inworks course list

updated for AY2017-2018: 3/31/2017

IWKS 2100: Human-Centered Design, Innovation and Prototyping
Introduces collaborative interdisciplinary design and innovation from a human perspective. Using the wide array of Inworks prototyping facilities, teams of students will design and implement human-oriented projects of increasing scale and complexity, in the process acquiring essential innovation and problem-solving skills.
Prerequisites: None. No previous design or prototyping experience is expected or required.
Credit hours: 3
Course Typically Offered: Fall & Spring

IWKS 2300: Computational Foundations of Innovation
Introduces the technological underpinnings of modern society, introducing the fundamental principles of computing. Students create realistic artifacts, and imbue those artifacts with interesting behavior by writing computer programs in on-line virtual world similar to Second Life and for simple Arduino-connected devices. In-class and in-world discussions and readings introduce important computing ideas and concepts. Completion of this course will prepare students for more advanced IWKS courses that require knowledge of computing principles and practices.
Prerequisites: None.
Credit hours: 3
Course Typically Offered: Fall

IWKS 3100: 3D Design and Prototyping
Introduces the design and computer-controlled fabrication of three-dimensional objects using both additive (3D printing) and subtractive (laser cutter, CNC router / milling machine) processes. Various commercial and open-source software tools for 3D design (CAD), manufacturing (CAM) and visualization will be explored. Increasingly complex projects throughout the semester will be used to illustrate fabrication techniques. The course will culminate in a final project.
Suggested Background: None. No previous experience in 3D design or prototyping required.
Credit hours: 3
Course Typically Offered: Spring

IWKS 3180: Inworks: Choose Your Own Adventure
Experiences in Design, Innovation and Prototyping
Provides weekly speakers, workshops and other experiences that educate and enrich across the design, innovation and prototyping landscape. Students may choose to participate in any five (for one credit), ten (for two credits) or fifteen (for three credits) activities. Each week, participating students will attend the scheduled activity, and then create a meaningful response that reflects the impact of that activity on their thinking or practice.
Prerequisites: None.
Credit hours: 1-3 (Variable)
Course Typically Offered: Fall and Spring

IWKS 3200: Data Science for Innovators

Introduces techniques for capturing, processing, visualizing, and making meaning out of large datasets. With the exponential growth and decreasing cost of data collection tools such as genome sequencing, social media, crowd sourced data, mobile phone apps, remote sensors, and data from other publically available sources, innovators are able to harness a rich array of data in their designs. This course will introduce the fundamentals of working with online data and large data sets, introduce widely used data analysis and visualization tools, and culminate in a cumulative project that incorporates data in a significant way.
Suggested Background: IWKS 2300 or similar experience.
Credit hours: 3
Course Typically Offered: Fall

IWKS 3300: NAND to Tetris
Foundations of Computer Systems
Introduces the principles and technologies that underlie the global information age. Starting from first principles, students gradually construct a fully functional simulated hardware platform, together with a modern software hierarchy, yielding a working basic yet powerful computer system. In the process of building this computer system, students gain a first-hand understanding of how hardware and software systems are designed and how they work together as one enterprise. The course involves considerable software development in the form of a series of laboratory assignments of increasing complexity, but requires only introductory programming experience.
Suggested Background: IWKS 2300 or similar computing experience
Credit hours: 3
Course Typically Offered: Spring

IWKS 3400: Game Design and Development I
Principles of Computer Game Development
Introduces the fundamental principles of computer game development, including the rich interplay of computer science, graphics design, physics, music, and narrative that comprise modern computer games. Students develop interactive 2D and simple 3D games in laboratory assignments of increasing complexity. The course involves considerable software development, but requires only introductory programming experience (e.g., IWKS 2300). Culminates with a final project consisting of a team-developed complete game.
Suggested Background: IWKS 2300 or similar computing experience
Credit hours: 3
Course Typically Offered: Spring

IWKS 3540: Synthetic Biology for Innovators
Introduces the fundamentals of synthetic biology for those who seek to use it as tool for innovation. Synthetic biology allows us to engineer new biological systems and redesign existing biological components by integrating aspects of biotechnology, evolutionary and molecular biology, systems biology, computer engineering, computational biology, and genetic engineering. Advancement in technological tools and techniques make this material accessible to motivated individuals from many disciplines, and no biology background is required. Culminates with a final team project focused on designing synthetic biology solutions that address human need.
Suggested Background: None. No previous background in biology is required.
Credit hours: 3
Course Typically Offered: Fall

IWKS 3550: Innovation Law and Policy
Introduces legal and regulatory foundations related to innovation, including intellectual property, telecommunications, electronic commerce and the Internet, biotechnology, ethical and equity considerations, and the financing of innovative ventures. The course examines these issues from the diverse perspectives of the legal, business, capital, development, consumer, and policy-making communities.
Suggested Background: IWKS 2100
Credit hours: 3
Course Typically Offered: Fall

IWKS 3600: Innovating for the Developing World
Explores the design and development of products and services that can be sustainably and gainfully used by the world's poorest citizens. Students in interdisciplinary teams will design, implement and evaluate viable solutions to a real problem faced by people in the developing world. The goal is to develop an understanding of the extraordinary challenges faced by individuals for whom basic survival is not a given, and the knowledge and skills necessary to create designs that respond appropriately to those unique circumstances. Provides a foundation for further study and practice in the area of technology and development.
Suggested Background: IWKS 2100
Credit hours: 3
Course Typically Offered: Fall

IWKS 3620: Mobile App Development
Introduces mobile application development, including front-end mobile application clients, data handling, connectivity to back-end services and cloud hosting. The course provides an overview and comparison of technical approaches employed by Apple iOS, Google Android, and cross-platform development environments. Students will install, develop, test, and distribute mobile applications while addressing challenges associated with development for any mobile platform: limited screen size and memory, gesture based GUI, varying connectivity, and the wide variety of target mobile devices.
Suggested Background: IWKS 2300 or similar computing experience
Credit hours: 3
Course Typically Offered: Fall

IWKS 3700: Innovation and Society
Analyzes impact of innovative design on work, sense of self and social systems, in education, healthcare, finance, and other sectors. Investigates how people customize / "hack" technologies they use, and the moral / ethical implications of being designers. Students will research the impact of an innovation of their choice and share via essays, models, videos, or another medium of their choice.
Suggested Background: None.
Credit hours: 3
Course Typically Offered: Fall

IWKS 3850: Product Design
Explores the design requirements associated with creating a product that will be manufactured in large quantities and used by potentially thousands of users. These requirements are often very different from those associated with creating a working prototype. This gap between prototype creation and starting a

business offers an interesting and unique set of design challenges. As part of the course, teams of students will engage in a realistic product design cycle.
Suggested Background: IWKS 2100
Credit hours: 3
Course Typically Offered: Fall

IWKS 4100: Advanced Human-Centered Design and Prototyping
An advanced exploration of design thinking and the user-centered design paradigm from a broad range of perspectives, emphasizing how user research and prototype assessment can be integrated into different phases of the design process. Using a team-based, project-oriented approach, students will develop advanced expertise in the design, development, and critique of solutions to important human problems. The course will make full use of Inworks' prototyping facilities.
Suggested Background: IWKS 2100 & 3100
Credit hours: 3
Course Typically Offered: Fall

IWKS 4120: IoT: The Internet of Things
In a world where everything is connected to everything else, how does that work? This course introduces techniques for (1) designing systems that can sense and respond to humans in meaningful ways, (2) creating networks of physical objects that collect and exchange data, and (3) creating autonomous devices. Examples of such systems include interactive art, wearable health monitors and game playing robots. Working individually and in teams, students develop projects using Inworks' materials, devices and fabrication tools, culminating with a final project of the students' choosing. The course involves considerable prototyping and software development, but requires only introductory programming and prototyping experience.
Suggested Background: IWKS 2300 or similar experience.
Credit hours: 3
Course Typically Offered: Spring

IWKS 4450: Game Design and Development II
Advanced Computer Game Development
Continuation of IWKS 3400, with increased emphasis on more advanced techniques including 3D rendering; multimodal music, complex narrative, animation, non-player AI, and advanced 3D techniques including diffuse, ambient, specular, and emissive lighting; vertex, pixel and geometry shaders; shadows; terrain building; reflective and refractive lighting; bump, parallax, and parallax occlusion mapping; Phong and Gouraud shading; "cel" shading; ray tracing; bloom; and high dynamic range lighting.
Suggested Background: IWKS 3400
Credit hours: 3
Course Typically Offered: Fall

IWKS 4500: Bio-Medical Design and Innovation
Introduces the biodesign innovation process, which involves identifying important human needs and inventing meaningful solutions to address them. The course examines how biotechnology and bio-inspired innovation improves the form and function of our designed world – garments, buildings, foods, medicines, healthcare delivery, infrastructure and more. The course explores how these processes can vary across disciplines, geographies and demographics. Students may participate in a national Biodesign Challenge; this course will prepare students to submit their final projects to the competition at the end of the semester.

Suggested Background: IWKS 2100 & 3450
Credit hours: 3
Course Typically Offered: Spring

IWKS 4520: Designing for Healthful Human Longevity
Explores the history of life-extension efforts, as well as present day technologies, companies, and organizations that seek to extend healthy human lifespans. Survey of the current state of the field, currently recognized barriers to success, and the ethical and equity considerations associated with success. Examination of leading theories of aging, current research in model organisms, and emerging techniques and technologies. The course will require a significant amount of reading and in-class discussion/debate.
Suggested Background: IWKS 2100, 3450, & 3700 or 4500
Credit hours: 3
Course Typically Offered: Maymester

IWKS 4680: Case Studies in Design
Explores why some projects succeed and others fail. Many human-centered interventions fail to meet their designers' objectives, reflecting the unique challenges associated with matching human need with feasibility. Explores how innovators can increase their chances for success by examining several successful (and unsuccessful) designs.
Suggested Background: IWKS 2100 & 3700
Credit hours: 3
Course Typically Offered: Fall [NOT OFFERED AY 2017-2018]

IWKS 4750: Innovating on Education
Explores how design-thinking and user-centered design can be used to develop and improve technology-mediated learning. Using a team-based project-oriented approach, students design, develop, and evaluate new modalities for digital education. Projects will include ways to educate general audiences as well as targeted ones, such as employees, customers, or medical patients.
Suggested Background: IWKS 3700
Credit hours: 3
Course Typically Offered: Spring

IWKS 4800: StartUp: Creating a New Venture from Scratch
Explores the entire entrepreneurial cycle, from inspiration to IPO. Teams of students are guided to create and launch a new company in a single semester. Culminates in a "pitchfest" to area entrepreneurs and venture capitalists. One of two alternative capstone courses for the Inworks Minor in Design and Innovation.
Prerequisite: Enrollment in the Inworks HCDI minor or certificate, or instructor permission
Suggested Background: IWKS 2100 & 3850
Credit hours: 4
Course Typically Offered: Spring

IWKS 4900: Undergraduate Capstone
Working closely with project sponsors, students design, implement, and evaluate a project for use in local industry and non-profit organizations. One of two alternative capstone courses for the Inworks Minor in Design and Innovation.
Prerequisite: Enrollment in the Inworks HCDI minor or certificate, or instructor permission
Suggested Background: IWKS 2100 & 3850

Credit hours: 4
Course Typically Offered: Fall

IWKS 4930: Special Topics in Human Centered Design and Innovation
Emergent issues and professional developments in design, innovation and prototyping. Consult the current online Inworks Course List for semester offerings as new special topics courses are frequently added. With permission, may be repeated for credit.
Credit hours: 1-4 (Variable)
Course Typically Offered: Fall and Spring

IWKS 4970: Independent Study in Human Centered Design and Innovation
Studies initiated by students or faculty and sponsored by a faculty member to investigate a special topic or problem related to design, innovation and prototyping. With permission, may be repeated for credit.
Prerequisite: Permission of an Inworks faculty member.
Credit hours: 1-4 (Variable)
Course Typically Offered: Fall and Spring

IWKS 5100: Human-Centered Design, Innovation and Prototyping
Offers a graduate-level introduction to collaborative interdisciplinary design and innovation from a human perspective, as well as introducing key theoretical and computational foundations of innovation. Using the wide array of Inworks prototyping facilities, teams of students will design and implement human-oriented projects of increasing scale and complexity, in the process acquiring essential innovation and problem-solving skills.
Prerequisite: None. No previous design or prototyping experience is expected or required.
Credit hours: 3
Course Typically Offered: Fall & Spring

IWKS 5120: IoT: The Internet of Things
Graduate version of IWKS 4120. Introduces techniques for (1) designing cyber-physical systems that can sense and respond to humans in meaningful ways, (2) creating networks of physical objects that collect and exchange data, and (3) for creating autonomous artifacts. Examples of such systems include interactive art, wearable health monitors and game playing robots. Working individually and in teams, students develop projects using Inworks' materials, devices and fabrication tools, culminating with a final project of the students' choosing. The course requires only introductory programming and prototyping experience. Graduate students will design and implement additional functionality, including connection to cloud services and more sophisticated data analysis.
Suggested Background: IWKS 5350 or similar computing experience
Credit hours: 3
Course Typically Offered: Spring

IWKS 5150: Advanced Human-Centered Design and Prototyping
Graduate version of IWKS 4100. An advanced exploration of design thinking and the user-centered design paradigm from a broad range of perspectives, emphasizing how user research and prototype assessment can be integrated into different phases of the design process. Using a team-based, project-oriented approach, students will develop advanced expertise in the design, development, and critique of solutions to important human problems. The course will make full use of Inworks' prototyping facilities.
Suggested Background: IWKS 5100 & 5170

Credit hours: 3
Course Typically Offered: Fall

IWKS 5170: 3D Design and Prototyping
Graduate version of IWKS 3100. Introduces the design and computer-controlled fabrication of three dimensional objects using both additive (3D printing) and subtractive (laser cutter, CNC router / milling machine) processes. Various commercial and open-source software tools for 3D design (CAD), manufacturing (CAM) and visualization will be explored. Increasingly complex projects throughout the semester will be used to illustrate fabrication techniques. The course will culminate in a final project.
Suggested Background: None. No previous experience in 3D design or prototyping required.
Credit hours: 3
Course Typically Offered: Spring

IWKS 5180: Inworks: Choose Your Own Adventure
Experiences in Design, Innovation and Prototyping
Graduate version of IWKS 3180. Provides weekly speakers, workshops and other experiences that educate and enrich across the design, innovation and prototyping landscape. Students may choose to participate in any five (for one credit), ten (for two credits) or fifteen (for three credits) activities. Each week, participating students will attend the scheduled activity, and then create a meaningful response that reflects the impact of that activity on their thinking or practice.
Prerequisites: None.
Credit hours: 1-3 (Variable)
Course Typically Offered: Fall and Spring

IWKS 5200: Data Science for Innovators
Graduate version of IWKS 3200. Introduces techniques for capturing, processing, visualizing, and making meaning out of large datasets. With the exponential growth and decreasing cost of data collection tools such as genome sequencing, social media, crowd sourced data, mobile phone apps, remote sensors, and data from other publically available sources, innovators are able to harness a rich array of data in their designs. This course will introduce the fundamentals of working with online data and large data sets, introduce widely used data analysis and visualization tools, and culminate in a cumulative project that incorporates data in a significant way.
Suggested Background: IWKS 5350 or similar computing experience.
Credit hours: 3
Course Typically Offered: Fall

IWKS 5300: NAND to Tetris
Foundations of Computer Systems
Graduate version of IWKS 3300. Introduces the principles and technologies that underlie the global information age. Starting from first principles, students gradually construct a fully functional simulated hardware platform, together with a modern software hierarchy, yielding a working basic yet powerful computer system. In the process of building this computer system, students gain a first-hand understanding of how hardware and software systems are designed and how they work together as one enterprise. The course involves considerable software development in the form of a series of laboratory assignments of increasing complexity, but requires only introductory programming experience. Graduate students will implement additional functionality, including network communication and FPGA implementation.
Suggested Background: IWKS 5350 or similar computing experience

Credit hours: 3
Course Typically Offered: Spring

IWKS 5350: Computational Foundations of Innovation
Graduate version of IWKS 2300. Introduces the technological underpinnings of modern society, introducing the fundamental principles of computing. Students create realistic artifacts, and imbue those artifacts with interesting behavior by writing computer programs in on-line virtual world similar to Second Life and for simple Arduino-connected devices. In-class and in-world discussions and readings introduce important computing ideas and concepts. Completion of this course will prepare students for more advanced IWKS graduate courses that require knowledge of computing principles and practices.
Prerequisites: None.
Credit hours: 3
Course Typically Offered: Fall

IWKS 5400: Game Design and Development I
Principles of Computer Game Development
Graduate version of IWKS 3400. Introduces the fundamental principles of computer game development, including the rich interplay of computer science, graphics design, physics, music, and narrative that comprise modern computer games. Students develop interactive 2D and simple 3D games in laboratory assignments of increasing complexity. The course involves considerable software development, but requires only introductory programming experience (e.g., IWKS 2300). Culminates with a final project consisting of a team-developed complete game. Graduate students will design more complex game functionality, including network-based and team-based games.
Suggested Background: IWKS 5350 or similar computing experience
Credit hours: 3
Course Typically Offered: Spring

IWKS 5450: Game Design and Development II
Graduate version of IWKS 4450. Continuation of IWKS 5400, with increased emphasis on more advanced techniques including 3D rendering; multimodal music, complex narrative, animation, non-player AI, and advanced 3D techniques including diffuse, ambient, specular, and emissive lighting; vertex, pixel and geometry shaders; shadows; terrain building; reflective and refractive lighting; bump, parallax, and parallax occlusion mapping; Phong and Gouraud shading; “cel” shading; ray tracing; bloom; and high dynamic range lighting.
Suggested Background: IWKS 5400 or similar experience in game development
Credit hours: 3
Course Typically Offered: Fall

IWKS 5500: Bio-Medical Design and Innovation
Graduate version of IWKS 4500. Introduces the biodesign innovation process, which involves identifying important human needs and inventing meaningful solutions to address them. The course examines how biotechnology and bio-inspired innovation improves the form and function of our designed world – garments, buildings, foods, medicines, healthcare delivery, infrastructure and more. The course explores how these processes can vary across disciplines, geographies and demographics. Students may participate in a national Biodesign Challenge; this course will prepare students to submit their final projects to the competition at the end of the semester.
Suggested Background: IWKS 5100 & 5540

Credit hours: 3
Course Typically Offered: Spring

IWKS 5520: Designing for Healthful Human Longevity
Graduate version of IWKS 4520. Explores the history of life-extension efforts, as well as present day technologies, companies, and organizations that seek to extend healthy human lifespans. Survey of the current state of the field, currently recognized barriers to success, and the ethical and equity considerations associated with success. Examination of leading theories of aging, current research in model organisms, and emerging techniques and technologies. The course will require a significant amount of reading and in-class discussion/debate.
Suggested Background: IWKS 5100, 5450, & 5700 or 5500
Credit hours: 3
Course Typically Offered: Maymester

IWKS 5540: Synthetic Biology for Innovators
Graduate version of IWKS 3540. Introduces the fundamentals of synthetic biology for those who seek to use it as tool for innovation. Synthetic biology allows us to engineer new biological systems and redesign existing biological components by integrating aspects of biotechnology, evolutionary and molecular biology, systems biology, computer engineering, computational biology, and genetic engineering. Advancement in technological tools and techniques make this material accessible to motivated individuals from many disciplines, and no biology background is required. Culminates with a final team project focused on designing synthetic biology solutions that address human need.
Suggested Background: None. No previous background in biology is required.
Credit hours: 3
Course Typically Offered: Fall

IWKS 5550: Innovation Law and Policy
Graduate version of IWKS 3550. Introduces legal and regulatory foundations related to innovation, including intellectual property, telecommunications, electronic commerce and the Internet, biotechnology, ethical and equity considerations, and the financing of innovative ventures. The course examines these issues from the diverse perspectives of the legal, business, capital, development, consumer, and policy-making communities.
Suggested Background: IWKS 5100
Credit hours: 3
Course Typically Offered: Fall

IWKS 5600: Innovating for the Developing World
Graduate version of IWKS 3600. Explores the design and development of products and services that can be sustainably and gainfully used by the world's poorest citizens. Students in interdisciplinary teams will design, implement and evaluate viable solutions to real problems faced by people in the developing world. The goal is to develop an understanding of the extraordinary challenges faced by individuals for whom basic survival is not a given, and the knowledge and skills necessary to create designs that respond appropriately to those unique circumstances. Provides a foundation for further study and practice in the area of technology and development.
Suggested Background: IWKS 5100
Credit hours: 3
Course Typically Offered: Fall

IWKS 5620: Mobile App Development
Graduate version of IWKS 3620. Introduces mobile application development, including front-end mobile application clients, data handling, connectivity to back-end services and cloud hosting. The course provides an overview and comparison of technical approaches employed by Apple iOS, Google Android, and cross-platform development environments. Students will install, develop, test, and distribute mobile applications while addressing challenges associated with development for any mobile platform: limited screen size and memory, gesture based GUI, varying connectivity, and the wide variety of target mobile devices.
Suggested Background: IWKS 5100 & IWKS 5350 or similar computing experience
Credit hours: 3
Course Typically Offered: Fall

IWKS 5680: Case Studies in Design
Graduate version of IWKS 4680. Explores why some projects succeed and others fail. Many human-centered interventions fail to meet their designers' objectives, reflecting the unique challenges associated with matching human need with feasibility. Explores how innovators can increase their chances for success by examining several successful (and unsuccessful) designs.
Suggested Background: IWKS 5100 & 5700
Credit hours: 3
Course Typically Offered: Fall [NOT OFFERED AY 2017-2018]

IWKS 5700: Innovation and Society
Graduate version of IWKS 3700 Analyzes impact of innovative design on work, sense of self, and social systems, in education, healthcare, finance, and other sectors. Investigates how people customize / "hack" technologies they use, and the moral / ethical implications of being designers. Students will research the impact of an innovation of their choice and share via essays, models, videos, or another medium of their choice.
Suggested Background: IWKS 5100
Credit hours: 3
Course Typically Offered: Fall

IWKS 5750: Innovating on Education
Graduate version of IWKS 4750. Explores how design-thinking and user-centered design can be used to develop and improve technology-mediated learning. Using a team-based project-oriented approach, students design, develop, and evaluate new modalities for digital education. Projects will include ways to educate general audiences as well as targeted ones, such as employees, customers, or medical patients.
Suggested Background: IWKS 5700 or equivalent
Credit hours: 3
Course Typically Offered: Spring

IWKS 5800: StartUp: Creating a New Venture from Scratch
Graduate version of IWKS 4800. Explores the entire entrepreneurial cycle, from inspiration to IPO. Teams of students are guided to create and launch a new company in a single semester. Culminates in a "pitchfest" to area entrepreneurs and venture capitalists. One of two alternative capstone courses for the Inworks Graduate/Professional Certificate in Design and Innovation.
Prerequisite: Enrollment in the Inworks graduate certificate, or instructor permission
Suggested Background: IWKS 5100 and 5850.
Credit hours: 4

Course Typically Offered: Spring

IWKS 5850: Product Design
Graduate version of IWKS 3850. Explores the design requirements associated with creating a product that will be manufactured in large quantities and used by potentially thousands of users. These requirements are often very different from those associated with creating a working prototype. This gap between prototype creation and starting a business offers an interesting and unique set of design challenges. As part of the course, teams of students will engage in a realistic product design cycle.
Suggested Background: IWKS 5100
Credit hours: 3
Course Typically Offered: Fall

IWKS 5900: Graduate Capstone
Graduate version of IWKS 4900. Working closely with project sponsors, students design, implement, and evaluate a project for use in local industry and non-profit organizations. One of two alternative capstone courses for the Inworks Graduate/Professional Certificate in Design and Innovation.
Prerequisite: Enrollment in the Inworks graduate certificate, or instructor permission
Suggested Background: IWKS 5100 and 5850.
Credit hours: 4
Course Typically Offered: Fall

IWKS 5930: Special Topics
Emergent issues and professional developments in design, innovation and prototyping. Consult the current online Inworks Course List for semester offerings as new special topics courses are frequently added. With permission, may be repeated for credit.
Prerequisite: Varies with Instructor
Credit hours: 1-4 (Variable)
Course Typically Offered: Fall and Spring
IWKS 5970: Independent Study
Studies initiated by students or faculty and sponsored by an Inworks faculty member to investigate a special topic or problem related to design, innovation and prototyping. With permission, may be repeated for credit.
Prerequisite: Permission of an Inworks faculty member
Credit hours: 1-4 (Variable)
Course Typically Offered: Fall and Spring