation, adapt rigorous illustration and animation tools in the production of a dwelling project that is rooted in its urban fabric.
Prerequisite: 48-100 Min. grade C

48-111 Exploring Pittsburgh

Spring: 3 units
The city of Pittsburgh is at once your (permanent or temporary) home and the site of many of your studio projects. In this class you will start exploring Pittsburgh - as built environment in which your work might be situated, as cultural context you need to interpret, and as creative material for your own work. You will learn some of Pittsburgh's urban history, looking at phases of physical growth and dramatic change over time. You will take walks, do site visits and sharpen your observation skills. You will critically engage with some of the evidence. You will start to read cities as complex and layered, shaped by invisible forces as much as by visible ones.

48-112 Digital Fabrication Skills

Spring: 2 units
"The formal qualities explored by designers today necessitates the use of sophisticated tools with a combination of flexibility and precision. This course serves as an introduction to the type of equipment and methodologies utilized in architectural fabrication. Students will develop a basic understanding of the field to leverage these processes to explore and represent the complex nature of their designs. Through lectures and lab sessions, students will learn the affordances of the machines available in the DFAB Lab (Digital Fabrication Lab), how to prepare 3D CAD models in Rhino 3D for digital fabrication, and basic CAM (Computer Aided Manufacturing) programming. A series of projects, each highlighting an individual machine, will reinforce this technical knowledge while requiring students to rationalize their designs so their physical manifestations are informed by the techniques introduced."

48-116 Introduction to Building Performance

All Semesters: 3 units
This course will introduce fundamental concepts of building physics. The knowledge and skills obtained from this course can be applied to studio projects and beyond, improving building design and performance through standard methods of evaluation and simulation tools. Couse curriculum running concurrent with studio projects will aid students in further developing and guiding design decisions to incorporate fundamental concepts related to climate, energy, light, relationship to site, and occupant visual and thermal comfort. Students will develop a general understanding of, site analysis, building placement and amp; form as it relates to building performance, photometric principles to evaluate lighting conditions, thermodynamic principles, and heat transfer, building energy, renewable and embodied energy. Skills, tools, and knowledge base learned in this course with enable designers and architects to employ sustainable practices at all phases of design, leading to better performing buildings.
Prerequisites: 62-125 and 62-122 and 62-123 and 62-126

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-120 Digital Media I

Fall: 6 units
IDM is a required course for all first year architecture students. The course introduces students to a wide range of digital methods and concepts available to architects for design, representation, and documentation. The coursework is directly coordinated with Studio assignments providing the students with the opportunity to master their digital skills in a meaningful manner. Due to the amount of content covered there is no single text for this course, but the course is supported by materials created by the instructor. IDM addresses topics such as digital image editing, vector illustration, HTML coding, and 3D modeling.

48-121 Drawing I

Fall: 6 units
Architects draw and build models for a variety of reasons: to record and reference; to analyze and reveal order, intent, and relationships; to speculate; and to visualize new propositions. The study of architecture requires the connection between the mind, the eye and the hand, so that the nature of ideas and their relationship to physical form can be investigated. The connection of the mind, hand and drawing skills requires considerable time and effort. This course introduces why architects use these forms of representation. Students are introduced to how to do basic academic research as well direct assignments that apply the fundamentals of freehand drawings and drafting techniques as it pertains to plans, sections, elevations and paraline drawing, analytical diagraming and model making.

48-125 Digital Media II

Spring: 6 units
IDM2 is a required course for all first year architecture students. This course is the continuation of IDM. IDM2 introduces students to measured drafting and the process of creating a construction drawing set. The coursework is directly coordinated with Studio assignments providing the students with the opportunity to master their digital skills in a meaningful manner. Due to the amount of content covered there is no single text for this course, but the course is supported by materials created by the instructor. IDM2 addresses topics such as digital drafting, construction drawings, advanced 3D modeling and HTML programming.
Prerequisite: 48-120

48-126 Drawing II

Spring: 6 units
Drawing and Appearance? is a traditional course in free-hand architectural drawing. Its central learning objective is building a capacity for visualizing three-dimensional space through the making of hand-made drawings. Two secondary objectives foster visual literacy: the ability to use line, tonal values and color to represent architectural space and the ability to use drawing to represent architectural proposals at various levels of abstraction Coursework includes free-hand and constructed perspective, shade and shadow projection, chiarroscurro drawing in colored pencil and color drawing in pastel. Work is submitted in three portfolio submissions of two weeks duration each. Coursework is built around exercises in the required course text: Drawing and Perceiving, John Wiley and Sons.

48-175 Descriptive Geometry

Spring: 9 units
Descriptive geometry deals with solving problems in three-dimensional geometry through working with two-dimensional planes using basic mechanical tools. Descriptive geometry deals with physical space, the kind that one is used to since birth. Things one can see around us have geometry and even things that one cannot see, also have geometry. All these things concern geometric objects almost always in relationshipsthat is, next to, above, below, intersecting with, occluding, hidden by and so onto one another that sometimes requires us to make sense of it allin other words, when we try to solve geometric problems albeit in architecture, engineering, or the sciences. In fact, descriptive geometry has proved itself to be practically useful; it has been one of the more important factors in the design of scientific apparatus, engineering systems and architectural structuresit is the basis of modern geometrical computing. Descriptive geometry is constructivemeaning, one uses conventional mechanical drawing tools: namely, compass, ruler, protractor, divider, triangles, etc., to construct solutions to geometric problems. This course specifically revolves around the historical techniques for manually solving three-dimensional geometry problems.

Course Website: http://soa.cmu.edu

48-200 Poiesis Studio 3: Architecture Biome and Climate

Fall: 18 units
By conceptually recognizing the built/natural environment as a complex web of interacting parts constantly exchanging energy and resources, we may learn to develop architecture that enriches the context from which it arises. In response, the Poiesis Studio 3 explores how architectural and landscape design can respond to a local biome and climate through passive design strategies. We highlight the use of precedent and the relevance of our changing climatic context in how architecture takes shape - how it develops its morphology. Through an iterative process students develop formal and programmatic organizations as field conditions, or aggregations that highlight the localized interconnectivity of buildings, bodies, and environment. These building and landscape morphologies redefine boundary conditions to promote a connection to the local biome. Their envelopes become mediators between interior and exterior, public and private, the social and the ecological. Working from the scale of the territory to that of the building enclosure our goal is to arrive at a sensorially rich, environmentally responsive, and resilient architecture.
Prerequisites: 48-105 Min. grade C and 48-100 and 62-122 and 62-125 and 62-104 and 48-025 and 62-123 and 62-126

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-205 Architecture Options Studios

Spring: 18 units
The second year option studios offer varied design strategies through material, computational, chronopolitical, cultural and ecological lenses.
Prerequisite: 48-200

Course Website: http://soa.cmu.edu

48-215 Materials & Assembly

Spring: 9 units
This course introduces and examines the fundamentals between design intent and construction materials, and the science of materials (performance) and their assemblies. Learning how materials and techniques inform spatial and form making decisions will be a central theme for the semester. Lectures and discussions will focus on the meaning, aesthetics and techniques related to the use of materials and the process of construction. A basic understanding of essential, well-known systems of building construction will be our base line. Discussions and case studies of contemporary systems that extend, experiment with and question these known systems will introduce you to the great depth to which this basic knowledge can lead you. Joint assignments with the design studio will provide you with an opportunity for an in-depth exploration of these fundamentals of construction through a direct application and synthesis of this new knowledge to your studio project.
Prerequisite: 48-100

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-217 Structures

Spring: 9 units
Structures is a required course taught in the second year. It is a successor course to Statics, complementing that previous course by emphasizing structural member design in wood, steel, and reinforced concrete; spatial synthesis of hierarchical one-way systems for gravity load; structural types for lateral load including braced frames, shear walls, and rigid frames; introduction to geometric structures such as cable nets, domes, shells, and air-supported structures.

48-222 Explorations in Craft: Soft Forms, Stable Structures

Fall and Spring: 9 units
Softness is an evocative quality in architecture, but how do we "find" and then fabricate those elusive forms? How do we manipulate materials with control when the forms we seek, or their own structural makeup may lack it? When do we follow the material and when do we control it? This course is focused on physical model making of soft forms. It offers a series of encounters with material specificity, including textile, metal, and plastic materials, and the techniques used in transforming 2D patterns to 3D forms. Demonstrations, and workshops will inform material qualities, their formal affordances, and structural stability. Design and application of cutting and sewing patterns, bending jigs and casting molds will introduce the planning required to facilitate thoughtful crafting. The methods we work with are intended to open possibilities and refine skills for future making, ranging from quick form finding strategies to techniques for execution with precision. Note: A materials fee will cover workshop costs.

48-234 Introduction to Structures

All Semesters: 3 units
This course introduces structural systems and the materials and elements that make up those systems. Students will study historical and contemporary examples of bridges, long-span roofs, and tall buildings from technical, social, and symbolic perspectives. Through these built works, students will become familiar with structural engineering terminology and the behavior of different structural systems. They will also learn how materials, construction, and non-technical factors influence structural form. Additionally, students will evaluate the aesthetics of large-scale structures and discuss the relationship between engineers and architects. As they learn about structures, students will develop their problem solving skills and ability to communicate ideas by practicing using equations, drawing, and writing.
Prerequisite: 48-105

48-240 History of World Architecture, I

Spring: 9 units
This survey cuts a broad swath through time, geography and cultures, surveying critical episodes in the built environment of Europe, the Middle East, Asia, Africa, and the Americas from ancient times through the nineteenth century. Reflecting the inseparable relation between building and human needs, this course is not only a history of architecture, but also a history through architecture. Over the semester, we will examine architecture as a form of cultural expression unique to its time and place. Through readings and lectures, we will study the ways that the design, use, meaning, and legacy of a building and its site was 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. There will be several exams over the course of the semester including during finals week.

Course Website: http://soa.cmu.edu

48-241 History of Modern Architecture

Fall: 9 units
This course investigates the global history of modern architecture and theory across the 20th century. We ask critical questions about the canon, the changing nature of history and theory, the biases embedded in terms like "modernism," "progress," and "Non-Western," and the deep legacies of colonialism, globalization, extractivism, and capitalism in which modern architecture so actively participated. The course loosely works backward in time to explore major movements and monuments of the Euro-American avant-garde and so-called "heroes" of modernism, but also diverse responses to modernity, including popular, tropical, vernacular, indigenous, and even anti-architecture around the world, including increasingly the Global South. The course content changes slightly every year to acknowledge the evolving understanding of the subject, but also to keep up with changes in architectural education, the discipline of architectural history, and professional practice, as well as changes in global culture, social context, and our student aspirations.

Course Website: http://soa.cmu.edu

48-250 Urbanism and the Social Production of Space

Fall: 9 units
The course introduces contemporary urbanism, offering a comprehensive exploration of how cities and urban systems are made, remade, and even unmade. It approaches contemporary urbanism through urban theory, research, and practice to investigate the relationship between a set of intentions and consequences. It reflects the multidimensional nature of the externalities that determine the complex processes of urbanization and draws discussions on the fields of architecture, planning, landscape architecture, and social science. With a focus on physical, social, environmental, technological, political, and economic forces that influence city-making and urban life, this course analyzes various types of urban issues and phenomena, exploring through the questions of aesthetics, power, equity, and sustainability measures. In doing so, the course offers an understanding of the challenges of the 21st century, spanning from architecture to the city to planetary, and equips students with both conceptual and practical frameworks to observe, document, and analyze diverse urban milieus.

48-300 Architecture Design Studio: Praxis Studio 1

Fall: 18 units
Typically, we do site research and then design something for that site. However, this is a studio where the design research part of the semester will become the project itself. We're going to do site research and correlate it with the information we can find. We're going to make unconventional models and experiment with how we construct a network of sites through sets of relationships, linguistic, computational, and visual descriptions. In principle, we're going to think critically about how we construct the identity of a place through its cultural, social, and ecological systems, and develop procedures for doing so. We will investigate Pittsburgh as a collective site. Over the course of the semester, we will develop a "necklace" or circuit of sites that addressing Event, Housing and Infrastructure. The Steel Necklace will be a composite of these three different architectural/urban interventions to address the cultural, social and ecological issues of Pittsburgh. As the urban condition is a network of shared expressions, lived experiences and relationships, our studio will be a collaborative studio exchanging and intermixing projects. Students will detail into the collective network developing in high resolution a housing component relative to infrastructure and event spatial interventions.
Prerequisites: 48-215 and 48-200 Min. grade C and 48-205 Min. grade C and 48-116 and 62-275 and 62-225

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-305 Architecture Design Studio: Praxis Studio 2

Spring: 18 units
This studio introduces integrated architectural design as the synthesis of disparate elements, demands, and desires. It situates architecture as a technological, cultural, and environmental process that is inherently contingent and entangled, yet tethered to a historical project of autonomy. It is within the contested space between these two notions of architecture that the studio operates. The studio sets out alternatives to extractive practices and introduces students to bio-based material practices and computationally facilitated methods of manufacturing and construction. While the studio directs attention to concerns of building, such as context, building systems, program, and regulatory constraints, it challenges students to situate design as a Project that engages contemporary discourse and ecological imperatives to explore emerging aesthetics, spatial organizations, and materializations. Our discussions and your work this semester will be guided by the following overarching questions: What is architecture's capacity to facilitate civic exchange/life in America today? How might we understand public space today? What are the public spaces, rooms, and interiors of the city in an era of increasing virtuality and privatization of public space? How do building typologies evolve and transform in response to technological and cultural shifts? How can architecture support and reveal the fluid and diverse needs of a community? How might a material-first, carbon-aware approach infuse the design process with greater material specificity and productive constraints?
Prerequisite: 48-300

Course Website: http://soa.cmu.edu

48-308 Reading and Writing Architecture

All Semesters: 9 units
As readers and learners, we consume lots of writing about architecture: articles appear in magazines, convincing and polished, finished products for which we struggle to imagine the process. We seldom pause to reflect on how that writing is produced, much less on how we could make writing a tool that works for us. In this collaborative, hands-on class we will work to demystify the process of writing in all its messiness and to highlight its iterative nature. We will explore how various genres of writing work and how architects can use them effectively, not only to communicate with audiences of all kinds but also to explore their own creative ideas. We will read writing about architecture by a number of different voices - architects, critics, historians, journalists, and activists. We will discover from their own approaches to writing what might work for us. We will experiment with writing and editing and explore how text, images and layout may come together to create a cohesive communication strategy. We will focus on becoming sophisticated as consumers and producers of written communication as we are for visual media.

48-310 Bizarre Details: stories of the ordinary, the uncanny, and the archit

Fall and Spring: 9 units
This design research course explores the current developments in hybrid, multi-platform design and communication mediums to prototype new ways of creative storytelling in architecture, visual development, and concept design. Research methods around oral storytelling, ethno-ecology, radical mapping, and the children's book can allow for the exploration of subjects in ways not available to typical architectural and urban research conventions. Throughout the Fall '23 Term designers will be tasked to use Pittsburgh, PA as a laboratory to develop a research project, from initial concept to an extensive script, including design elements, character development, as well as an urban critique of the city. Frameworks around composition, color, mapping, modeling, the parallel projection, and techniques in painting that are used in architecture, visual development, and concept design will ask how storylines translate and transform in the creation of a comprehensive project using industry techniques. To curate the explorations, we will explore innovative ideas in visual storytelling using techniques of interactivity in children's book design, experimenting with new forms of narrative strategies. The experimentations will result in a final exhibition at the end of Fall 2023.

48-313 New Pedogogies

Spring: 9 units
No course description provided.

48-314 New Pedagogies

Fall and Spring: 9 units
New Pedagogies are courses offered by new and visiting faculty (sections A-D). Please visit https://soa.cmu.edu/courses for complete course descriptions.

48-315 Environmental Systems: Climate & Energy in Buildings

Fall: 9 units
Our commitment to designing net zero energy and indeed carbon positive buildings and communities is critical to environment equity and the UN Sustainable Development Goals. This course introduces architectural design responses for energy conservation and natural conditioning, human comfort, and the site-specific dynamics of climate. The state of the art in building energy conservation and passive heating and cooling technologies will be presented in lectures and supported by readings and assignments. An overview of energy flows in buildings and energy design standards is illustrated by lectures on building energy conservation successes, and emerging demands for a broader definition of sustainability. To understand the significance of architectural design decision-making on energy consumption and comfort, students will compile a professional energy consultant's report for a residential-scale building, 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.

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-317 The Chair

All Semesters: 9 units
Making entitles to an intimate connection with the site, native atmosphere, building components, and their assemblies, where a designer/maker can operate at local - regional and global levels comprising all the building systems. This sedulous process takes very closer to the materials where a designer/ maker can gather insights into material behavior (both mechanical and visual) and is better placed to alter the effects of architecture through its materials and generating processes. The same can be applied to chair making. The chair no longer remains a chair, as the making process makes it a ground of experimentation and learning to shape the material into the desired object. The reaction with the matter is no more inert, as it tends to provide feedback to the maker while shaping it. This immersive process of learning by doing in entirety, aids students, in improvising their thought process, the judgment of material behavior, use of the right tool to save material, and developing novel ideas for production and assembly. Prototyping and making largely help develop the understanding concept of joinery/material behavior, and properties in relation to form. The exercise allows understanding chair as a piece of furniture, the manner of making that gives qualities to an abstract design or idea, the know-how of handling material, emergence of tacit knowledge in the maker, and tolerance and feedback from the material.

48-318 Discourse and Praxis in the Climate Emergency

Spring
This course engages with emergent modes of architectural thinking and praxis in the climate emergency. If buildings consume vast resources and are embedded in extractive systems of material and labor, how can discourse be deployed to consider other forms of praxis?

48-324 Structural Design 1: Form and Forces

Fall and Spring: 6 units
This course introduces fundamental concepts of static equilibrium and stability of structures. In contrast to conventional methods of learning structures that are based on numerical calculation and analysis of stresses in materials, this course explores a new geometric approach to understanding the relationship between form and forces of structures through graphic statics, a graphical method of visualizing, designing and analyzing equilibrium. By using geometry as the common language between architecture and structure, the students will explore new ways of shaping structural form by drawing and manipulating the geometry of forces. Through a series of lab exercises, the students will learn how to construct form and force diagrams used in graphic statics, and learn how the behavior of basic structural systems can be understood through such representations. The lab exercises are complemented by group design projects, where the students have the opportunity to apply the concepts and principles learned in the lab to design and build physical structural models that will be loaded to failure. No prior knowledge is required for this course. Structural Design 1 is the first of three courses of the Structural Design curriculum offered at Carnegie Mellon Architecture.
Prerequisite: 48-205

Course Website: http://soa.cmu.edu

48-328 Detailing Architecture

Spring: 9 units
"This course examines the role of the architectural detail in the formation/ thematic development of a work of architecture and how the detail reinforces the theoretical position of the architect.
Prerequisite: 48-205

Course Website: http://soa.cmu.edu

48-332 Teaching and Learning

Intermittent: 6 units
In this course, students will learn about effective strategies for teaching architecture and the built environment. Topics include the cognitive differences between novices and experts, instructional techniques, and goal alignment. As part of the coursework, each student will implement these teaching strategies to design and teach a lesson. Elements of developmental psychology, learning theories, and classroom practices will inform the architectural education lesson. Teaching and learning techniques can be generalized for communication with clients, practice, and the community.

48-336 Architecture and Agency

All Semesters: 9 units
If buildings consume vast resources and are often embedded in extractive systems of material and labor, how can the agency of architecture be deployed to consider other forms of thinking and praxis? What tactics, strategies, manifestos, and actions can architects deploy to resist, upend, destabilize or reinvent normative mechanisms of architectural production? How do such practices seek new modes of conceiving the architectural project and its concomitant processes; radically reinvent the brief, site, program, material or tectonic capabilities? This course will consider agency simultaneously through historical and contemporary forms of praxis as well as theories that inform them.

Course Website: http://soa.cmu.edu

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

All Semesters: 9 units
The history of the main cities of Europe during the XIX century is a history of change and transformation. The physical environment and the political, financial and administrative structures adapt to the needs of new masses of population and to the challenges of metropolitan life. In some cases, cities even acquire new representative functions, as they become a national capital. This course traditionally offers an overview of the urban culture of XIX century Europe, reconstructing aspects of the broader historical context and then focusing on reading the effects of the XIX century transformations on the physical appearance, structures and image of present-day European cities, such as Paris, London, Berlin, Barcelona, Vienna and Rome. This semester we will add to this analysis, acquired by learning and applying a set of essential questions about XIX century urban transformations, a second look at the image of the city - the issue of how the city is represented and described in the various moments of its Nineteenth century transformation (from historical maps, to paintings, from postcards to literary descriptions). We will try to consider its changing visual representation and the different perception of its character and peculiarities over time, finally discussing how the Nineteenth century image of each city still affects how it is viewed today. We will rely, along with the usual reading materials (articles, book excerpts) also on visual documentation, such as photography and film. The course is based on lectures and discussions and requires personal elaboration, as well as a fair amount of reading and writing.
Prerequisite: 48-240

48-339 IDeATe: Making Things Interactive

Spring: 12 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. You'll also dive into the fields of VR/AR/MR and experiment with combining these disciplines with physical computing. Through weekly exercises and a term project the class will introduce basic analog electronics, microcontroller programming, projection mapping and virtual reality; as well as exploration into using kinetics and materials to make the things you design perform. Emphasis will be on creating innovative experiences. The graduate edition of this course will require additional work including a paper that can be submitted to a peer-reviewed interaction design conference such as CHI, UIST, or TEI. Students from all disciplines are welcome: but please note that the class demands that you master technical material. Experience in at least one of: programming, electronics, or physical fabrication is strongly recommended.(Participants will provide their own supplies and materials.)
Prerequisites: 60-223 or 16-223

Course Website: http://soa.cmu.edu

48-340 Modern Architecture and Theory 1900-1945

Intermittent: 9 units
This architectural history lecture course surveys the modern buildings and literature of the first half of the twentieth century, focusing primarily on Europe but extending also to non-western countries. We begin with a look at the "crisis of modernity" that plagued most of western civilization in the late 19th-century, and then focus on the major movements of both the avant-garde and other responses to modernity from 1900-1945. The course includes lectures, readings, and discussions about a broad range of issues, including 1) Formal tendencies; 2) Theoretical issues; 3) National traditions; 4) Biographical sketches; 5) Significant technologies and materials; 6) Political motivations; 7) Social and amp; cultural influences. Emphasis will be placed on the relationship of buildings to the more general cultural, intellectual, and historical circumstances in which they were created, especially the important manifestoes, theoretical and critical writings that so determined the project of modern architecture. Work for the course involves extensive reading and a major research paper.
Prerequisite: 48-240

48-341 Expression in Architecture

Intermittent: 9 units
This architectural history seminar will explore expression in architecture in its many forms, particularly in written works of architectural theory through the ages. We start with the premise that architecture is not merely pragmatic, technical, or functional: it can express or communicate like a language, it can represent and inspire like many of the arts, it can shape behavior and emote, it can trigger memories, emotions, or meanings. As Isozaki put it: ?Architecture is a machine for the production of meaning.? We?ll investigate many ways that architects have theorized the design process, as well as the forms, materials, and contexts of architecture, to express a myriad of ideas and sensibilities. We?ll also look at the ways that buildings can communicate and have meaning, often beyond the intent of the architect, and usually changing over time. Some of the topics to be explored include the classical orders, gothic geometry and mystical light, the theatrical space of the Baroque, architecture parlante, character, and style in the Enlightenment, tectonics as structural expression, political architecture and morality, the aesthetics of functionalism, Expressionism, key terms such as ornament, representation, linguistics, and semiotics, as well as more recent theoretical constructs such as embodiment, materiality, atmosphere, and affect. The work of the seminar will include intensive weekly readings, especially of primary sources by the architects seeking to express ideas, weekly presentations and discussions about the sources, and a term paper on an important theory of expression in architecture of your choice.
Prerequisite: 48-240

48-348 Architectural History of Mexico & Guatemala

Intermittent: 9 units
Despite the leveling forces of mass culture and globalization, the geographic and social diversity of the U.S. has created distinctive regional mosaics of landscape and architecture. Say New England and images of English Pilgrims, town greens with white framed churches, and industrial mill villages may come to mind. The Southwest conjures different images, perhaps of adobe pueblos, Spanish friars, arid ranches, and the color turquoise. The built environment of the Midwest, the California coast, the Mississippi Delta, and many places in between reflect particular regional identities that have been both unconsciously and consciously created over time. This course examines the historical development of regional patterns in the American built environment. It investigates how and why a regions architectural identity evolved in the ways that it did. To what degree is place something to respond to, to interact with, and to what degree is place something that is created? Our focus will be primarily pre-20th century when the forces of vernacular traditions were stronger, we will also examine more recent trends of regionalism as an aesthetic choice and a theoretical stance.
Prerequisite: 48-240

48-350 Postwar Modern Architecture and Theory

Intermittent: 9 units
This architectural history lecture course surveys the modern buildings and architectural theory of the post-World War II period. It begins with the cataclysm of WWII and the fundamental shifts it caused on the conception of modernism, technology, cities, and geo-politics. It proceeds to investigate themes such as rebuilding and reconstruction, grand modern masters such as Mies, Kahn, and Le Corbusier, the fascination with technology, megastructures and utopian thought, the need for monumentality, meaning, and regional identity, and the dissemination of modernism from corporate America to the third world. It ends with the rupture in modernism associated with the social revolutions and the rise of a post-modern architecture in the late 1960s and early 1970s. The course includes lectures, readings, and discussions to define the unique character of the postwar period, as modernism both reigned supreme, and began to be questioned. Emphasis will be placed on the relationship of buildings to the more general cultural, intellectual, and historical circumstances in which they were created. Special attention will be devoted throughout the course to the important manifestoes, theoretical and critical writings that so determined the project of modern architecture. Work for the course involves extensive reading, preparing for class discussions, and a major research paper.
Prerequisites: 48-240 or 48-241

48-355 Perspective

Intermittent: 9 units
This freehand drawing course considers perspective from three understandings of perceptual psychology. Part 1, built on the pedagogy of Kimon Nicolaides, aligns with the Transactionalist understanding of perception. It considers perspective as discovered truth. Part 2 builds on the early work of 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. Part 3, aligning implicitly with Gestalt psychology, treats perspective as an imposed schema. The course concludes with a final project built around the student's interest.
Prerequisite: 62-126

48-356 Color Drawing

Intermittent: 9 units
48-356 Color Drawing provides practice in the use of color to depict architectural surroundings. Following preliminary exercises using pastels, watercolor is used for most of the course. A central objective is that by the end of the course, students will have good judgement in evaluating color hue, value, and temperature and gained confidence in use of watercolor. Coursework assumes some knowledge of linear perspective. Work consists of in-class exercises and weekend assignments built on these. Students can expect to spend up to 6 hours of work per weekend.
Prerequisites: (48-121 and 48-126) or (48-130 and 48-135) or (62-126 and 62-125) or (48-120 and 48-125)

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-359 Special Topics: Design Build / Building Systems

All Semesters: 9 units
In this studio we will consider Thoreau's essayso much of it about his own design/build experiencein today's context. Collectively, we will design a cabin to meet the high standards of sustainability set by Eden Hall. After a round of prototyping, testing, and design development, the studio will create a set of construction documents and shop drawings. Covid and funding allowing, we will begin building the cabin at mid-term, with construction continuing into the summer or fall as required. This studio has a nine credit co-requisite, 48-358 Cabin Building Systems, which is also open to CEE students. Its focus will be on the building systems for the cabin that is being developed in the parallel studio. Topics include energy performance (e.g. production, renewable energy systems, passive and active ways to achieve efficiency, and modeling); integrated structural and engineering systems (e.g. building envelope, water treatment and management, heating and cooling systems, and electrical and lighting systems; and sensing for monitoring and control. The class will have a team-based format that is hands-on and lab-oriented rather than a seminar structure, and it will contribute directly to the build part of the studio.

48-367 Material Histories

All Semesters: 9 units
Materials affect the way we engage with a building and carry cultural meanings connected with complex histories, deeply and at times messily intertwined with the social, political and ecological context. In this seminar we will look at the history of the architecture of the last two centuries by following the thread of the history of materials. We will discuss the ways in which buildings of the past and the practice of architecture were affected by which materials were available, how they were produced, and the craft required to work them. We will reflect on how architects interpreted, manipulated, or added to those meanings through their own work. Materials' lifecycles and the networks of extraction, production, transportation, and reuse had an impact on the built environment in the past, just as they do today. We will learn from historical examples to assess the consequences of the choices we make as designers. Finally, we will critically engage with the presence of history as a layer of complexity embedded in the material itself - an effect that is compounded in the practice of reuse of materials with patina, marked from their past use.

48-368 Rediscovering Antiquity: Archaeology for Architects

Spring: 9 units
The course follows the intertwined histories of architecture and archaeology from the mid-eighteenth to the early twentieth century, critically engaging with the outsized influence of classical antiquity on architectural theory and practice and its role of authority and model in the Western artistic and cultural debate. The traces of classical antiquity, buried in the Mediterranean and Middle Eastern landscape, retained part of their cultural significance over the centuries and became the object of a "rediscovery", almost a cultural obsession. Artists, travelers and architects filtered and re-interpreted the reality of ancient objects and places, conjuring up their own vision of the past and nourishing their own creative pursuits from a continuous dialogue with history. At the same time, new political agendas, new biases and new goals were associated with antiquity, influencing the way the past of the region was explored, how the finds were studied and exhibited in residences and Museums, and ultimately creating a stern competition to appropriate this legacy, with deep links to colonialism and imperialism. The ripple effects are still being felt today, for example in the discussion about the repatriation of cultural heritage. We will study the history of this moment to better understand the cultural vantage point that often influenced the fabric of our cities, presided over the creation of many of our cultural institutions and the buildings that represent them, and had a deep and lasting impact on the ideas about architecture and its relationship with history. This will help us grasp more clearly the impact of the "passage to the Modern" and some of the complex and still open issues it brought about.
Prerequisite: 48-205

48-369 Sustainable Architecture and Urbanism for the Gulf Region

Intermittent: 3 units
Ensuring a sustainable built environment in Qatar is critical to sustainable Gulf Region and indeed a sustainable world. The quality of our architecture and urban design can significantly address the challenges of heat, water, energy, mobility, material resources, waste, and health. This course is intended for non-architects to explore the potential of sustainable design for desert climates. Six weeks of explorations and presentations will introduce each student to: Climate analysis for Gulf Region countries and their 'twins' around the world; Green standards for desert climates with their embedded metrics (eg UNSDG, LEED, GreenStar, WELL); and Precedent as a precursor to innovation - a search for great sustainable examples across building types and land use. In-class and homework assignments will create a series of collaborative student slide shows each week. As possible, invited speakers and site visits will be pursued. The final week will be dedicated to a class perspective on the importance of the built environment for carbon and climate change, and student recommendations for building and infrastructure goals for a more sustainable Gulf region. CMU-Q graduates should be dedicated to a more sustainable built environment and understand the design changes needed for sustainability, the benefits to quality of life and to ecological sustainability. Every discipline is a catalyst and a stakeholder in our future - as client, as design/engineer, as consumer, as financier, as scientist.

48-371 City & Suburb: Housing in America after 1850

Fall and Spring: 9 units
This architectural history course examines the development of American house and housing choices during the period 1850-1975. A recurring picture of the "American Dream" has typically included the image of a single-family, detached dwelling set within its own green yard in the suburbs. However powerful and durable that image is, the history of house and home in America is actually a far more complex story with many different twists and turns. In the course we will look at both urban and suburban housing choices and cultures, ranging from single family detached dwellings to multi-unit housing, and across a social spectrum income, class, race, and gender. Through the use of occasional field trips, we will use Pittsburgh as a touchstone for understanding broader national trends in the history of American urban and suburban housing. The course is organized as a lecture course supplemented with field trips and discussions based on field trips and primary source readings. The additional time slot on Thursday afternoons will be used only when field trips are scheduled. Student work will include a research paper and several shorter written assignments throughout the semester.
Prerequisite: 48-240

48-373 Istanbul Constantinople. An Urban History

Fall and Spring: 9 units
A dynamic metropolitan area, with a burgeoning population and rapid urbanization, Istanbul is at the same time a finely woven tangle of historical layers. In this class we will introduce urban history and its methods as we focus on key moments of Istanbul's history. We will delve deeply into the city's powerful and at times competing historical narratives. We will trace the growth and transformation of the urban fabric, discussing Istanbul's role as imperial capital of the Romans, the Byzantines, the Ottomans, its changing fortunes in the twentieth century and the historical roots of the present-day world city. We will discuss cultural specificity and reactions to international models, the challenges of preservation and transformation of the urban fabric and the political making and re-making of its cultural identity. We will also take into account the power of this city to fascinate and inspire through the centuries - the imagined city as a layer of the physical one.
Prerequisite: 48-240

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

Fall: 9 units
An introduction to the architecture of the lands where Islam spread over the centuries, this course aims to provide a basic understanding of major epochs and regional variations. We will learn the function and meaning of the most important building types, examine how these types changed over time to adapt to the needs of changing societies and consider influences and exchanges with other traditions. We will examine the historical context within which art and architecture developed and explore critically the lingering signs of those traditions in contemporary society.

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-380 Constructing Value(s): Economies of Design

Spring: 6 units
This course explores the systems of economic, political, social, and regulatory forces driving the production of contemporary architectural projects. It critiques these systems, examines alternatives, and tests interventions in pursuit of value propositions outside of the bottom-line driven norms of late capitalism. What do design economies driven by equity, circularity, ecology, pluriversality look like? Through lecture and discussion, real world case studies in both for-profit and non-profit sectors, both locally and internationally, students explore the process of project development from multiple perspectives and gain insight into dynamics that determine if, how, and when projects are realized as well as relationships among various stakeholders, including architects, developers, and communities.

Course Website: http://soa.cmu.edu

48-381 Issues of Practice

Spring: 6 units
"This course explores the interdependence of contracts, drawings, specifications, and correspondence and introduces the concept of the Standard of Care. It addresses business development, staff training, and time management and introduces the economic, cultural, and political contexts in which architecture is created. To reflect the pedagogical priorities of the school, social justice related issues related to architecture will be examined. Students will engage with practitioners, consultants, constructors, and others who together form the design and construction team to learn the specific knowledge and skills the team members bring and to understand the importance of collaboration. They will study the effects of owner expectations and field conditions. Students will learn the value of, and path to, licensure, exploring NCARB's licensure path and Architectural Experience Program (AXP). The course describes alternative career paths that would allow students to use knowledge and creative skills gained in their time in the School of Architecture. The class will align with related courses to provide a comprehensive exploration into the broad profession of architecture and be taught in coordination with the students' concurrent architecture studios so that the students can consider their studio projects from a practitioner's business perspective."

Course Website: http://soa.cmu.edu

48-383 Ethics and Decision Making in Architecture

Intermittent: 6 units
This course investigates ethics for architecture and the built environment. Students will learn about ethics as a discipline, how to identify an ethical issue, and how one might work through an ethical problem. Frameworks will be presented with case studies for practice and discussion. On a macro scale, we will consider the entanglement of architecture with capital as well as sustainability and climate change. We will also touch upon day-to-day concerns regarding safety, zoning, contracts, material selection, internet of things and workplace discrimination. Reading responses and class discussions are the primary format for learning. Each student will also conduct an ethical assessment of one of their studio projects. Non-architects are welcome.

Course Website: http://soa.cmu.edu

48-386 Portfolio & Resume Preparation (UG)

All Semesters: 3 units
No course description provided.

48-390 Physical Computing Studio

Spring: 10 units
This collaborative studio course will allow interdisciplinary teams to develop wearables with a focus on assistive technology. The ubiquitous nature of mobile devices coupled with low-cost and easily integrated sensors and actuators make this a good time to approach real problems for a range of users from the physically disabled to athletes. Teams will learn skills in hardware, software, fabrication, and design communication in order to effectively develop and share their ideas.
Prerequisites: 60-223 Min. grade C or 16-223 Min. grade C

Course Website: http://ideate.cmu.edu/

48-400 Architecture Design Studio: Praxis Studio 3

Fall: 18 units
This studio is the capstone of your undergraduate education and is an opportunity for you to integrate the various technical aspects of your professional degree to date. Each student will have the opportunity to select from one of three proposed building typologies and project scales. As a requirement of this studio, students will participate in student teams developing each project to a high level of technical development. The objective of this studio is to go beyond the typical studio project and to demonstrate the necessary integration within the structural system, building envelope, environmental control systems and life safety system while providing the measurable outcomes of building performance as part of the design process (NAAB student criteria 6). Consultant engineers play an active role in the studio process providing expertise and discussions resembling professional practice. This semester the three studio instructors will be Professors Gerard Damiani, Erica Cochran Hameen and Stephen Lee.
Prerequisite: 48-305 Min. grade C

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-405 Advanced Synthesis Options Studio II

Spring: 18 units
Having proven competency in the spectrum of skills determined necessary for tomorrow's architect during the first three years of the program, students in their fourth and fifth year are permitted to select from a variety of studio options, each providing the opportunity to build upon or augment some of those skills with new or more nuanced perspectives. All advanced synthesis studios are open to both years, the vertical integration offering enhanced learning opportunities.The content and focus of each studio is governed by faculty interests, which run the spectrum of architectural pursuits, ranging in scale from the design of a piece of furniture to a city and in approach from a comprehensive and complex building program to a critically-driven speculation. They may also be interdisciplinary in nature, taking advantage of the unique juxtapositions made possible at Carnegie Mellon.
Prerequisites: 48-412 and 48-400

48-408 Co-designing an Indigenous Biodiversity Knowledge Learning Space for the Vertica

Spring: 12 units
This is an advanced comprehensive Critical Practice track studio, with one large, complex, semester-long building design project. The studio pedagogy is based on the parallel development of a real project currently being planned, a new performance space for the San Francisco Symphony; it is on the same site and with the same goals and constraints as the actual project. The participation of clients, the professional design team working on these projects, and users is incorporated in the studio? exploration and design process, culminating in review presentations to the client and project team and publication of the body of work. This studio is also a key component of Carnegie Mellon University?s Theater Architecture Program, and is offered annually to fourth- and fifth-year students in the Bachelor of Architecture program. The co-Requisite, Theater Architecture Seminar (48:408), provides in-depth research in the typology, analysis of precedents, and the programming and planning of the studio project.

48-409 History and Future of Interaction Design

All Semesters: 9 units
The history of Interaction Design (IxD) is far richer than what is visible from today's tech. Many great ideas have been mangled and even lost. By making prototypes inspired by this history, we reach new insights and illuminate a future of promises and perils. In this course you begin by mining historical IxD innovations by building prototypes in a modern vernacular that forefront lost contributions. In 3 sprints you render a powerful but lost essence in the form of a concept storyboard, video, or clickable prototype. Thus you explore the History of IxD. To explore the Future of IxD, you are invited to invent itby developing your own vision in the design of a final project prototype with the focus and scope that you control. Coursework is partly historical review and largely designing and producing prototypes in a studio setting, especially suited for backgrounds in interaction design, computational design, responsive architecture, media, or coding.

48-410 Advanced Synthesis Options Studio II

Spring: 18 units
The vertically-integrated advanced studios encourage interdisciplinary collaboration from arts, technology, research and design. They range from large scale urban and ecological projects, to detailed investigations of materials, and fabrication strategies.
Prerequisite: 48-305 Min. grade C

48-425 EX-CHANGE: Exhibition & Publication in Practice

Spring: 3 units
Are you interested in exploring exhibition design, curating, or publishing as part of your practice? This course will give you hands-on experience, inviting you into the process of planning, designing, and curating the 2023 EX-CHANGE, an exhibition and publication that will be launched at the School of Architecture in fall 2023. EX-CHANGE is the School of Architecture's annual exhibition and publication celebrating student work from first year to PhD. Inaugurated in 2017, EX-CHANGE represents an ongoing opportunity to shine new light on the SoA's programs and to position the work within larger questions of research and practice. Students will work alongside EX-CHANGE director Sarah Rafson and the professional design team who have been selected for the 2023 EX-CHANGE to get a glimpse into editorial and curatorial practice. This is an opportunity to play a role in shaping an exciting school-wide event.

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

Fall: 9 units
If there is a benefit to recent global and national upheavals, it may be that we are even more keenly aware of the importance of equity, of social justice, and a more sustainable future. That sustainability must cover the full range of the UN Sustainable Development Goals and your understanding of how you can contribute to a better future through design in the built environment is a primary goal of this course. High performance buildings are achieved with designs that effectively integrate passive and active systems. This course focuses on active systems in commercial buildings and their integration with passive design elements you've studied previously: envelope, ventilation and lighting. We also consider building codes that address outside air requirements for ventilation, and for energy and water efficiency, and discuss where related US building codes lead or lag in promoting exceptional building performance. Environmental sustainability and buildings within the United States receive the greatest emphasis in our work, but we also consider how performance definitions may change where resources like energy or water are limited or unavailable. The active systems covered include lighting, ventilation, heating/cooling, water distribution and water heating, and renewable energy production and amp; storage.

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-435 Modern Mexico & Guatemala: 19th-21st Century Architecture

Fall and Spring: 9 units
This course focuses on the 20th-century architectural and urban history of Mexico City. We will study both the high-style design vanguards and the vernacular built environment. Topics include the 19th-century ruralscapes and cityscapes that sprouted the seeds of the 1910 Mexican Revolution, the role of arts and architecture in a post-revolutionary world, changing ideas about art and architecture within a globalizing world of international influences, projects oriented toward the elites including upper-class suburbs by prominent architects, projects directed towards the working classes including informal settlements by unnamed "squatters", and the cascading environmental challenges that have pushed to the forefront of the 21st century. A recurring theme of the course will be the various and competing architectural expressions of Mexican identity and #8212; Mexicanidad. Non-majors are welcome.

Course Website: http://soa.cmu.edu

48-438 Modern Mexico & Guatemala: 19th-21st Century Architecture

All Semesters: 9 units
This course examines the architectural history of modern Mexico and Guatemala, with an emphasis on the 20th century, but drawing on the 19th and 21st centuries as well. We will use architecture as a lens through which we study how both the high-style design vanguards and the vernacular built environment were responses to forces such as industrial modernization, urban growth, economic fluctuation, international relationships, political and social revolution, indigenous discrimination, genocide, and cultural regeneration. Throughout the course we will look at the countries' urban and rural architectural evolution as explicit and implicit expressions of identity (Mexicanidad or Guatemalidad).

48-442 History of Asian Architecture

Intermittent: 9 units
This course is intended to serve as an introduction to the evolution of urban spaces and the function of the architecture in South Asia, China, Korea and Japan. It is organized chronologically and will examine the impact of indigenous philosophical principles on the organization of villages, capital cities, and religious centers. The course will begin in the Indus Valley where complex urban planning along with public and private architecture flourished from 2600-1900 BCE. We will examine South Asian Hindu and Buddhist cave monasteries as well as freestanding Hindu temples and identify the salient architectural forms that identify each type. We will then move to China where the earliest villages were arranged according to ideas about nature and the organizing system of fengshui. By the earliest Chinese dynastic period, urban planning and building placement were beginning to be codified according to Confucian and Daoist ideals. Later Chinese imperial centers were consciously designed according to Confucian regularity and hierarchy in order to make visual statements about power. We will then move to consider urban organization and Buddhist temples in China, Korea to Japan where South Asian and Eurasian models were adopted and adapted. The examination of the Japanese warrior culture will include castles, new ideas in residential architecture, the Pleasure Quarters, and retirement villas. Contemporary architecture will be addressed through individual and group projects that will investigate specific structures and situate the buildings within the cultural and historic circumstances that led to their creation.
Prerequisite: 48-240

Course Website: http://soa.cmu.edu

48-448 History of Sustainable Architecture

Intermittent: 9 units
The History of Sustainable Architecture investigates themes of nature, ecology, pollution and conservation in the built environment and visual arts. The term ?sustainable architecture? is a comparatively recent one, arising in reaction to the destructive and toxic nature of the industrial era and its strident ambassador, Modern architecture. Yet, an esthetic and philosophical view of harmony with nature accompanies many forms of historical human activity in the built environment. Similarly, issues of waste removal, mechanical systems and natural materials that characterize current concerns have illustrative historical roots in numerous civilizations going back centuries and even millennia in pre-Industrial or non-industrial cultures. This course will engage texts and examples relating not simply architecture, landscape and urban history, but also art, philosophy and popular culture as a means to understand the many precedents for today? s interest in sustainable architecture and planning. The course will examine texts and works by figures including Vitruvius, Pliny, Leon Battista Alberti, Thomas Cole, Frederic Law Olmsted, Buckminster Fuller, Reyner Banham, Ebenezer Howard, Hassan Fathy, Bernard Rudofsky, Norman Foster, Robert Smithson, Andy Goldsworthy and more. Students will be encouraged to apply principles from the class to understanding and execution of work in their own discipline.

48-452 Real Estate Design and Development

Fall: 6 units
This course will introduce the Real Estate development process and explore the interdependence of development drivers and the design process. Classroom learning, exercises and guest-lectures will introduce students to the concepts of market and financial analysis, as well as the basic techniques of budgeting, proforma development, and valuation. Parallel to this investigation, students will evaluate real world developments and interface with the development professionals that executed them to learn how development drivers shaped the development process and decision making. Students will study how market demand, tenant requirements, site constraints, and available capital affect feasibility, and through this the ultimate design solution. The semester's effort culminates in the execution of a mini-development project. Students will work in teams to complete a basic market analysis, program evaluation, schematic design, construction and development cost estimate, proforma analysis, and a determination of financial feasibility. Development practitioners will interface with student teams during this mini-project to offer "real world" guidance on student schematic designs and feasibility analysis.
Prerequisite: 48-305

48-453 Urban Design Methods

Fall: 6 units
This undergraduate lecture course introduces urban design history, theory and methods. It is a required supporting course for the Urban Laboratory design studio, and similarly examines urban design at multiple scales: city form and networks, neighborhoods and block structures, streets, public spaces, and urban building typologies. Key issues introduced include the emergence and evolution of urban design as a discipline, economic, social and political factors affecting the contemporary city, and environmental sustainability at the urban scale. A wide variety of cities, projects, proposals and methodologies are examined. Assignments include readings from seminal texts, quizzes, and a final examination.
Prerequisite: 48-305

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

Intermittent: 9 units
If all design can be read as attempts to predict and to shape the future, then no one looks further into the future than the urban designer and the urban planner. The work in which they are involved often does not materialize in their lifetimes; in fact, the duration of the projects are so long twenty, thirty, fifty and hundred year timeframes, it is more than likely that he or she will pass on before the project reaches fruition. The trouble with predicting the future is that it is so uncertain, so undecided, so unknowable. A brief look backwards reveals that we are not the first generation to consider the future. History is replete with predictions, some of which were actualized, the vast majority of which were not. Today's forecasts for tomorrow vary wildly. A handful of optimists view the future through rose colored glasses, whereby humanity is delivered to salvation via technological wonders and the widespread adoption of common social values. A larger group predicts the end of the world as we now know it, but even they cannot agree on the cause of our demise, with those arguing that climate change will kill us clashing with those convinced that we will be destroyed when robots achieve technological singularity. Shy of total extinction, however, any vision of the future requires designers, and will likely occur in urban (or formerly urban) locations. As of this decade, for the first time in history, more than half of the world's population, almost three and a half billion people, live in towns and cities. Estimates suggest that by 2030 this number will swell to almost five billion.
Prerequisite: 48-205

48-459 Material Simulacra

All Semesters: 9 units
This fabrication-based course interprets Jean Baudrillard's ideas of "panic-stricken production of the real and the referential, above and parallel to the panic of material production." Serial mold-generated surface studies activated by material properties, behavior, intuition, and expression ask how our perceptions of the real is mediated by language of the made artifact. Structured as the tripartite investigation: TheoryResearch-Craft, this seminar's pedagogy is centered on the cultural, historical, ethical, aesthetic and tectonic values of architectural materialism to arrive at an awareness of what a material conveys. Analog and digital techniques and simulations engage the technological and intellectual roles of the craftsperson.

Course Website: http://soa.cmu.edu

48-470 The Depth of Surface

Fall: 9 units
Lamination is the process of gluing wood together along the edge or face of a plank. There is unlimited variety in the ways to do this and to generate pattern in the process. This course will prescribe a few basic ways to laminate following standard rules of wood working and then introduce the possibilities of pattern generation. Generally lamination is unidirectional, however, in this class we will introduce ways to achieve cross directional patterning and the use of inlay to elaborate on the idea of patterning. Projects will be visual and sculptural statements. Their function will be limited and will not be furniture. 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. As visual idea statements the greatest clarity of vision will be achieved through careful construction.

48-473 Hand and Machine Joinery, New Directions

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

48-478 Digital Tooling

All Semesters: 6 units
This course serves as an immersive analysis of the available technologies located in the Digital Fabrication Lab at Carnegie Mellon and beyond. Students begin to understand equipment limits/boundaries, purposes and concepts; and the possibilities that arise from thoroughly comprehending how these tools work. During your Digital Experience, students begin to understand more systematically how to use these tools to their advantage. A better understanding of the equipment proves very useful towards a SoArch Student's 3rd, 4th and 5th years at Carnegie Mellon; but more importantly provides a fundamental understanding of a leading edge technology that will certainly prove itself as an integral tool for any Designer throughout their professional career. It is based on the idea that pushing the limits of design fabrication; comes from knowing the limits of your tools. The course operates by discovering tooling extremes; thus indicating limits, and then incorporating these boundaries (and/or breaking them) with Digital Fabrication methods and tooling; ultimately providing a platform in which students begin to understand and incorporate project efficiency. Prerequisites: Imagination, Laser Cutting, Milling and 3D-Modeling Experience required. (Rhinoceros 3D Preferred)
Prerequisite: 48-205

48-482 Advanced Structural Design: Computational Explorations

Fall: 9 units
This course covers advanced topics in computational structural design and analysis. Students will explore various form-finding algorithms and computational design methodologies, learning to use structural geometry as a key design driver for creating efficient and expressive forms. Key topics include: parametric structural modeling; computational structural analysis; structural optimization; and form finding. The course is hands-on and skill-focused, organized around interactive workshops and design projects throughout the semester, each addressing specific computational tools and design objectives. Students are expected to have basic knowledge of statics and structural design and be comfortable using Rhino and Grasshopper.

48-485 Design and Documentation in Revit

Fall and Spring: 3 units
This course will guide you through the process of designing in Revit from the schematic, conceptual design phase, to the construction document phase. The course will start with basic concepts moving on to more advanced topics. Layering information and how much to incorporate into the model, based on stakeholders and end users, will be discussed. Capturing the essential information from the BIM model will be explored to develop presentations, bidding documents, and construction documents to relay relevant information to clients, consultants, and contractors. We will discuss when it is imperative to model in 3D and when to overlay 2D linework detail. Real-time rendering techniques that streamline the design process will be explored using Enscape. The skills learned from this course will help you understand the phases of design and documentation in the Revit environment.

48-486 Systems, Cybernetics, Conversation

All Semesters: 9 units
Across many design disciplinesarchitecture and computational design, media and interaction design, design of services and organizationsmethods for grappling with complex adaptive systems is now table stakes. Furthermore, design today demands profound, authentic attention to equity, human and non-human living systems, climate and environment, sustainability and ethics. Overall, designers must have skills to collaborate in cross-disciplinary teams. An encompassing framework for these disparate disciplines and domains of 21st-century design is the transdisciplinarity (or "antidisciplinarity") of Cybernetics. Cybernetics can be understood as the study of "systems with purpose", whether machines or living things, including their unpredictable interactions. Central to Cybernetics is conversation as a mechanism of design, inclusivity, participation, innovation, and the impetus to action. The course offers systems frameworks and models of conversation that are also relevant to Designing for the Internet of Things (48-675), Inquiry into Computation Design (48-727), and Design Studies: Systems (51-277). Class time balances readings, discussion panels, and guest conversations with executing assignments that involve systems modeling; creating conditions for designing that are participatory and inclusive; and prototyping in a range of media (installations, screen-based interactivity, physical prototypes, workshops, etc.) that offer responses to global wicked challenges.

48-493 Representing Activism

Intermittent: 9 units
Efforts to promote social, political, economic and environmental change range in form from written word to direct action. Sources of injustice that those efforts address are multi-dimensional and complex. Effective forms of activism are fueled by creativity that synthesize and distill complex constellations of information and foster understanding. REPRESENTING ACTIVISM explores the role of multi-media graphic representation as a lens through which change and social justice can be fostered. Exploration of efficacy in application will span four dimensions, 1) Social Media, 2) Film, 3) Poster/Graphic Design, and 4) Publication - all aspiring to achieve the status of art. Art and Activism are predicated on exposing the truth. Art has the unique power to convey messages across linguistic and cultural barriers that often divide. Part of the Activist's challenge is to grip and inspire people to action. With the avalanche of information and media modern society absorbs every day, this is increasingly hard to do. Sometimes it is too much to ask people to stop and think: sometimes it's too much just to ask them to stop. Successful art compels this, penetrating apathy and imploring the viewer to look deeper and explore the narrative that is embedded in what elicited a visceral response. This seminar aspires to compel action in the public interest through artful representation.

48-494 Beyond Patronage

Intermittent: 9 units
TBD

48-497 Pre-Thesis

Spring: 3 units
This 3 unit course is designed for B.Arch and M.Arch students a year before their final Spring semester. The course develops an understanding of research methods, and explores the formation of ideas for architecture thesis projects. Many directions of architectural thinking (spatial, material, ideological and procedural), will be discussed and in framing a theoretical position we will see how an architecture thesis can use a creative process to discover and express findings in relation to large questions and to disciplinary discussions. This is a required course for Fall Thesis Seminar in F23 (9units) and Spring Thesis ASOS S24 (18units).

Course Website: http://soa.cmu.edu

48-500 Advanced Synthesis Options Studio

Fall
Having proven competency in the spectrum of skills determined necessary for tomorrow's architect during the first three years of the program, students in their fourth and fifth year are permitted to select from a variety of studio options, each providing the opportunity to build upon or augment some of those skills with new or more nuanced perspectives. All advanced synthesis studios are open to both years, the vertical integration offering enhanced learning opportunities.The content and focus of each studio is governed by faculty interests, which run the spectrum of architectural pursuits, ranging in scale from the design of a piece of furniture to a city and in approach from a comprehensive and complex building program to a critically-driven speculation. They may also be interdisciplinary in nature, taking advantage of the unique juxtapositions made possible at Carnegie Mellon.
Prerequisite: 48-410

48-505 Advanced Synthesis Options Studio III

Spring: 18 units
Having proven competency in the spectrum of skills determined necessary for tomorrow's architect during the first three years of the program, students in their fourth and fifth year are permitted to select from a variety of studio options, each providing the opportunity to build upon or augment some of those skills with new or more nuanced perspectives. All advanced synthesis studios are open to both years, the vertical integration offering enhanced learning opportunities.The content and focus of each studio is governed by faculty interests, which run the spectrum of architectural pursuits, ranging in scale from the design of a piece of furniture to a city and in approach from a comprehensive and complex building program to a critically-driven speculation. They may also be interdisciplinary in nature, taking advantage of the unique juxtapositions made possible at Carnegie Mellon.
Prerequisite: 48-105

48-510 Advanced Synthesis Options Studio IV

Spring: 18 units
The vertically-integrated advanced studios encourage interdisciplinary collaboration from arts, technology, research and design. They range from large scale urban and ecological projects, to detailed investigations of materials, and fabrication strategies.
Prerequisites: 48-400 Min. grade C or 48-410 Min. grade C

48-516 NOMAS Competition

All Semesters
Coming Soon.

48-517 Carnival Gateway Project Management

Spring
This course is for the team responsible or the design and project management of the Carnival Entryway Pavilion, to be completed for the 2023 CMU Carnival, April 13-15. The course is conducted by NOMAS and advised by Professor Vicky Achnani.

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

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

Course Website: http://soa.cmu.edu

48-524 Building Performance Modeling

Fall: 9 units
"You can't hammer a nail over the Internet" Matthew B. Crawford, Shop Class as Soulcraft: An Inquiry Into the Value of Work The Design/ Build ASO Studio is part of a year-long, interdisciplinary, design-build project to provide a diverse group of students with the opportunity to work with their eyes, hands, and brains to transform an idea from a virtual world into the physical world. The elective is an opportunity for any student to join the spring "build" activity for 9 units. In this semester, we will again work campus constituents to improve the quality of life on campus through engaging design intervention(s). The project is fully funded, and the expectation is that the project will be turned over to the campus community by the last day of classes in the spring semester. During the fall, the Building Integration Option Studio (BIOS) students envisioned a farmer's market for Hazelwood Green creating design proposals at three scales-XL-M-XS. These design proposals for "XS" components will be a potential launching point for the spring build experience. These designs are just that-launching points-they have not been considered in the context of the Carnegie Mellon campus, so design will be a critical component of the early spring.
Prerequisite: 48-305 Min. grade C

Course Website: https://omerkaraguzelphd.wixsite.com/praxismodeling (https://omerkaraguzelphd.wixsite.com/praxismodeling/)

48-525 Thesis Seminar

All Semesters: 9 units
This seminar prepares undergraduate students planning to work on a thesis project in the following semester. Thesis work requires individual effort to identify a valid area of concern, understand the disciplinary discourse around a chosen topic and its cultural and social context, determine which are the appropriate means and methods to implement the project, and establish the criteria by which to evaluate the work. Students enter this course with an initial thesis statement, a body of background research and a set of questions that can be interrogated by engaging in research and discussion. The seminar help them refine the scope of the thesis argument, define appropriate research methods and sharpen communication about thesis work in all of its phases. In addition, it facilitates group conversation and exchange of ideas, providing dialogue, feedback, and continued motivation.

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-527 5th-Year/Senior Seminar

Intermittent: 3 units
Seminar for students graduating from the Bachelor of Architecture and Bachelor of Arts in Architecture programs.

Course Website: http://soa.cmu.edu

48-528 IDeATe: Responsive Mobile Environments

Intermittent: 9 units
As part of this project-based course, we'll get hands-on with emerging technologies, concepts and applications in the Internet of Things through a critical lens. We'll prototype everyday intelligences and design smart and connected devices that examine and speculate on the strange, supernatural, and mystic qualities of the smart home. The first half of the semester will introduce students to building connected devices and intelligent spaces through technical development workshops, readings, applied explorations, and guest lectures. The second half of the semester will be organized as an applied collaborative project.

Course Website: http://daraghbyrne.me/teaching/responsive-mobile-environments/

48-530 Human-Machine Virtuosity

Spring: 12 units
Human dexterous skill embodies a wealth of physical understanding which complements computer-based design and machine fabrication. This project-oriented course explores the duality between hand and machine through the practical development of innovative design and fabrication systems. These systems fluidly combine the expressivity and intuition of physical tools with the scalability and precision of the digital realm. Students will develop novel hybrid design and production workflows combining analog and digital processes to support the design and fabrication of their chosen projects. Specific skills covered include 3D modeling (CAD), 3D scanning, algorithmic geometric modeling, digital and robotic fabrication (additive and subtractive manufacturing), motion capture and computer based sensing, and human-robot interaction design. Areas of interest include architecture, art, and product design.

48-531 Fabricating Customization: Prototype

Intermittent: 9 units
Architects have long flirted with production and manufacturing. This has been pursued to yield greater affordability, customization, and expression, and as of late, more carbon-aware material selection and manufacturing. This course builds upon this rich history and foregrounds architectural component customization to explore prototyping and customization within the context of contemporary practice. It introduces students to a range of prototyping and design for manufacturing frameworks. Through case studies and lectures, the course offers students an overview of existing and emerging modes of collaboration between designer and manufacturer in service to the production of a customized building component. The course places great emphasis upon the reciprocity of design and prototyping, challenging students to leverage physical artifacts as tools for thinking and testing. Throughout the semester, students will utilize additive and subtractive fabrication techniques to iterate the design of architectural components. Through this process, students will build proficiency in prototyping to design, test, and refine components of limited scope and scale.

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-541 The Cut, The Beach and Beyond

All Semesters
The Cut, the Beach and amp; Beyond will be a FALL design elective with a SPRING build option studio working with Campus Design and amp; Facility Development, the Department of Civil and Environmental Engineering and campus constituents to improve the quality of life through design intervention(s) on campus.

48-543 Color Constructs

All Semesters: 9 units
In this course you will study and experiment with the relationships and perception of space and form through two- and three-dimensional optical experiments using color. Lectures, discussions, and field trips will delve into color theory particularly focused on the work of artist, designer, and educator Joseph Albers, look at culturally defined use of color, and its experience. In keeping with Albers definition of color theory as a hands-on experiential and experimental process of creating relationships through perception students will work on skills needed to craft compelling images using linear, planar and volumetric assemblies in digital and analog media. Initial weekly exercises will cover principles of color relativity, intensity, temperature, etc., and consider various principles of graphic perception including but not limited to vibrating and vanishing boundaries, figure ground reversals, and the illusion of transparency. Through this process you will gain an understanding of the use of color in the graphic representation of designs, patterns, diagrams and architectural representations that will inform the use of color in transforming the perception of space. The final assignment will be a three-dimensional color structure.

Course Website: http://soa.cmu.edu

48-545 Design Fabrication

Spring: 9 units
Design Fabrication is a project based seminar exploring the application of Computer Aided Manufacturing (CAM) in architecture. The course meets in the School of Architecture's Design Fabrication Lab (dFAB), which serves as a context to better understand the interconnected affordances of building materials, machine processes, and modeling software for design thinking. During the semester students receive hands-on introductions to dFAB equipment, including laser cutting, cnc routing, and 3D printing. Concepts will be explored and tested through iterative making/prototyping. Course Focus The course focuses on Transdimensional Fabrication, a manufacturing framework that forefronts design thinking across space and time. A growing array of approaches in contemporary architecture are motivated by this focus (e.g. flat pack, 4D printing, metamaterials, kinetic architecture, robotic origami, design for disassembly, etc.). We will investigate Transdimensional Fabrication concepts through three that forefront design translations: 2D 3D, Space Time, Assembly Reconfiguration Disassembly

Course Website: http://soa.cmu.edu

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

48-554 Entangled: Remaking Nature from the Picturesque to the Hypernatural

All Semesters: 9 units
This seminar questions how we perceive, represent, and reconstruct our world in relation to evolving concepts of "nature" and their manifestation in architecture, art, and landscape. It is focused on the intellectual trajectories that define ecology and environment to arrive at the paradigm shift theoretician Donna Haraway has termed natureculture. We will first familiarize ourselves with historical ways of seeing "nature" and how this has formed the landscapes of the Anthropocene. This will help us put a critical lens on land, environmental and ecological art, ecoventions, architectural living systems, biomimicry, biophilia, and projective ecologies while we consider the influence of gardens, responsive landscapes, hyper-natures, and artificial ecologies in changing the way we design and build. We look for not only relevance but joy and beauty in practices that highlight the relation between desire, responsibility, more-than-human wellbeing, and ecological justice. This may help us build notions of care and stewardship and an understanding traditional and emergent cultural constructs that can define an eco-centric practice which shapes building futures. The course surveys texts from a range of topics including ecological aesthetics, architecture, art, landscape urbanism, and ecologically focused philosophy and theory. It includes weekly readings, discussions, presentations, and visual or written deliverables. Open to graduate and undergraduate students in Architecture and allied fields.

48-555 Introduction to Architectural Robotics

Fall: 9 units
This course provides an introduction to industrial robotics and automated fabrication within the field of Architecture. A series of lectures will cover the basic components, as well as their work flows, needed to design flexible automation - while work sessions will develop skills in hands-on programming, RAPID, work flow simulation, fixtures, and sensors. We will also issue competency-building projects within the lab environment in order to provide students with hands-on experience using the equipment. Upon covering the fundamental software and hardware content, an end-of-semester project will challenge you to apply your newfound knowledge to solve a final prompt. This is a portal course to all sanctioned coursework using the School of Architecture's Robotic Fabrication Lab. Upon successful completion, students will be eligible and prepared to enroll in advanced robotic fabrication courses.

48-557 Formless as an Operation

All Semesters: 9 units
This seminar focuses on the formless as an operation relative to social constructs, parametrics and aesthetics. Geometry is often thought of as a rational or a structure that secures and grounds things, however the structures of the built environment is an unfolding and indeterminate product. Social constructs can be defined as formless or the informe, as coined by George Bataille; an operational existence. In expanding the one's idea of operating, the use of formless allows us to consider the indeterminate. The indeterminate for our purpose in exploring context relative to spatial and cultural traditions. Within social and political space, traditions become spatial operators. How can we spatialize and draw traditions, rituals, and narratives? We will investigate the means and methods of representation relative to the formless and the built environment. Participants in the seminar develop an archive, original visualizations that utilizes multiple mediums and platforms, and culminate in a final project a part of an exhibition.

Course Website: http://soa.cmu.edu

48-558 Reality Computing

Fall: 12 units
Reality computing encompasses a constellation of technologies focused around capturing reality (laser scanning, photogrammetry), working with spatial data (CAD, physical modeling, simulation), and using data to interact with and influence the physical world (augmented reality / virtual reality, 3d printing, robotics). This semester the studio will focus on utilizing these technologies to capture places and objects to digitally recreate them for archives, artifacts, and interactive experiences. We will explore and analyze how to optimize these creations for real-time rendering and analyze how these platforms bridge the divide between "virtual" and "real."

48-560 Design & Redesign of Capital Cities

Fall: 9 units
This architectural and urban design history course examines the cultural histories of the design and redesign of world cities. The scale of urban interventions we will look at varies greatly, from the macro-scale of designing totally new capitals to the micro-scale of altering small nodes within a city. We explore the relationship between form and culture by considering political, social, economic, and aesthetic forces that have shaped the public realm of urban as well as suburban spaces. We focus on recognizing and understanding the rationale behind the design, re-design, and use of culturally important urban spaces during their own time, making periodic forays into the issues that influence those spaces today. Non-majors are welcome.

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-564 Furniture Design & Construction

Spring: 9 units
This course is for students who already have a basic knowledge of hand tools and machines, and standard fabrication methods. Wood is the primary material, although other supplemental materials are permitted. One functional project will be built during the semester. Because all the equipment in the shop is traditional analog, the fabrication will remain analog. All operations will be done with hand tools or machines operated and controlled by hand. The emphasis of the design phases will also be non-digital. However recognizing the versatility of CAD, students will be permitted to advance and refine their ideas using their computer. One full scale orthographic drawing by hand will still be required, including plan, elevations, sections, and dimensions on 1/8" ply or mdf.
Prerequisites: 48-105 and (48-470 or 48-473)

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

Fall
This course is designed to introduce a student to 3D software tools (3 units each), including Autodesk AutoCAD 3D, Revit Architecture, and/or 3D Studio MAX. Using building information and parametric modeling, materials, lighting, rendering, and animation students will create integrated CAD or BIM projects, 3D video animations, and realistic renderings. Students can choose to learn one, two, or all three applications. Course objectives are to develop an understanding of how to properly set up and manipulate 3D projects integrating software applications, replicating real world projects in leading architectural, lighting, design, construction, and engineering firms; learn how to create detailed 3D CAD models using surfaces and solids; learn about BIM parametric modeling using Revit Architecture; and learn how to apply materials, lighting, and rendering using AutoCAD, Revit, and 3D Studio Max. At the conclusion of this course, students will have 3D projects for one or more applications and animations if using 3DS Max. 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. The course will be primarily taught asynchronously via video lectures and other materials. Some live remote meetings will be held for topic previews and project reviews. In person and remote office hours will be held weekly.

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-569 GIS/CAFM

Spring
A Geographic Information System (GIS) provides storage, retrieval, visualization, and analysis of geographically referenced data. GIS provides analytical tools to investigate spatial relationships, patterns, and processes of location-based data such as cultural, demographic, economic, environmental, health, physical, social, and other phenomena. GIS creates digital twins (virtual representations) of natural and built environments and integrates many types of digital models. GIS topics include geographic concepts (projections and map scales), map design, geodatabases (importing spatial and attribute data, geocodes, table joins, and data aggregation), spatial data processing, digitizing, data mining, multivariate cluster analysis, drive and walk time networking, raster GIS, spatial statistics (proximity and hot spot analysis), animation, and 3D GIS. CAFM (Computer Aided Facility Management) and IWMS (Integrated Work Management Systems) topics include space and asset management, building operations, environmental health and safety, and real property. The course includes in-person and asynchronous video lectures to learn important GIS concepts and a brief introduction to work management systems. Software tutorials cover leading GIS software from Esri Inc. Applications include ArcGIS Pro, ArcGIS Online, ArcGIS Map Viewer, ArcGIS Story Maps, and Dashboards. Subject areas are related to architecture, engineering, construction management, building performance, environmental health, sustainability, public policy, urban design, and planning.
Prerequisite: 48-205

Course Website: http://soa.cmu.edu

48-576 Mapping Urbanism

Intermittent: 9 units
This seminar provides the critical tools necessary to examine the city as both a representation and a reality in flux. Through an interdisciplinary framework, students study urban history, theory, visual thinking and spatial mapping. Contemporary urban issues are introduced through weekly lectures, readings, and class discussions. Parallel to these urban explorations, students learn to employ a diverse set of representational techniques to create inventive mappings. Upper-level (300 and 400 level) undergraduate students and graduate students are encouraged to register.

48-587 Architecture Lighting Design

Intermittent: 9 units
Through hands-on exploration of light students will develop a design process for lighting public spaces. All classes will be held in a fully equipped light lab to give the students full access to experimenting with light in design applications. Understanding how light creates focus and mood will be explored in class lab exercises. Discussion topics will include the role of the architectural lighting designer in the collaboration process, establishing design goals and a lighting point of view, communicating design ideas, analyzing successful lighting design in case studies for interior and exterior applications, and becoming familiar with the technical tools of lighting design. The final design project will include lighting mock-ups of a building site.
Prerequisite: 48-105

Course Website: http://soa.cmu.edu

48-596 LEED Buildings and Green Design

Spring: 6 units
Green building and sustainable design have been rapidly gaining acceptance in all sectors of the building market. Global issues of energy use, emissions, resource depletion, and land use are forcing building professionals to re-evaluate standard design and construction processes, and look to more environmentally friendly practices. The U.S.Green Building Council (USGBC) developed green building rating systems entitled Leadership in Energy and Environmental Design (LEEDTM) in order to define "green building" by establishing a common standard of measurement. LEED considers green building methods and technologies in several categories including site, water, energy, materials, and indoor air quality, and awards points towards an overall green building rating of certified, silver, gold or platinum. Currently, LEED registered projects make up 3% of the current U.S. commercial building market, and Pennsylvania is the third leading state with LEED registered projects. There is now a demand for design professionals with knowledge and experience not only in sustainable design but specifically with the LEED rating system as well. This course will provide students with background knowledge of the USGBC, the LEED system, as well as referenced standards related to specific topics. The course will benefit greatly from the large number of LEED projects in the Pittsburgh region, which will serve as case studies. Upon completion of the course, students will be prepared to take the LEED Professional Accreditation Exam, which is quickly becoming the standard of recognition for green building professionals.
Prerequisite: 48-315

48-607 Architectural Agency: Dig Where You Stand!

All Semesters
The course is organized as a graduate seminar that concludes the cycle of required courses in the history and theory of architecture for the MArch program. By revisiting histories of the twentieth and twenty-first centuries, it treats the profession as an uncertain, contested, and contingent category. It situates histories of architecture across continents in relation to developments, forces and processes including globalization, imperialism, nationalism, climate breakdown, (post)industrialization, as well as decolonization struggles and social, racial and gender movements. Instead of instrumentalizing architecture's history as a repository of formsa series of canonical buildings that each architect should recognize and reverethe course puts emphasis on relational thinking and contextualization. How did architects, buildings, and objects respond to the aforementioned developments and forces? How have architects addressed the ever-expanding crises of human displacement? How does the praxis of architecture contribute to the global environmental degradation? What type of reparative propositions have been put forth for a more equitable coexistence in a warmer, scarcer, and unstable planet? The course will take place in the archives of the Heinz Architectural Center at Carnegie Museum of Art. By digging in and out the Center's collection, the course focuses on specific case studies to bring to the foreground tensions, questions, relations, interdependencies, and alliances.

48-608 Co-designing an Indigenous Biodiversity Knowledge Learning Space for the Vertica

Fall and Spring: 12 units
The seminar emerges from the instructor's work while co-founding the "Vertical University" project in Nepal. As a subversion to the traditional way we understand knowledge, the "Vertical University" builds on the learning potential inherent in the place-based, deep-seated indigenous knowledge of farmers living in biodiversity-rich landscapes. The project spans across a vertical gradient starting at a 67-meter elevation in Koshi Tappu to Mount Kanchenjunga (the third tallest peak in the world) at 8,586 meters. For us, farmers are the professors; the villages are the classrooms, and the 8-000 meter vertical gradient is the "Vertical University." Across this belt, the project is anchored in six regions. However, the seminar will be focused on Kurule-Tenupa, a community where these imaginative ideas and aspirations come to life. A local community-based learning ground on 16 acres of land has been established under the leadership of local indigenous leaders. Through this elective and collectively with the community (online), we'll design this library as a new repository of knowledge that reinforces the local indigenous communities' relationship with their ecology. This production seminar aims to generate a design for the Indigenous Knowledge Library, which will be built in Kurule-Tenupa. If successful, this important typology, we hope, will be replicated in other parts of the project and, hopefully, throughout Nepal.

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-610 Bizarre Details: stories of the ordinary, the uncanny, and the architectural com

Fall and Spring: 9 units
This design research course explores the current developments in hybrid, multi-platform design and communication mediums to prototype new ways of creative storytelling in architecture, visual development, and concept design. Research methods around oral storytelling, ethno-ecology, radical mapping, and the children's book can allow for the exploration of subjects in ways not available to typical architectural and urban research conventions. Throughout the Fall '23 Term designers will be tasked to use Pittsburgh, PA as a laboratory to develop a research project, from initial concept to an extensive script, including design elements, character development, as well as an urban critique of the city. Frameworks around composition, color, mapping, modeling, the parallel projection, and techniques in painting that are used in architecture, visual development, and concept design will ask how storylines translate and transform in the creation of a comprehensive project using industry techniques. To curate the explorations, we will explore innovative ideas in visual storytelling using techniques of interactivity in children's book design, experimenting with new forms of narrative strategies. The experimentations will result in a final exhibition at the end of Fall 2023.

48-611 On Speed / Space, Time & Information

All Semesters: 9 units
This seminar focuses on relations between architecture, information and computing technologies, and society as they are conditioned by speed: rates of transfer, response, exchange, movement, cognition, and more. Development in the last century has been marked nearly always by new velocities, at times testing or altering human tolerances for construction, for perception, for adaptation, for reliance on shelter and on computational systems. These roles of speed reveal ways that architecture and information systems embody shifts in culture, in technology, and in society - but also shifts in less obvious things like the emergence of global finance and geopolitics. Since late Capitalism and the rise of post/industrial economies, these shifts continue as indicators for unprecedented ecological and economic phenomena. Speed, in short, is not neutral or relative but always a function of its circumstance. In readings and class discussions, we will consider roles of speed in things like modular construction and shifts to rapid prototyping and fabrication; in the dissemination of Cybernetic thought; in evolving forms of public space with new telecommunications technologies; and in ecologies of material use. Readings in architecture, in media theory, in philosophy and more will explore ways that time is understood, is constructed in different ways, and to different ends. The seminar culminates with the recent movements toward "accelerationism" - rushing modernism and capitalism to some logical conclusions - and an interest in experiences beyond human perception in slowness.

Course Website: http://soa.cmu.edu

48-613 New Pedagogies

All Semesters: 9 units
Coming Soon.

48-614 New Pedagogies

All Semesters: 9 units
New Pedagogies are courses offered by new and visiting faculty (sections A-D). Please visit https://soa.cmu.edu/courses for complete course descriptions.

48-616 NOMAS Competition

Fall and Spring
Coming Soon.

48-617 Carnival Gateway Project Management

Spring
This course is for the team responsible or the design and project management of the Carnival Entryway Pavilion, to be completed for the 2024 CMU Carnival, April 11-14. The course is conducted by NOMAS and advised by Professor Omar Khan.

48-618 Discourse and Praxis in the Climate Emergency

Spring
This course engages with emergent modes of architectural thinking and praxis in the climate emergency. If buildings consume vast resources and are embedded in extractive systems of material and labor, how can discourse be deployed to consider other forms of praxis?

48-619 Machine Intelligence, Cybernetics and Design

Spring: 9 units
The course brings forward cybernetic epistemology, concepts, and models that bridge machine intelligence and the evolution of 21st-century architectural/design practice. The dominance of artificial intelligence, especially with the substitution of machine learning for the broader meanings of AI and more so for machine intelligence, has created a severely limited view of what computation can afford architecture/design, as well as the rapidly evolving techno-culture, and no less society and culture more broadly.

48-621 Beyond the Buildings Footprint

All Semesters: 9 units
This project-based seminar explores the use of machine learning and other software to create a speculative future for Braddock, Pennsylvania, a town just nine miles outside of Pittsburgh. To be mindful of the areas history and our engagement with it, we will study the work of LaToya Ruby Frazier to understand the social and ecological effects of steel extraction, emission, and construction. Frazier builds a visual archive of the intersection of the steel industry, the environment, and the human body, describing her work as excavations of hidden histories, from the micro to macro level. Students are encouraged to collect data using photography, film, record sounds, 3D scanning, and taking drone footage of the site. The workflow will deploy generative adversarial neural networks, various 3D modeling, and rendering software. Students will produce a short animation for the final deliverable. The seminar welcomes students with little or no experience with computation and those with more experience.

48-622 Explorations in Craft: Soft Forms, Stable Structures

Fall and Spring: 9 units
Softness is an evocative quality in architecture, but how do we "find" and then fabricate those elusive forms? How do we manipulate materials with control when the forms we seek, or their own structural makeup may lack it? When do we follow the material and when do we control it? This course is focused on physical model making of soft forms. It offers a series of encounters with material specificity, including textile, metal, and plastic materials, and the techniques used in transforming 2D patterns to 3D forms. Demonstrations, and workshops will inform material qualities, their formal affordances, and structural stability. Design and application of cutting and sewing patterns, bending jigs and casting molds will introduce the planning required to facilitate thoughtful crafting. The methods we work with are intended to open possibilities and refine skills for future making, ranging from quick form finding strategies to techniques for execution with precision. Note: A materials fee will cover workshop costs.

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-623 Pittsburgh through the Archives

Fall: 9 units
This new class is designed for upper level Undergraduates and Master students who would like to delve deeper into the urban history of Pittsburgh and at the same time develop research skills that can be applied to other cities. In this small-group, hands-on elective seminar students engage with primary sources in the local archives, explore the urban environment with step-by-step guidance, gain insight from researchers with different disciplinary viewpoints and finally produce their own individual investigation as part of a collaborative class project.

48-625 Thesis Seminar

Fall
This seminar is designed for students planning to work on a thesis project in the M.Arch program and is intended to prepare students for a semester long, studio-based thesis project in the following Spring. You will enter this course with a written thesis statement, a body of background research related to your topic(s), and an initial set of questions that can be interrogated by engaging in research and discussion. Your continued progress is supported by the collective engagement of the seminar participants and the structure provided by course assignments and deadlines, in addition to individual conversations and targeted feedback from the instructor. The seminar focuses on refining the scope of the thesis argument, defining the methods to make the topic(s) of inquiry actionable through design-based methods, and sharpening the communication about thesis work in all of its phases. Thesis work is highly self-directed and requires a level of metacognitive thinking, which includes identifying a valid area of concern motivating the work, understanding the disciplinary and societal context for the project, identifying the means and methods for acting, and establishing the criteria by which to evaluate the work. The course is structured around the individual effort required to advance these aims. In addition, it facilitates group conversation and the regular exchange of ideas, providing dialogue, feedback, and continued motivation.

48-626 Bending Active System_ Bamboo Research Pavilion Using Robotic Arm and Steam Bend

Fall: 3 units
Bamboo, a material brimming with immense, yet largely unexplored, potential, particularly within the realm of architecture, stands as a testament to natures ingenuity. If we look at the current scenario, this fastest-growing, low-cost, carbon-sequestering natural resource remains an unconventional material, in the practice of Architecture, always given the peripheral roles of scaffoldings and at times more than that. This way the potential of such versatile material remains highly underutilized. Its time to shift our perspective and explore the full potential of this protean material in the 21st century. Grown tremendously in the developing parts of the global south, tooling bamboo has predominately relied on traditional techniques. Bamboo embodies flexibility, stiffness, and efficiency in material distribution, yielding lightweight yet efficient systems. This natures extreme product offers high resistance to tensile stresses, buckling, and bending stresses and its elastic properties are remarkable. The research taps into these properties of bamboo to arrive at a spanning and spatial system that stems from its intrinsic properties. Traditional ways of using bamboo as a whole culm restrict the abilities of spanning, and bending, and make it more vulnerable to splitting. Bending activates the tensile capacity of the bamboo and allows for more efficient material distribution. Combining bamboo and digital fabrication enables radically unique and spatially versatile configurations. Digital fabrication with this irregular material is challenging but immensely rewarding, unlocking new possibilities for shaping this material. CNC routing can offer efficient and precise sectioning of bamboo culm and bending bamboo using robotic arms reduces the burden of custom Jig for each new bend profile.

48-630 M.Arch Studio: Praxis 1

Fall: 18 units
TBA

Course Website: https://soa.cmu.edu/march (https://soa.cmu.edu/march/)

48-631 Fabricating Customization

Fall
to be created by the department
Prerequisite: 48-205

48-634 Architectural Theory & Contemporary Issues

Fall
This graduate seminar explores important writings and ideas being discussed in architecture today in relation to "Design Ethics," one of the central pedagogies of the SoA and the M.Arch program. Theory is framed not primarily as design principle, but as a critical framing device to investigate the dominant forces and paradigms engaging architecture today, in the academy, the profession, and the community. Architecture is considered as both material technology and social agenda, a driver of inequality but also potentially a social justice machine, a high-tech, economic, ecological, and political change-agent. The focus is on current discourses, processes, and contexts rather than on the history of theory, or the latest buildings or architects. The seminar examines a different theme each week, with topics that vary annually to acknowledge the dynamic nature of the profession, environment, and global contexts. The work of the seminar will focus on readings, weekly presentations and discussions about the sources. For additional units, students may elect to do a research paper on a theoretical aspect of architecture that connects to the co-requisite course "Situating Research" and might lead to a thesis or grant proposal.

Course Website: https://soa.cmu.edu/march (https://soa.cmu.edu/march/)

48-635 Environmental Systems: Climate & Energy in Buildings

Fall: 9 units
Our commitment to designing net zero energy and indeed carbon positive buildings and communities is critical to environment equity and the UN Sustainable Development Goals. This course introduces architectural design responses for energy conservation and natural conditioning, human comfort, and the site-specific dynamics of climate. The state of the art in building energy conservation and passive heating and cooling technologies will be presented in lectures and supported by readings and assignments. An overview of energy flows in buildings and energy design standards is illustrated by lectures on building energy conservation successes, and emerging demands for a broader definition of sustainability. To understand the significance of architectural design decision-making on energy consumption and comfort, students will compile a professional energy consultant's report for a residential-scale building, 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.

Course Website: https://soa.cmu.edu/march (https://soa.cmu.edu/march/)

48-636 Architecture & Agency

Spring: 9 units
Coming Soon

48-637 Structures/Statics

Spring: 9 units
We examine structural types, structural behavior, material behavior, and construction constraints that underlie our design of buildings, emphasizing the need for a designer to envision a complete 3-D structure. We mostly build "orthogonal structures" constructed in horizontal and vertical planes, requiring high-strength modern materials such as steel or reinforced concrete, comprising roughly 75-80% of the course. This is complemented by "geometric structure" where the three-dimensional shape dictates function; prominent examples include membranes, cable nets, historic masonry domes, and shells. Geometric structure is characterized by "form-finding." Statics underlies all topics, and our treatment is consistent with NCARB expectations.

Course Website: http://soa.cmu.edu

48-638 Structural Design 2: Materials and Analysis

Fall and Spring: 9 units
This course introduces fundamentals of strength of materials, computational modeling of structures and basic Finite Element (FE) analysis. This is a hands-on, skill-building course about learning how to translate a conceptual design intent into a computational structural model, then apply material and boundary condition constraints to analyze and understand structural behavior. These learning goals are achieved through three components: lab exercises, workshops and group design projects. Through a series of lab exercises, the students will learn the fundamental structural properties of standard construction materials (masonry, steel, concrete and timber), and learn how to perform basic calculations to understand the behavior of simple structures made of those materials under various loading conditions. Lab exercises are accompanied by hands-on workshops, where the students learn a specific computational tool or skill that will enable them to translate the lessons learned from the lab exercises into a computational design environment. The knowledge learned from the labs, together with the skills gained from the workshops, are then synthesized into group projects where the students will have an opportunity to apply and test what they have learned. Basic knowledge of statics and structural design is expected, and the students are assumed to have taken Structural Design 1 at CMU or an equivalent, introductory structural design course from another institute. Structural Design 2 is the second of three courses of the Structural Design curriculum offered at Carnegie Mellon Architecture.

48-640 M.Arch Studio: Praxis II

Spring: 18 units
Architecture transforms and shapes relations between individuals, communities, objects and environments. Praxis II will continue to understand architecture as a modulator of complex cultural and historical flows, but will aim to do so by intensively exploring, evaluating, and expanding the role that tectonic cultures and their associated modes of architectural expression play in shaping our world. Through a non-linear, multi-scalar, iterative design process, small teams will develop and refine detailed architectural assemblies attuned to methods of construction, craft, and labor practices; to the role of structural configurations in organizing the spatial distribution of occupancies and human experiences; to how envelopes regulate and respond to thermal and visual performance while also participating in aesthetic discourse; to ecological synergies and impacts; to modes of participation in carbon culture, including environmental management systems, commuting culture, and other patterns of integration with urban context; and ultimately to the disciplinary imperative to integrate/orchestrate these multiple systems. Students will develop design skills while negotiating the complex issues of site, program, climate, aesthetics, and performance. Students will use a range of technologies, such as daylighting and radiation simulation, and Virtual Reality, for designing spaces that respect the natural environment and engage human perception.

Course Website: http://soa.cmu.edu

48-641 History of Modern Architecture

Spring
This course investigates the global history of modern architecture and theory across the 20th century. We ask critical questions about the canon, the changing nature of history and theory, the biases embedded in terms like "modernism," "progress," and "Non-Western," and the deep legacies of colonialism, globalization, extractivism, and capitalism in which modern architecture so actively participated. The course loosely works backward in time to explore major movements and monuments of the Euro-American avant-garde and so-called "heroes" of modernism, but also diverse responses to modernity, including popular, tropical, vernacular, indigenous, and even anti-architecture around the world, including increasingly the Global South. The course content changes slightly every year to acknowledge the evolving understanding of the subject, but also to keep up with changes in architectural education, the discipline of architectural history, and professional practice, as well as changes in global culture, social context, and our student aspirations.

Course Website: http://soa.cmu.edu

48-642 History of Asian Architecture

Spring: 9 units
This course is intended to serve as an introduction to the evolution of urban spaces and the function of the architecture in South Asia, China, Korea and Japan. It is organized chronologically and will examine the impact of indigenous philosophical principles on the organization of villages, capital cities, and religious centers. The course will begin in the Indus Valley where complex urban planning along with public and private architecture flourished from 2600-1900 BCE. We will examine South Asian Hindu and Buddhist cave monasteries as well as freestanding Hindu temples and identify the salient architectural forms that identify each type. We will then move to China where the earliest villages were arranged according to ideas about nature and the organizing system of fengshui. By the earliest Chinese dynastic period, urban planning and building placement were beginning to be codified according to Confucian and Daoist ideals. Later Chinese imperial centers were consciously designed according to Confucian regularity and hierarchy in order to make visual statements about power. We will then move to consider urban organization and Buddhist temples in China, Korea to Japan where South Asian and Eurasian models were adopted and adapted. The examination of the Japanese warrior culture will include castles, new ideas in residential architecture, the Pleasure Quarters, and retirement villas. Contemporary architecture will be addressed through individual and group projects that will investigate specific structures and situate the buildings within the cultural and historic circumstances that led to their creation.

48-643 Color Constructs

Spring: 9 units
In this course you will study and experiment with the relationships and perception of space and form through two- and three-dimensional optical experiments using color. Lectures, discussions, and field trips will delve into color theory particularly focused on the work of artist, designer, and educator Joseph Albers, look at culturally defined use of color, and its experience. In keeping with Albers definition of color theory as a hands-on experiential and experimental process of creating relationships through perception students will work on skills needed to craft compelling images using linear, planar and volumetric assemblies in digital and analog media. Initial weekly exercises will cover principles of color relativity, intensity, temperature, etc., and consider various principles of graphic perception including but not limited to vibrating and vanishing boundaries, figure ground reversals, and the illusion of transparency. Through this process you will gain an understanding of the use of color in the graphic representation of designs, patterns, diagrams and architectural representations that will inform the use of color in transforming the perception of space. The final assignment will be a three-dimensional color structure.

48-644 M.Arch Pre-Thesis

Spring: 3 units
This 3 unit course is designed for B.Arch and M.Arch students a year before their final Spring semester. The course develops an understanding of research methods, and explores the formation of ideas for architecture thesis projects. Many directions of architectural thinking (spatial, material, ideological and procedural), will be discussed and in framing a theoretical position we will see how an architecture thesis can use a creative process to discover and express findings in relation to large questions and to disciplinary discussions. This is a required course for Fall Thesis Seminar in F23 (9units) and Spring Thesis ASOS S24 (18units).

Course Website: http://soa.cmu.edu

48-647 Materiality and Construction Systems

Spring: 9 units
This course introduces students to contemporary methods of construction and draws attention to the materialization of architectural intent. It foregrounds the historical, technological, and conceptual basis of construction systems to understand the building as a process and cultural artifact. The course provides an overview of established and emerging construction systems to reveal how and why building processes are utilized. Materials and methods of construction are positioned as both constraints and affordances, each with distinct spatial, structural, environmental, economic, and aesthetic concerns. Through lectures, readings, and detailed analysis, students will learn about the construction of fundamental architectural conditions, including foundations, walls, frames, envelopes, and roofs. Production methods, spanning the vernacular to the digital will introduce cultures of building and design for manufacturing considerations.

Course Website: http://soa.cmu.edu

48-649 Design Leadership

Spring: 6 units
This graduate seminar will explore architecture and adjacent creative fields for design leadership models to fuel future-forward speculation. How might we shape leadership and culture in a new design era?

Course Website: http://soa.cmu.edu

48-651 Vector Visions: Introduction to Image Processing and GenAI for Designer

Fall: 3 units
This mini-course integrates computer vision and generative AI for students in architecture, urban design, sustainable design, and related fields. It covers fundamental image processing and generative AI concepts like GANs and Diffusion models. Through hands-on projects, students will process and manipulate image data from buildings to urban landscapes. Students will build a solid understanding of image processing and discover its crucial role in emerging AI technologies. By the end of the course, students will be able to apply these skills to real-world design challenges, using tools such as Python, TensorFlow, and OpenCV.

48-652 Pixels to Photons: Introduction to Stable Diffusion and Projection Mapping

Fall: 3 units
This mini-course bridges parametric design, generative AI, and interactive visualization. Students will explore Grasshopper's parametric capabilities with Stable Diffusion, progressing from basic setups to advanced techniques. The focus then shifts to TouchDesigner, enabling the creation of dynamic projection mappings with Stable Diffusion outputs. Students will learn to build responsive environments, animate images, and develop real-time systems for design representation, gaining skills in computational design and AI-assisted creativity. By the end of the course, students will be able to create interactive projection mappings and animate images using Stable Diffusion, transforming digital parameters into captivating architectural visualizations and experiences.

48-658 Constructing Value(s): Economies of Design

Spring
This course explores the systems of economic, political, social, and regulatory forces driving the production of contemporary architectural projects. It critiques these systems, examines alternatives, and tests interventions in pursuit of value propositions outside of the bottom-line driven norms of late capitalism. What do design economies driven by equity, circularity, ecology, pluriversality look like? Through lecture and discussion, real world case studies in both for-profit and non-profit sectors, both locally and internationally, students explore the process of project development from multiple perspectives and gain insight into dynamics that determine if, how, and when projects are realized as well as relationships among various stakeholders, including architects, developers, and communities.

Course Website: http://soa.cmu.edu

48-667 Material Histories

Fall and Spring: 9 units
Materials affect the way we engage with a building and carry cultural meanings connected with complex histories, deeply and at times messily intertwined with the social, political and ecological context. In this seminar we will look at the history of the architecture of the last two centuries by following the thread of the history of materials. We will discuss the ways in which buildings of the past and the practice of architecture were affected by which materials were available, how they were produced, and the craft required to work them. We will reflect on how architects interpreted, manipulated, or added to those meanings through their own work. Materials' lifecycles and the networks of extraction, production, transportation, and reuse had an impact on the built environment in the past, just as they do today. We will learn from historical examples to assess the consequences of the choices we make as designers. Finally, we will critically engage with the presence of history as a layer of complexity embedded in the material itself - an effect that is compounded in the practice of reuse of materials with patina, marked from their past use.

48-668 Sankofa Bamboo Greenhouse

Fall
COMING SOON.

48-670 MArch Thesis

Spring: 18 units
Coming Soon.

48-674 History of Architecture in the Islamic World- A Primer

Fall and Spring: 9 units
An introduction to the architecture of the lands where Islam spread over the centuries, this course aims to provide a basic understanding of major epochs and regional variations. We will learn the function and meaning of the most important building types, examine how these types changed over time to adapt to the needs of changing societies and consider influences and exchanges with other traditions. We will examine the historical context within which art and architecture developed and explore critically the lingering signs of those traditions in contemporary society.

48-676 Connected Communities: Technology, Publics, Politics, and Participation

Intermittent: 6 units
This seminar examines how smart and connected technologies can be designed for neighborhoods, what considerations are involved, and what effects such technologies create for communities. We will introduce and critically examine the relationships between smart systems with the places, infrastructures, histories, politics, publics and problems that surround them. To do this, we will survey topics across research and practice across different domains. These will reveal approaches, methods and design factors to designing systems for communities, as well as the challenges created when computing becomes a non-human participant in communities and publics. The first five weeks of this mini-course will introduce a series of topical readings, cases, guest lectures, case studies, and design exercises. The rest of the course will invite students to investigate topics and contexts of interest to them. By the end of the course, students will be familiar with the socio-technical considerations for designing systems for places and publics.

48-677 Hines Competition

Intermittent: 3 units
This course is for graduate students participating in the prestigious national Urban Land Institute (ULI) Hines competition. This is an intensive real estate and urban design competition that will take place January 9 - January 23rd. Optional pre-competition preparation workshop sessions will be offered the week prior to January 9th. The course itself includes delivering and sharing competition entries and completing a post-competition survey. The purpose of the competition and companion course is for cross-disciplinary teams of graduate students to work collaboratively to create a complex urban design and real estate proposal on a real site in North America. Competition entries include a narrative, drawings and financial analysis. Each team will select and work with a design faculty advisor(s). This course is typically required for Masters of Urban Design (MUD) students. Previous real estate course work or knowledge is preferred. All registrants will be wait-listed until their teams have been registered with ULI (deadline December 9th). Please contact the coordinator Valentina Vavasis to participate.

Course Website: https://americas.uli.org/programs/awards-competitions/hines-student-design-competition/

48-682 Advanced Structural Design: Computational Explorations

Fall: 9 units
"This course introduces advanced topics in computational structural design and analysis. Through various form-finding algorithms and design methodologies, the students will learn how to use structural geometry as a key design driver to shape efficient and expressive forms. Typologies of structures that will be explored include but are not limited to: compression-only shell structures, tension-only membrane structures, compression-tension combined structures and fully spatial, non-manifold structures. Then, simple structural optimization techniques will be introduced and used to refine and improve the initially form-found geometries. Lastly, the class will also investigate various strategies for developing structurally-informed fabrication geometry. The course is organized around a series of hands-on workshops and several design projects throughout the semester, each addressing specific computational tools and design objectives. While the tools and methods that will be used in the course are digital, each project will emphasize physical fabrication and making, and therefore deliverables will always include both digital results and physical models. This is not an introductory course, and we will not be introducing basics of coding or structural analysis. Interested students are expected to have completed all required structural design courses in their respective curriculum at CMU or at previous institutions, and have a high-level understanding of all fundamental structural design concepts and ideas. The students will also be expected to have extensive experience in Python coding (comfortable writing their own geometric algorithms; we will not be using Grasshopper)."

48-685 Design and Documentation in Revit

Spring
This course will guide you through the process of designing in Revit from the schematic, conceptual design phase, to the construction document phase. The course will start with basic concepts moving on to more advanced topics. Layering information and how much to incorporate into the model, based on stakeholders and end users, will be discussed. Capturing the essential information from the BIM model will be explored to develop presentations, bidding documents, and construction documents to relay relevant information to clients, consultants, and contractors. We will discuss when it is imperative to model in 3D and when to overlay 2D linework detail. Real-time rendering techniques that streamline the design process will be explored using Enscape. The skills learned from this course will help you understand the phases of design and documentation in the Revit environment.

48-686 Systems, Cybernetics, Conversation

Spring: 12 units
Across many design disciplinesarchitecture and computational design, media and interaction design, design of services and organizationsmethods for grappling with complex adaptive systems is now table stakes. Furthermore, design today demands profound, authentic attention to equity, human and non-human living systems, climate and environment, sustainability and ethics. Overall, designers must have skills to collaborate in cross-disciplinary teams. An encompassing framework for these disparate disciplines and domains of 21st-century design is the transdisciplinarity (or "antidisciplinarity") of Cybernetics. Cybernetics can be understood as the study of "systems with purpose", whether machines or living things, including their unpredictable interactions. Central to Cybernetics is conversation as a mechanism of design, inclusivity, participation, innovation, and the impetus to action. The course offers systems frameworks and models of conversation that are also relevant to Designing for the Internet of Things (48-675), Inquiry into Computation Design (48-727), and Design Studies: Systems (51-277). Class time balances readings, discussion panels, and guest conversations with executing assignments that involve systems modeling; creating conditions for designing that are participatory and inclusive; and prototyping in a range of media (installations, screen-based interactivity, physical prototypes, workshops, etc.) that offer responses to global wicked challenges.

48-692 Shaping Daylight Through Simulation and Virtual Reality

Fall: 9 units
Light is one of the critical aspects of valued architectural spaces, influencing ambiance, the overall atmosphere, and occupant perception, whether positively or negatively. In this course, we will explore the quantities and qualities of light. We will study how we can design with and for light while understanding the paradox of lighting designthat it is both science and art. Digital design and simulation tools will be augmented with virtual reality (VR) to extend quantitative measurements of lighting to include qualitative aspects of light such as its influence on occupants' subjective impressions of a space, wellbeing and comfort.

Course Website: http://soa.cmu.edu

48-699 Environmental Racism, Injustice, & Unfreedom: Lessons for Architecture

All Semesters
Environmental racism refers to the disproportionate concentration of environmental harms in low-income communities of color (particularly Black and indigenous communities) through the systematic workings both historic and ongoing of white privilege and white supremacy. More broadly, environmental injustices also include restrictions to environmental resources and infrastructures, and the unjust placements and displacements of communities of color resulting from uneven development. In this seminar we will examine the histories of environmental racism and injustice through close reading of literature from a range of fields including Environmental Justice, urban political ecology, Black geographies, and indigenous studies. We will ground our conceptual understandings through a closer look at ongoing environmental justice issues in Braddock and North Braddock, including through dialogue with local advocates and community members. Through the course of the semester students will develop a case study focusing on air pollution in the Mon Valley region, working collaboratively to produce an annotated bibliography of atmospheric pollution and community action.

Course Website: https://soa.cmu.edu/courses#graduate (https://soa.cmu.edu/courses/#graduate)

48-701 Entangled: Remaking Nature from the Picturesque to the Hypernatural

All Semesters: 9 units
This seminar questions how we perceive, represent, and reconstruct our world in relation to evolving concepts of "nature" and their manifestation in architecture, art, and landscape. It is focused on the intellectual trajectories that define ecology and environment to arrive at the paradigm shift theoretician Donna Haraway has termed natureculture. We will first familiarize ourselves with historical ways of seeing "nature" and how this has formed the landscapes of the Anthropocene. This will help us put a critical lens on land, environmental and ecological art, ecoventions, architectural living systems, biomimicry, biophilia, and projective ecologies while we consider the influence of gardens, responsive landscapes, hyper-natures, and artificial ecologies in changing the way we design and build. We look for not only relevance but joy and beauty in practices that highlight the relation between desire, responsibility, more-than-human wellbeing, and ecological justice. This may help us build notions of care and stewardship and an understanding traditional and emergent cultural constructs that can define an eco-centric practice which shapes building futures. The course surveys texts from a range of topics including ecological aesthetics, architecture, art, landscape urbanism, and ecologically focused philosophy and theory. It includes weekly readings, discussions, presentations, and visual or written deliverables. Open to graduate and undergraduate students in Architecture and allied fields.

48-706 Urban Design Studio II: Urban Systems

All Semesters: 18 units
Optimistic assessments about Pittsburgh's livability mask a complicated reality where prospects for health and well-being are starkly differentiated along lines of race, class, and gender. Environmental harms, underpinned by the ongoing legacies of industrial production, extraction, and segregative planning, create a toxic combination adversely impacting human health, ecology, and community futures. These challenges necessitate multidisciplinary, collaborative, and emancipatory approaches to knowing the built environment, and community-centered methods in urban design that attend to the local histories, embodied knowledges, and political ecologies of life in toxic systems. This studio will expand on MUD students' understanding of neighborhood-scaled urban design through the examination of urban systems and systemic processes, focusing on the infrastructures of toxicity, and modes of local action against them. It will be anchored in an ongoing collaboration with North Braddock Residents For Our Future, a grassroots organization which has led the opposition to unconventional gas drilling and environmental injustice in Braddock and North Braddock and surrounding communities.

Course Website: http://soa.cmu.edu

48-709 History and Future of Interaction Design

All Semesters: 12 units
The history of Interaction Design (IxD) is far richer than what is visible from today's tech. Many great ideas have been mangled and even lost. By making prototypes inspired by this history, we reach new insights and illuminate a future of promises and perils. In this course you begin by mining historical IxD innovations by building prototypes in a modern vernacular that forefront lost contributions. In 3 sprints you render a powerful but lost essence in the form of a concept storyboard, video, or clickable prototype. Thus you explore the History of IxD. To explore the Future of IxD, you are invited to invent itby developing your own vision in the design of a final project prototype with the focus and scope that you control. Coursework is partly historical review and largely designing and producing prototypes in a studio setting, especially suited for backgrounds in interaction design, computational design, responsive architecture, media, or coding.

48-711 Paradigms of Research in Architecture

Spring
Architectural "research" by many practitioners is often limited to precedent studies and/or intuitively evaluating alternative design solutions and materials. Deeper analytical activities risk being perceived as unnecessary overhead expenditures. On the other hand, "architectural" research by many scholars is often confined to laboratory settings or so esoteric that the findings are of little use to practitioners. This course challenges the false dichotomy between these two frames and provides an introduction to a wide range of research strategies including Experimental, Simulation, Quantitative, Qualitative, Correlational, Interpretive-historical, Logical Argumentation, Case Study, and Mixed Methods. Throughout the semester there will be guest lectures from faculty who will share their expertise, successful research strategies and methods, innovative ideas for future research, and the results of their current and past research. Students will apply a variety of research paradigms and methods to their research interests, improve their verbal and visual presentation skills, and prepare a research proposal presentation with a problem statement, literature review, methodology/methods, anticipated findings, and bibliography.

Course Website: http://soa.cmu.edu

48-712 Graduate Seminar 2: Issue of Global Urbanization

Intermittent
Abstract: By 2050 the number of urban dweller across the world will double. The seminar is an investigation into the future of cities focusing on three existential challenges: the escalating environmental crisis, growing social inequity and technological dislocation. In the face of these wicked problems, we will address the role and agency of designers and planners, decision makers and citizens in tackling what Jeremy Rifkin describes as the Third Industrial Revolution and how to lay the foundational infrastructure for an emerging collaborative age. These issues are explored through contemporary writings and case studies that situate urban transformations in the US within a broader global context, with a specific focus on the political as articulated through the negotiation of top-down planning and bottom-up behavior of cities. The seminar course will revolves around reading reflections, in-class presentations and student moderated discussions on theories and case studies of global urbanization. This is a 3- or 6-unit course that requires attendance at one 1.5-hours class per week. The extra credits involve a more extensive final paper. Students from diverse disciplines are welcome in this seminar. Key Topics: Global Urbanization, Uneven Growth, Political Economy, Ecological Urbanism, Resilience, Cosmopolitan Localism, Smart Cities, Commons. Course Relevance: An understanding of theories and practice of urbanism in global developments. Course Goals: The seminar provides an understanding of the social, political, economic and environmental forces at play in shaping our built environment and reflects on the role and agency of designers and planners can have in building more resilient and sustainable cities.

Course Website: http://soa-cmu.edu

48-713 MUD Urban Ecology

Fall: 9 units
Urban ecology describes the complex relationships between humans and our environment and is bound by an understanding of system dynamics. Urban ecology draws from our understanding of urban settlements and the cultural values that shape them, as well as our conception of ecology as the resources and flows that support biotic systems. Urban ecology situates humans and our activities as part of a dynamic and living environment that is more continuum than a dichotomy. This class will examine the shifting regimes of urban ecology and equip students with skills and core concepts that enable them to lead or contribute to transition through design. As designers we are trained to see patterns and #8212;urban ecology asks us also to see processes and to speculate on effects and possible outcomes. This course will discuss the systems and the logics that create the patterns, and we will explore how our design process may be different when dealing with the ambiguity and uncertainty of systems design. We will learn the fundamentals of systems dynamics modeling as it applies to the design of historical and contemporary landscapes, infrastructure, and spatial practices at the macro-, meso-, and micro-scales.

Course Website: http://soa.cmu.edu

48-715 MSCD Pre-Thesis 1

All Semesters: 6 units
This seminar introduces graduate students in Computational Design to the rudiments of graduate level academic research, and offers a space to discuss inchoate research methods, questions, and projects in the field. Assignments require students to gain familiarity with past and current research in the field in order to distinguish different research traditions, practices, opportunitiesand pitfalls. An emphasis is placed on the materialities and socio-technical infrastructures of computing.

Course Website: http://SOA.cmu.edu

48-716 MSCD Pre-thesis II

All Semesters: 6 units
With the notion of "critical technical practice" as a touchstone, this graduate-level seminar draws from across design, media, and science and technology studies to cultivate an awareness of the discursive and political dimensions of technology in design, and to guide participants in the formulation of a graduate thesis in computational design. Through readings, discussions, written assignments, and presentations participants develop the skills to identify and refine a research question, situate it within a wider scholarly conversation paying attention to ethical citational practices argue for its relevance, and creatively engage with conceptual and methodological research challenges. As a final deliverable, participants produce a thesis proposal and present it to faculty and students.

Course Website: https://soa.cmu.edu/courses#graduate (https://soa.cmu.edu/courses/#graduate)

48-720 Planning by Design: Campuses, Waterfronts, Districts, and Cities

Spring
In responding unprecedented challenges of density, information, equity, and climate change, cities continue to define and design "districts." Waterfront, historic, arts, innovation and ecodistricts draw on models including on university/corporate campuses, neighborhoods, main streets, and downtowns. How can cities remake districts in that are viable in terms of engagement and opportunity? How can they be meaningful and inclusive in a society that appears to be increasingly less place-based? Through presentations, case studies, and the semester project, students will develop strategies to respond to these challenges.

Course Website: http://soa.cmu.edu

48-721 Building Controls and Diagnostics

Intermittent: 12 units
The course will introduce students to collecting and processing data acquired from building systems and evaluating their performance. It will discuss the basics about control systems, including both traditional control logics, like rule-based control and model predictive control, and advanced control logics like reinforcement learning based control. Proficiency in Python and maturity in mathematics is required. Knowledge of website design and reinforcement learning is recommended.

Course Website: http://soa.cmu.edu

48-722 Building Performance Modeling

Fall
This graduate-level course examines the emergence of computation as a pivotal concept in contemporary architecture and design through a selection of design theories and practices responding to the so-called "computer revolution". An aim of the course is to explore computation beyond particular technologies and tools, and to cultivate an awareness of design technologies as cultural artifacts shaping disciplinary identities and worldviews, and shifting conceptions of design, creativity, nature, body, and place. The semester is divided into two-week thematic modules, often with computational design faculty participating as guests covering topics derived from their own research. Each module includes readings and a short team-based project expanding on the topic introduced. Topics include among others shape grammars, tangible interaction, responsive environments, cybernetics, and architectural robotics. The course also introduces participants to the rudiments of academic research, in particular to the elements and structure of an effective research paper. Participants practice reading and responding to both historical documents and contemporary research related to each topic, and develop a critical understanding of a rapidly expanding landscape of hybrid practices, theories, and research methods linked to computational and interactive forms of creative practice.

Course Website: https://soa.cmu.edu/courses#graduate (https://soa.cmu.edu/courses/#graduate)

48-723 Performance of Advanced Building Systems

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

48-724 Scripting and Parametric Design

Intermittent: 10 units
This course prepares students for modeling geometry through scripted development of parametric schemes primarily for design applications that is, to introduce students to basic scripting in geometrical modeling environment with a focus on algorithms relating to form making and to reinforce and extend basic concepts of parametric modeling. Contemporary approaches to modeling geometry are computational reflected in designers wanting much more control over the generative process by varying parameters, in turn, enhancing the efficiency with which they navigate design variations, analyze design artifacts and explore design manifestations. This course has two parts: firstly, to supply the basics of object-oriented programming and algorithmic thinking using Python language constructs, and secondly, to supply the basics of scripting generative form making specifically, by customizing procedures for generative design via scripts in GhPython in conjunction with Rhino/ Grasshopper objects. A number of different form-making algorithms are explored, e.g., fractals, rule-based models, cellular models, agent- based models, and optimization- based models. The course consists of lectures, computer instruction and weekly assignments. Prior exposure to Rhino/ Grasshopper is required.

48-725 Graduate Real Estate Development

Fall
This course teaches the fundamentals of real estate development in the U.S. You will learn about the real estate development process and the social, economic and regulatory context in which land use and real estate development take place. We will learn about project team members and processes; market research; site constraints and zoning; basic project budgeting and types of funding sources. We will also discuss social equity issues related to land use, including affordable housing, racial segregation and economic inequality. This course typically includes international students which allows us to learn from each other and compare real estate and land use issues in various countries. The primary objective of this course is for students to understand how these issues might affect their professional and personal lives, whether they become designers, contractors, engineers, public policy professionals or real estate developers. The course includes learning terminology, reading current news articles, and completing a team project, sometimes with a Pittsburgh-based client. Students will have the first two weeks of class to select nine or 12 credits; 12 credit students will complete additional work. Open to graduate students from any school including SoA, Tepper and Heinz Undergraduates with instructor permission only

Course Website: https://soa.cmu.edu/courses#graduate (https://soa.cmu.edu/courses/#graduate)

48-729 Sustainability, Health and Productivity to Accelerate a Quality Built Environmen

Fall
Given the United Nations Sustainable Development Goals and the growing demand for sustainable design, professional practices are "tooling up" around the world to deliver high performance and environmentally responsible buildings, infrastructures 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. This course explores the relationship of quality buildings, building systems, infrastructures and land-use to productivity, health, well-being and a sustainable environment. The course begins with a series of lectures on high performance enclosure, mechanical, lighting, interior and networked building design decisions and extends to sustainable communities and infrastructures. The course engages students in the research literature that relates these building design decisions to multiple cost/performance impacts, including: energy, carbon, facilities management, organizational change, technological change, attraction/retention (quality of life), individual productivity, organizational productivity, salvage and waste (the circular economy), tax and insurance, and critically to environmental and human health.

Course Website: https://soa.cmu.edu/courses#graduate (https://soa.cmu.edu/courses/#graduate)

48-731 Sustainable Design Synthesis Prep

Spring
Synthesis Prep is an intensive course designed to help students refine their research plan and prepare for their synthesis project. Over the course of the semester, students will develop a research plan, present their research goals and findings, and author a preliminary report. With a refined timeline and deliverables, students will evaluate the efficacy of their approach and update their plan as necessary. The course will provide students with a comprehensive understanding of their area of study, with critical excerpts organized and professionally cited. Through field work, simulation, and analysis, students will initiate new contributions to ensure that the Synthesis methods, timeline, and deliverables are feasible within the Spring semester.

Course Website: https://soa.cmu.edu/courses#graduate (https://soa.cmu.edu/courses/#graduate)

48-733 Environmental Performance Simulation

Intermittent
"Design of a boat is optimized for sail-driven locomotion. Buildings should be able to sail using free energy if wind, air, sun and internal heat sources to temper indoor environment", Brendon Lewitt. Based on this viewpoint, this course introduces fundamental knowledge in building physics in relation to a range of environmentally responsive building design principles and computational approaches for increased resiliency for human habitability with minimal reliance on mechanical systems. EPS course refreshes some of the fundamental building physics topics such as building thermodynamics (heat and amp; mass transfer mechanisms), photometric quantification of light and luminous environment, human visual and thermal comfort, thermal modeling and the principles of generating electricity from sunlight (photoelectric effect). EPS course outlines a series of environmental design principles with emphasis on evidence-based design approaches and reviews of building case studies are evaluated against actual buildings in operation. Focus is also given to integration of multi-valent environmental design strategies into the early stages of performative architectures. EPS also introduces state-of-the-art architectural design and amp; research oriented environmental performance simulation and amp; visualization tools, methods and techniques (based on the algorithmic/parametric modeling ecosystem of RHINO-Grasshopper-DIVA-ArchSIM -Ladybug-Honeybee programs). Computational introductions will be accompanied with pre-established/seed workflows which are ready for future adaptation and extension by the students.

48-737 Detailing Architecture

All Semesters: 9 units
"This course examines the role of the architectural detail in the formation/ thematic development of a work of architecture and how the detail reinforces the theoretical position of the architect.

Course Website: http://soa.cmu.edu

48-738 Special Topics: Ecological Footprints

Fall: 6 units
The Ecological Footprint is a measure of the demand that human activity puts on the biosphere. More precisely, it measures the amount of biologically productive land and water area required to produce all the resources an individual, population, or activity consumes, and to absorb the waste they generate, given prevailing technology and resource management practices (Global Footprint Network 2010). This course will engage students in the metrics and impacts of our collective consumption and waste of: -Energy -Materials (Cradle to Cradle) -Food -Water -Transportation -The Integration of Systems towards Quality of Life Starting at the global context, this course will address challenges/opportunities to advance regenerative practices, improving our relationship to nature. Learning from international best practices, we will continue to explore ecological footprints at the global, national, regional, city, neighborhood, building and individual scale. The course will be based on lectures and readings, with assignments and student presentations to fully explore each of the footprint characteristics. Experts on water, energy, materials, food and other resources have been invited to lecture. By mid semester, an application project will be selected for ecological footprint analysis and the development of design, engineering, and operational guidelines towards reducing that footprint. The potential application projects include: the CMU campus footprint and Donner House retrofit; the Energy Innovation Center and education of the trades in reducing our regions footprint; or a new Net Zero building for Carnegie Mellon University. This will be a collaborative effort.
Prerequisite: 48-305

48-739 Making Things Interactive (Graduate)

Fall: 12 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. You'll also dive into the fields of VR/AR/MR and experiment with combining these disciplines with physical computing. Through weekly exercises and a term project the class will introduce basic analog electronics, microcontroller programming, projection mapping and virtual reality; as well as exploration into using kinetics and materials to make the things you design perform. Emphasis will be on creating innovative experiences. The graduate edition of this course will require additional work including a paper that can be submitted to a peer-reviewed interaction design conference such as CHI, UIST, or TEI. Students from all disciplines are welcome: but please note that the class demands that you master technical material. Experience in at least one of: programming, electronics, or physical fabrication is strongly recommended.(Participants will provide their own supplies and materials.)

48-743 Introduction to Ecological Design Thinking

Intermittent: 9 units
This seminar offers an overview of scholarly, design-based and research-based approaches to issues of ecology and sustainability in architecture and urban design. The seminar intends to question contemporary paradigms of sustainability within the built environment and includes inquiries from different disciplinary perspectives ranging from history, theory, technology, engineering, art and design. The goal of this seminar is to offer a platform for critical thinking, in-depth discussion and analysis of actionable methodologies related to sustainability, and procedures relevant to the shaping of our physical environment and social systems. Composed of a series of lectures, readings and short assignments, this seminar will lead students through a diverse collection of interdisciplinary views and positions towards defining what is our understating of sustainability today, and what is a role of large scale ecology within the constructed environments. Students will be introduced to a wide overview of technical, analytical, practical, theoretical and intellectual inquiries that will help them to navigate varied fields of expertise and enable their future investigation of innovative sustainable strategies for the built environment. This seminar will consist of majority of lecture sessions and 2 project review sessions, spread across the fall semester. Each session will introduce set of readings and/or a small exercises related to the lecture theme. The invited lecturers come from both: academia and practice. Invited speakers' areas of research and design work feature diverse approaches to issues of sustainability and technology. This seminar serves as a platform for development of a cross-disciplinary theoretical foundation to investigate varied methodologies towards sustainable design practice.

48-745 Design Fabrication

Fall and Spring: 9 units
Design Fabrication is a project based seminar exploring the application of Computer Aided Manufacturing (CAM) in architecture. The course meets in the School of Architecture's Design Fabrication Lab (dFAB), which serves as a context to better understand the interconnected affordances of building materials, machine processes, and modeling software for design thinking. During the semester students receive hands-on introductions to dFAB equipment, including laser cutting, cnc routing, and 3D printing. Concepts will be explored and tested through iterative making/prototyping. Course Focus The course focuses on Transdimensional Fabrication, a manufacturing framework that forefronts design thinking across space and time. A growing array of approaches in contemporary architecture are motivated by this focus (e.g. flat pack, 4D printing, metamaterials, kinetic architecture, robotic origami, design for disassembly, etc.). We will investigate Transdimensional Fabrication concepts through three that forefront design translations: 2D 3D, Space Time, Assembly Reconfiguration Disassembly

Course Website: http://soa.cmu.edu

48-746 Shape Machine

Fall: 9 units
A shape machine is any computational technology that fundamentally expresses the way shapes are represented, indexed, queried and manipulated. In this course the shape machine is based on visual rules (shape rules) grounded in symbolic rules (programming language instructions) to provide a robust technology to individuals who use drawings and visual models to develop and communicate their ideas. A shape machine is intended to be a computational, visual and disruptive technology for shape cognition and computing, which intersects with such fields as design, artificial intelligence, computer science, and mathematics. We consider a particular kind of shape machine - spatial grammars - which have their origin in formal grammars for spatial composition. Grammatical approaches to designing offer an alternative to traditional approaches. The goal of grammars is not to produce a single design as the final outcome, but, rather, to provide an understanding of the underlying spatial relations that come into play in an eventual design. For nearly three decades, grammars have been studied extensively to understand style in architecture, engineering, design, fine art and ornament. Recently, there has been an increasing application of grammatical ideas to other disciplines. Specifically, there is resurgent interest in implementing shape grammars for application. This is the focus of this course.
Prerequisite: 48-724

48-749 Special Topics in Computational Design

Intermittent: 6 units
Today's wicked challenges are many-dimensional and fundamentally intractable, yet countless members of our university have great passion to confront them. Systems thinking and rigorous approaches to complex adaptive systems are required to model the nested entanglements across social, technical, and environmental contexts. However, the required systemic models and their underlying principles are not available in approachable form and have generally not been expressed in terms of wicked challenges. To address this gap, students in this seminar take part in researching and designing a global public colloquium called Colloquies for Transgenerational Collaboration to be held in hybrid mode in Fall 2023 at CMU. The unique organizing principle is to proceed from the concerns, worldview, and values of grad students and rising faculty, who will then be paired with local and international practitioners in systems, cybernetics, and wicked design challenges. The resultant public conversations will become the basis for on-going design and co-creation, to be documented and widely shared to benefit future researchers.

48-750 Design & Redesign of Capital Cities

Fall: 9 units
This architectural and urban design history course examines the cultural histories of the design and redesign of world cities. The scale of urban interventions we will look at varies greatly, from the macro-scale of designing totally new capitals to the micro-scale of altering small nodes within a city. We explore the relationship between form and culture by considering political, social, economic, and aesthetic forces that have shaped the public realm of urban as well as suburban spaces. We focus on recognizing and understanding the rationale behind the design, re-design, and use of culturally important urban spaces during their own time, making periodic forays into the issues that influence those spaces today. Non-majors are welcome.

Course Website: https://soa.cmu.edu/courses (https://soa.cmu.edu/courses/)

48-752 Zero Energy Housing

Fall: 9 units
Are you interested in designing or renovating the high-performance multifamily housing of the future? Would it surprise you to know that despite numerous successful single-family projects, only a limited number of successful multistory, multifamily zero examples exist? Creating multifamily housing that reaches net zero or carbon neutral goals is challenging since occupant behavior can influence the outcome as much as building design and construction. Yet multifamily housing is an essential typology to address rapid development and urbanization. Take on the challenge of creating high performance housing for our net zero future by exploring the technical and social demands of multifamily zero energy design or renovation. 48-752 is a graduate level course designed to support that goal. Through lectures, outside research, discussion, and a final applied project, you'll explore the design approaches, codes, policy, technology, and energy infrastructure options that can help you achieve the housing performance we know is essential for a sustainable future.

Course Website: http://soa.cmu.edu

48-753 Intro to Urban Design Media

Fall: 6 units
This course explores new forms of media and representation in Urban Design. The seminar is a project-based course consisting of bi-weekly exercises and reading assignments. Students will adopt their own hometown as the primary site for their analysis and representation. Throughout the semester, students are tasked with identifying a specific subject unique to their site of inquiry. They will then analyze, interpret, and re-represent their subject through a variety of media, including collages, maps, images, renders, matrices, animated GIFs, and AI-generated imagery. Consideration will be given to drawing/image quality, technique, and aesthetics.

48-755 Introduction to Architectural Robotics

Fall: 9 units
This course provides a practical, hands-on introduction to the application of industrial robotics in architectural and related construction domains. It also provides students with the necessary knowledge and safety protocols to work in the architectural robotics lab at CMU SoA. Through lectures, labs, and project work you will learn the industrial robotic fundamentals of on-line programming, off-line programming, simulation, end-of-arm-tool (EOT) development, workcell development, and interacting with peripheral sensors. This course is a prerequisite for more advanced engagement with the lab equipment through SoA courses, student thesis projects, and research. No prior knowledge of industrial robotics is required to succeed in the course. Students should have basic knowledge of Rhinoceros 3D modeling and visual scripting in Grasshopper. Prior programming experience is recommended, but not required. All students should exhibit careful attention to lab safety policies and the determination to test ideas through physical making and iteration.

Course Website: https://soa.cmu.edu/courses#graduate (https://soa.cmu.edu/courses/#graduate)

48-756 Project Planning and Reporting

Fall
The goal of this course is to expose the class to advanced project scheduling methods and familiarize the students with the primary reporting practices as performed in the construction industry such as change management, resource charts, and project status reports. The course objectives are as follows: 1. Outline and discuss the established practical approaches of planning and reporting; 2. Demonstrate the dynamic nature of construction projects stemming from inherent uncertainties. 3. Hone a student's adaptability to the dynamism of the process while delivering construction projects. This course will include both discussions on assigned topics and a studio-based collaborative group project. In order to provide a real-world experience to the students the second half of the semester will feature a group project focused on tracking a construction project with varying situational scenarios such as changes in resources and scope creep. Throughout the semester there will be one midterm and intermittent homework with the final deliverable being a "close out" document, which would essentially be a compilation of all the work during the semester projects.

Course Website: http://soa.cmu.edu

48-758 Responsive Mobile Environments (Grad)

Intermittent: 12 units
As part of this project-based course, we'll get hands-on with emerging technologies, concepts and applications in the Internet of Things through a critical lens. We'll prototype everyday intelligences and design smart and connected devices that examine and speculate on the strange, supernatural, and mystic qualities of the smart home. The first half of the semester will introduce students to building connected devices and intelligent spaces through technical development workshops, readings, applied explorations, and guest lectures. The second half of the semester will be organized as an applied collaborative project.

Course Website: http://rme2021.daraghbyrne.me

48-759 Value Based Design Introduction

All Semesters
This course will teach students the importance of Value Based Design across all project types and amp; delivery methods. The student will receive a firm grasp on the roles of each project stakeholder in a range of small to large construction projects.

Course Website: https://soa.cmu.edu/

48-763 Protean Systems: Sustainable Solutions for Uncertain Futures

Intermittent
Uncertainty perpetually plagues the built environment. The inability of our buildings and cities to adapt to shifting circumstances has led to an enormous amount of waste. Throughout the semester we will explore various types and scales of change and each week we will review various concepts such as Mass Customization, Computationally Responsive Environments and amp; Facades, Open Building, Shearing Layers of Change, Adaptive Reuse, Metabolism, Persistence, Preservation, Circular Economy, Design for Deconstruction and amp; Reuse (DfD+R), and Repair/Maintenance. To deepen our understanding of the concepts students will present group case studies each week and apply their understanding of the concept(s) to a project of their choosing as a design exercise or develop a detailed, individual case study report. Students in this course will: Compare many ways architects have attempted to deal with change in the past. Analyze the effectiveness of specific precedents over time. Diagram how anticipated and unanticipated forces of change impact architecture. Design innovative protean solutions of your own. The course welcomes students from all SoA and SoD undergraduate and graduate programs.

Course Website: https://soa.cmu.edu/courses#graduate (https://soa.cmu.edu/courses/#graduate)

48-764 BIM for architects: Leveraging Revit Parametric Design to Empower Innovative Arc

Fall
Building Information Modelling (BIM) has the potential to empower design by allowing architects to consider many design options, analyze the project while designing, and communicate the design to the client for feedback to allow an informed decision-making dialogue. The course will offer hands-on experience working with Autodesk Revit on an architectural BIM project. Students will gain the ability to leverage parametric abilities of Autodesk Revit program for a better preliminary design process. The course will focus on learning advanced parametric modelling techniques in Revit, and exploring analytic possibilities available for architects in early stages of the design: quantitative program area analysis, energy analysis, lighting analysis, initial cost analysis. This course is directed at graduate students, fourth and fifth-year undergrads are welcome as well. Basic knowledge of Revit modeling is required, either from 48485, 48568 (the Revit 3-unit section), 12711, or other background approved by the instructor.
Prerequisites: 48-485 or 48-568 or 12-711

48-770 Introduction to Machine Learning in Design

Spring
With the recent blooming of artificial intelligence (AI) and machine learning (ML) came a renewed interest in how these technologies may impact architecture and other creative practices. Introduction to Machine Learning in Design introduces students to this emerging field, giving them the tools to make their own machine-learning-based design tools by adapting state-of-the-art models, developing new models, and understanding how data shapes machine learning algorithms. Throughout this course, students explore two main fields of machine learning and their potentials in design and making problems: Unsupervised Generative Models, Natural Language Processing. Students will be introduced to the fundamental concepts of each field and get hands-on experience with state-of-the-art research and tools to implement them. Prospective students should have strong Python programming skills. Prior basic familiarity with Machine Learning is a plus. Taking Fundamentals of Programming (15-112) or school of architecture courses such as Design + Computation 1 or Scripting and Parametric Design before taking this course is strongly recommended but not mandatory.

Course Website: http://soa.cmu.edu

48-779 Processes of Digital Design Fabrication

Intermittent: 3 units
Digital Fabrication techniques are well established and widely used across all stages of design to production. Contemporary pre-occupations with materiality, ornament, digital craft, and surface topology are tethered to the affordances of these workflows and their direct connection to digital design methods. The impact of these processes reverberates across scales and around the globe, its presence undeniable. Off-site, prefabrication techniques are increasingly reliant upon computational methods to achieve greater control and precision, while recasting traditional design to production workflows. The architects traditional conveyor of design intent, the working drawing, and its conventions of plan and section are increasingly supplemented with machine and robot code. Meanwhile the jobsite and field construction of buildings remains a largely human endeavor, reliant upon the skill of local labor to assemble the many components that constitute a building to produce the one-off piece of architecture. This tension between the promise of the factory floor and the messy reality of the job site reflects the evolving nature of construction and its regimes of labor. Building construction is an industry in flux rooted in traditions that pre-date the emergence of computation, yet also in the midst of digital disruption as seen in advancements in onsite architectural robotic fabrication. Lest they succumb to greater marginalization, architects must engage these transformations and leverage their design affordances. Practitioners should be versed in the basic principles of digital fabrication and understand its affordances and potential influence upon the design process. Translations from drawing and model to building increasingly rely upon these modes of production. Emerging practitioners must be capable of engaging these modes of communication and leveraging these techniques in the realization of their design intent.

48-781 Spatial Analysis in Infrastructure Planning

Spring
A Geographic Information System (GIS) provides storage, retrieval, visualization, and analysis of geographically referenced data. GIS provides analytical tools to investigate spatial relationships, patterns, and processes of location-based data such as cultural, demographic, economic, environmental, health, physical, social, and other phenomena. GIS creates digital twins (virtual representations) of natural and built environments and integrates many types of digital models. GIS topics include geographic concepts (projections and map scales), map design, geodatabases (importing spatial and attribute data, geocodes, table joins, and data aggregation), spatial data processing, digitizing, data mining, multivariate cluster analysis, drive and walk time networking, raster GIS, spatial statistics (proximity and hot spot analysis), animation, and 3D GIS. CAFM (Computer Aided Facility Management) and IWMS (Integrated Work Management Systems) topics include space and asset management, building operations, environmental health and safety, and real property. The course includes in-person and asynchronous video lectures to learn important GIS concepts and a brief introduction to work management systems. Software tutorials cover leading GIS software from Esri Inc. Applications include ArcGIS Pro, ArcGIS Online, ArcGIS Map Viewer, ArcGIS Story Maps, and Dashboards. Subject areas are related to architecture, engineering, construction management, building performance, environmental health, sustainability, public policy, urban design, and planning.

Course Website: http://soa.cmu.edu

48-783 Generative Modeling (GRAD)

Fall and Spring: 9 units
This course introduces students to the fundamentals of generative modeling using computer aided design as practiced in the field of architecture. Core competencies will be developed through modeling projects and software intensive labs, while a broader critical framework for conceiving of contemporary and historical parametric practices will be encouraged through periodic lectures. Emphasis will be placed on careful consideration of digital mediums and developing a sense of craft related to digital modeling in the hope that students will become conscientious makers and consumers of digital content. Students will be encourage to understand and apply algorithmic problem solving to the many design constraints encountered in architecture. The course will explore the relationship of parametric workflows to design thinking and will situate contemporary trends in a broader framework of computational design. The course will also forefront complex form-making as a response to bio-mimicry, systems thinking, and mass-customization. Rather than positioning parametric modeling as a disruption of historical architectural design process, the course will encourage students to consider how new tools might augment the discipline's historical commitments to orthographic projection, perspectival drawing, and physical modeling.

48-786 Portfolio & Resume Preparation

Fall and Spring: 3 units
Portfolio is a unique document that showcases your professional and academic journey through various media and interfaces. Portfolio's capacity to represent a body of work and as a storytelling tool is emphasized in this course. The course proposes a fresh way of thinking about portfolio types and their content. Portfolio is a document through which you invite an audience to explore mediums of your creative thinking, forms of imagination, sense of materiality and possibilities of shaping the real conditions. The course deals with curating the content, editing your portfolio, resume, cover letters and work sample design. We shall look at myriad drawing types, layouts, typefaces and get into technicality of workflow, project sequence and details of the portfolio. In each session we shall select a particular content of the portfolio and discuss through presentations, diagrams, key references and students and amp;#39; work. Each project has its prompt, is unique in terms of its scale, modes of investigation and tools of representation. A successful portfolio shows diverse tools of thinking and communication.

48-788 Proseminar in Computational Design

Fall: 6 units
No course description provided.

48-795 LEED

Spring: 6 units
If you're interested in sustainable infrastructure and community design, have you considered how "green" strategies may vary around the world? Are there universal goals for the design of sustainable transportation, water systems or energy infrastructure, or must green goals and design approaches be adapted to a national or local context? 48795 A4, LEED, Green Infrastructure and Community Rating in Global Context, is a graduate level mini-course that compares global community and infrastructure rating systems to gain perspective about sustainable infrastructure development and community design. The course uses two rating systems and #8212;the US Green Building Council's Leadership in Energy and Environmental Design (LEED) Cities and amp; Communities Rating System and the Institute for Sustainable Infrastructure (ISI) Envision Rating Systemas springboards for exploration and discussion of other world rating systems that address these topics. We'll consider how the goals and implementation of a rating system may reflect the national context in which the system was created and discuss emerging issues that may be omitted from these rating systems. The course provides a foundation for taking USGBC's LEED Green Associate and/or LEED Accredited Professional exams, or the ISI Envision Sustainability Professional exam and is designed to hone your critical thinking about sustainable urban design and infrastructure development in a global context.
Prerequisite: 48-315

Course Website: http://soa.cmu.edu

48-801 Office Visits

Fall: 6 units
Each candidate will arrange with their home office a virtual 'visit' for members of the degree program and organize presentations of the projects, methodological challenges, recurring problems, best and worst practices within the context of their office experience. Asynchronous Course Delivery (Fall 2014) - and gt; September 18, through December 7, 2014 Online Synchronous Course Conclusion (Fall 2014) - December 8-11, 2014

48-802 Principles of Research I

Fall: 6 units
Candidate's current knowledge of problems, methods and outcomes based on their professional work. Overview of the eight knowledge areas as existing disciplines and their potential place in them. Asynchronous Course Delivery (Fall 2014) - and gt; September 18, through December 7, 2014 Online Synchronous Course Conclusion (Fall 2014) - December 8-11, 2014

48-803 Areas of Practice

Fall: 6 units
Candidate presentations of area(s) of expertise summarizing the methods and problems that are prevalent; using case studies to establish a situated approach to research. Asynchronous Course Delivery (Fall 2014) - and gt; September 18, through December 7, 2014 Online Synchronous Course Conclusion (Fall 2014) - December 8-11, 2014

48-804 International Exchange I

Fall: 12 units
Conduct workshops for collaborative research and information exchange meetings with EU cohorts visiting from the Universit and #233; Toulouse III - Paul Sabatier, Doctoral Programs in Architecture. Asynchronous Course Delivery (Fall 2014) - and gt; September 18, through December 7, 2014 Online Synchronous Course Conclusion (Fall 2014) - December 8-11, 2014

48-805 Directed Study I

Fall: 6 units
Prepare the first publishable article under the supervision of the advisor, based on the current professional practice record of the candidate. Submitted to a committee of faculty for approval. Asynchronous Course Delivery (Fall 2014) - and gt; September 18, through December 7, 2014 Online Synchronous Course Conclusion (Fall 2014) - December 8-11, 2014

48-809 International Exchange II

Spring: 12 units
Visit Universit and #233; Toulouse III - Paul Sabatier, Doctoral Programs in Architecture and participate in collaborative research and information exchange meetings with EU cohorts, based on the cohorts current knowledge base culled from their practice experience. Asynchronous Course Delivery (Spring 2015) - January 18, through May 13, 2015 and #8212; Online Synchronous Course Conclusion (Spring 2015) - May 14 through 17, 2015

48-810 Comparative Analysis of US and EU Practices

Spring: 6 units
Practices in the building sector vary considerably in the US versus the EU. The instructor will provide a rich collection of national and international initiatives in the AEC domains and include a stimulating series of site visits to important installations in the area. Asynchronous Course Delivery (Spring 2015) - January 18, through May 13, 2015 and #8212; Online Synchronous Course Conclusion (Spring 2015) - May 14 through 17, 2015