ASU
ARIZONA STATE UNIVERSITY

GENERAL STUDIES COURSE PROPOSAL COVER FORM

Course information:

*Copy and paste **current** course information from Class Search/Course Catalog.*

College/School	College of Liberal Arts and Sciences	Department/School	**Dean - Interplanetary Initiative**

Prefix:	**IPI**	Number:	**241**	Title:	**Designing & Making for an Interplanetary Future**	Units:	**3**

Course description: **Humanity's future as an interplanetary species is only made possible through the continued development of new technologies able to provide solutions to difficult problems. Facilitates students developing proficiency in both "making" and "designing". While not an engineering course, seeks to support students in gaining basic technical "makerspace" abilities. But more important than the hard skills, students grow in their capacity for technical design thinking—the process by which modern technologies are imagined and developed. Hands-on and project-based. Students learn tools and processes for solving global and interplanetary problems, with special consideration given to the ways that technologies impact society. Students gain basic proficiency in the mechanical, electrical, computer programming and design aspects of technology development in makerspaces, through supervised research and design of creative projects that relate to aerospace engineering, space exploration, and/or an inclusive, interplanetary future. As a part of this course, students gain basic knowledge of CAD modeling and 3D printing, circuits and soldering, Arduino programming, tinkering and debugging methods, creative problem solving, team-based project management, the relationship between technology and society, and basic technological design methods.**

Is this a cross-listed course? No If yes, please identify course(s):

Is this a shared course? No If so, list all academic units offering this course:

*Note- For courses that are crosslisted and/or shared, a letter of support from the chair/director of **each** department that offers the course is required for **each** designation requested. By submitting this letter of support, the chair/director agrees to ensure that all faculty teaching the course are aware of the General Studies designation(s) and will teach the course in a manner that meets the criteria for each approved designation.*

Is this a **permanent-numbered** course with topics? No

If **yes**, each topic requires **an individual submission**, separate from other topics.

Requested designation: Humanities, Arts and Design–HU **Mandatory Review:** No

*Note- a **separate** proposal is required for each designation.*

Eligibility: Permanent numbered courses **must** have completed the university's review and approval process. For the rules governing approval of omnibus courses, contact Phyllis.Lucie@asu.edu.

Submission deadlines dates are as follow:

For Fall 2021 Effective Date: October 2, 2020 For Spring 2022 Effective Date: March 5, 2021

Area proposed course will serve:

A single course may be proposed for more than one core or awareness area. A course may satisfy a core area requirement and more than one awareness area requirements concurrently, but may not satisfy requirements in two core areas simultaneously, even if approved for those areas. With departmental consent, an approved General Studies course may be counted toward both the General Studies requirement and the major program of study. It is the responsibility of the chair/director to ensure that all faculty teaching the course are aware of the General Studies designation(s) and adhere to the above guidelines.

Checklists for general studies designations:

Complete and attach the appropriate checklist

- Literacy and Critical Inquiry core courses (L)
- Mathematics core courses (MA)
- Computer/statistics/quantitative applications core courses (CS)
- Humanities, Arts and Design core courses (HU)
- Social-Behavioral Sciences core courses (SB)
- Natural Sciences core courses (SQ/SG)
- Cultural Diversity in the United States courses (C)
- Global Awareness courses (G)
- Historical Awareness courses (H)

A complete proposal should include:

- ☐ Signed course proposal cover form
- ☐ Criteria checklist for General Studies designation being requested
- ☐ Course catalog description
- ☐ Sample syllabus for the course

ARIZONA STATE UNIVERSITY

☐ Copy of table of contents from the textbook and list of required readings/books

Proposals must be submitted electronically with all files compiled into one PDF.

Contact information:

Name Katherine McConachie E-mail kmcconachie@asu.edu Phone 602-543-4332

Department Chair/Director approval: ***(Required)***

Chair/Director name (Typed): Linda Elkins-Tanton Date: 09.29.2021

Chair/Director (Signature): Linda T. Elkins-Tanton

Arizona State University Criteria Checklist for

HUMANITIES, ARTS AND DESIGN [HU]

Rationale and Objectives

The humanities disciplines are concerned with questions of human existence and meaning, the nature of thinking and knowing, with moral and aesthetic experience. The humanities develop values of all kinds by making the human mind more supple, critical, and expansive. They are concerned with the study of the textual and artistic traditions of diverse cultures, including traditions in literature, philosophy, religion, ethics, history, and aesthetics. In sum, these disciplines explore the range of human thought and its application to the past and present human environment. They deepen awareness of the diversity of the human heritage and its traditions and histories, and they may also promote the application of this knowledge to contemporary societies.

The study of the arts and design, like the humanities, deepens the student's awareness of the diversity of human societies and cultures. The arts have as their primary purpose the creation and study of objects, installations, performances, and other means of expressing or conveying aesthetic concepts and ideas. Design study concerns itself with material objects, images and spaces, their historical development, and their significance in society and culture. Disciplines in the arts and design employ modes of thought and communication that are often nonverbal, which means that courses in these areas tend to focus on objects, images, and structures and/or on the practical techniques and historical development of artistic and design traditions. The past and present accomplishments of artists and designers help form the student's ability to perceive aesthetic qualities of artwork and design.

The Humanities, Arts and Design are an important part of the General Studies Program, for they provide an opportunity for students to study intellectual and imaginative traditions and to observe and/or learn the production of artwork and design. The knowledge acquired in courses fulfilling the Humanities, Arts and Design requirement may encourage students to investigate their own personal philosophies or beliefs and to understand better their own social experience. In sum, the Humanities, Arts and Design core area enables students to broaden and deepen their consideration of the variety of human experience.

Revised March 2021

Proposer: Please complete the following section and attach appropriate documentation.

ASU - [HU] CRITERIA			
HUMANITIES, ARTS AND DESIGN [HU] courses must meet *either* 1, 2 or 3 *and* at least one of the criteria under 4 in such a way as to make the satisfaction of these criteria **A CENTRAL AND SUBSTANTIAL PORTION** of the course content.			
YES	**NO**		Identify Submitted Documentation That Demonstrably Provides Evidence
☐	☒	**1.** Emphasizes the study of values; the development of philosophies, religions, ethics or belief systems; and/or aesthetic experience.	
☐	☒	**2.** Concerns the interpretation, **critical** analysis, or creation of written, aural, or visual texts; and/or the **critical analysis (not summary or memorization)** of historical development of textual traditions.	
☒	☐	**3.** Concerns the interpretation, critical analysis, or engagement with aesthetic practices; and/or the **critical analysis (not summary or memorization)** of historical development of artistic or design traditions.	See syllabus and attached justification document.
☒	☐	**4.** In addition, to qualify for the Humanities, Arts and Design designation a course must meet one or more of the following requirements:	See 4.c
☐	☒	**a.** Concerns the development of human thought, with emphasis on **demonstrable critical analysis** of philosophical and/or religious systems of thought.	
☐	☒	**b.** Concerns aesthetic systems and values, especially in literature, arts, and design.	
☒	☐	**c.** Emphasizes aesthetic experience and creative process in literature, arts, and design.	See syllabus and attached justification document.
☐	☒	**d.** Concerns the **demonstrable critical analysis** of literature and the development of literary traditions	
		THE FOLLOWING TYPES OF COURSES ARE EXCLUDED FROM THE [HU] DESIGNATION EVEN THOUGH THEY MIGHT GIVE SOME CONSIDERATION TO THE HUMANITIES, ARTS AND DESIGN:	
		• Courses devoted primarily to developing skill in the use of a language.	
		• Courses devoted primarily to the acquisition of quantitative or experimental methods.	
		• Courses devoted primarily to teaching skills.	

Course Prefix	Number	Title	General Studies Designation
IPI	241	Designing and Making for an Interplanetary Future	

Explain in detail which student activities correspond to the specific designation criteria. Please use the following organizer to explain how the criteria are being met.

Criteria (from checksheet)	How course meets spirit (contextualize specific examples in next column)	Please provide detailed evidence of how course meets criteria (i.e., where in syllabus)
3	Critique of and engagement with the process of technological and engineering design	See attached justification for expanded discussion.
4.c.	Emphasis on the technological and engineering design process	See attached justification for expanded discussion.

Humanities, Arts, and Design Justification

3. Critique of and engagement with the process of technological and engineering design:

4.c. Emphasis on the technological and engineering design process:

Statement on how IPI 241 meets the HU Criteria

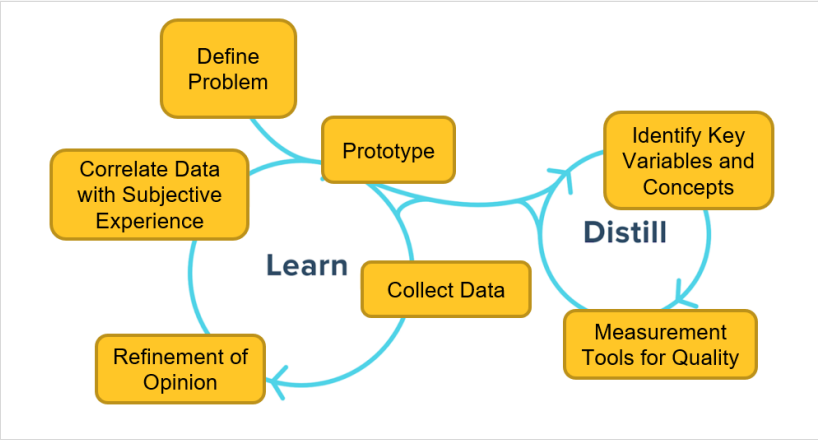
Developed as a core class for the Technological Leadership major, IPI 241: "Designing and Making for an Interplanetary Future" is an interdisciplinary course bridging the gap between Science, Technology and Society studies and technological design. In this course, students are guided through the process of both designing and actually physically making new space technologies; however unlike an ahistoric and apolitical engineering course (where course content focuses only on how-to), this course seeks to ground students' making skills in an understanding and appreciation for how technological and engineering designs shape society and how society in turn shapes technological design, which is especially important as humans become increasingly an interplanetary species.

Course content is divided into "making" (Mechanical, Electrical, and Programming) and "designing" (Methods for Decision Making, Societal Implications of Technology, and Working as a Team) pathways, which contain a varying number of modules. The course is designed to be taken several times, with student-driven projects that may span several classes, and similar to a Montessori school, the course is designed to be self-directed, so that students are motivated to learn through increased autonomy. For these reasons, students must take modules from each of the six aforementioned pathways, but they have freedom to choose which modules will fulfill that requirement. (Students that repeat the course would end up taking all twelve currently available modules.)

Half of the course content that is taught during the first half of the class is "making," technical know-how that is supplemented with videos from engineers and other technologists. The course content primarily focuses on how the making skills that students are learning have applications in the design work done by NASA or other aerospace companies. Some of the scientists and engineers who contribute to students' understanding of technological making and designing include: Cloudsat Mission Manager Deborah Vane, NASA Instructor Don Higdon, manufacturing engineer Dr. Tim Minshall, technical manager for MIT's D-Lab Sher Vogel, Astrophysicist Evgenya Shkolnik, and Principal Investigator of NASA's Psyche mission Lindy Elkins-Tanton. While learning "making" skills, students are also getting exposed to a normal technological design process (what Edward Constant II would refer to as *normal technology*.)

On the "designing" side, this course delves deeper into the basic steps, but also the meanings and assumptions behind technological design. Technological design is understood for this course as a series of decisions—decisions that address subjective needs of certain society members (and maybe not others). These decisions end up prioritizing some subjective needs over others. Unlike science, which tends to describe reality, technology usually envisions a possible, future reality. Technology almost by definition seeks to affect change

in the world. For this reason, the course does not talk about design, but decision-making, and technological design is grounded in the "Technical Inquiry Cycle," (pictured below) a concept which combines Stribling's *How Engineers Think and Implications for Public Interest Technology*, which explores "how ill-defined social metrics, such as social justice or the public good, might be…incorporated into engineering design" (Stribling, 2021, p2) with NASA's engineering design process, and the Beagle Inquiry Cycle from Beagle Learning.



Emphasis is placed on the subjective nature of design and the inherent biases of designers who do the prioritizing. In both modules on the "Tools for Decision Making" pathway (one module is more theoretical and delves deeper into the Technical Inquiry Cycle, while the other employs common engineering tools towards similar ends), students learn to understand technical designs as a series of functions that address subjective needs that are either essential or non-essential and then prioritized. These design decisions prioritize some users over others. A reading from one of the modules challenges students to think critically about the design decisions of cell phones and the reasons behind the redesign of those phones when they started to sell widely in Africa (Marsh, 2018).

The culminating exercise from the "Engineering Design Tools" module asks students to use their tools to examine a technology from their kitchen: What functions are essential? What functions are non-essential? What subjective customer needs are addressed by the design decisions? Whose needs are not? What are some other design possibilities? And finally, students are asked to synthesize their analysis and answer how the appliance could be redesigned to meet the needs of a different user.

An even deeper exploration of the push and pull between society and technology occurs in modules on the Societal Implications of Technology pathway. The two modules are "Societal Values into Technology" (where readings tend to focus on how societal values shape technology) and "Societal Values out of Technology" (where readings tend to focus on how technologies shape society); however, both modules tend to have similar progressions. The first exercises have readings that examine the connection between societal values and technology. Langon Winner's (1980) "Do Artifacts Have Politics?" argues that the racist politics of NYC city planner, Robert Moses, are embodied in the design of Long Island bridges, which are lower than normal, preventing city busses (and thus minorities) from accessing the beach, while Jamie Wetmore's (2007) "Amish Technology" explores how the Amish use technology selectively to reinforce their culture, community, and religious beliefs. Both modules include articles on science fiction and where our future with technology may go. Okarafor (2018) tells a story of a mother in a future Nigeria whose smart house helps her to give birth. The narrative however brings up all sorts of questions such as the power relationship between a user and their technology, cultural intersections with technology, and the unintended consequences of technology. Doctorow

(2018, n.p.) explores how Mary Shelley's story Frankenstein centered around society's reaction to an age of intense technological change, "a story about technology mastering humans rather than serving them." A key in each of these modules, which ties these thoughts back to technological design, are the fourth exercises which explore engineering design paradigms that seek to remedy ethical gaps in the development of technology, either *participatory design*, which is often used in the field of global development to include marginalized voices in the design process (especially as most technologies are developed in the Global North and then exported to the Global South where the technology may not suit the societal aspirations there), or *praxis*, which challenges the unreflective, Western mores of normal technological design.

The last "design" pathway is "Working as a Team," which helps students work collaboratively in the design process, mimicking the process of *normal technology*, where technological systems cannot be understood by any single person, technology components are being developed across numerous countries, time zones, and cultures, and soft-skills are becoming increasingly important in technological development. These modules seek to directly address communication and teamwork, with an aim towards helping students work together in their final group projects.

The group projects, which encompass the second half of the course, seek to put into full practice both the "making" and "designing" competencies that students first learned during the first half of the course. Groups will be expected to create a functional prototype that is designed using the Technical Inquiry Cycle and to consider, apply ethical considerations, and even critique their own design choices through a societal lens.

Citations

Doctorow, Cory. (2018) I've Created a Monster! (And So Can You). Frankenbook. Available at https://www.frankenbook.org/pub/ive-create-a-monster/release/1

Marsh, Jenni. (2018) Chinese smartphone giant Tecno is dominating the African market with $40 phones. CNN.com. Available at: https://www.cnn.com/2018/10/10/tech/tecno-phones-africa/

Okarafor, Nnedi. (2018). Mother of Invention. Slate. Available at: https://slate.com/technology/2018/02/mother-of-invention-a-new-short-story-by-nnedi-okorafor.html

Stribling, Eric. (2021). How Engineers Think and Implications for Public Interest Technology. Technology and Society Magazine. 40, 3. IEEE. [in publication].

Wetmore, Jameson. (2007). Amish Technology: Reinforcing values and building community. Technology and Society Magazine. 10, 21. IEEE.

Winner, Langdon. (1980). Do Artifacts Have Politics? Daedalus, Vol. 109, No. 1, Modern Technology: Problem or Opportunity? MIT Press. pp. 121-136.

DESIGNING AND MAKING FOR AN INTERPLANETARY FUTURE

IPI 241

Eric Stribling
estribli@asu.edu
Office: Eric Stribling's Personal Zoom Meeting Room (see link below).
Office Hours: 11:00 – 11:55 Mondays and Thursdays or by special appointment
Telephone: 347-927-8742

"I would like to die on Mars. Just not on impact." – Elon Musk

Pre-Requisites:

None.

Course Description:

Humanity's future as an interplanetary species will only be made possible through the continued development of new technologies able to provide solutions to difficult problems. This course seeks to facilitate students developing proficiency in both "making" and "designing". While not an engineering course, this course seeks to support students in gaining basic technical "makerspace" abilities. But more important than the hard skills, students will grow in their capacity for technical design thinking – the process by which modern technologies are imagined and developed.

This course is hands-on and project-based. Students will learn tools and processes for solving global and interplanetary problems, with special consideration given to the ways that technologies impact society. Students in this course will gain basic proficiency in the mechanical, electrical, computer programming, and design aspects of technology development in makerspaces, through supervised research and design of creative projects that relate to aerospace engineering, space exploration, and/or an inclusive, interplanetary future. As a part of this course, students will gain basic knowledge of CAD modeling and 3D printing, circuits and soldering, Arduino programming, tinkering and debugging methods, creative problem-solving, team-based project management, the relationship between technology and society, and basic technological design methods.

Course Objectives:

By the end of this course, students will:

- Demonstrate basic proficiency in the mechanical, electrical, computer programming, and design aspects of technology development in makerspaces
- Apply creative problem-solving skills through working on open-ended projects
- Connect making concepts to relevant applications in space exploration and interdisciplinary approaches to creating an inclusive, interplanetary future
- Demonstrate an appreciation for including societal considerations in technological design
- Build several unique, self-directed projects they can add to their portfolio to use as evidence of their skills when applying to internships and jobs

Learning Outcomes

By the end of this course, students will be able to:

- 3D print basic physical shapes that correspond with measurements students take of physical objects or other CAD designs.
- Build a working electrical circuit with a power source and electrical components that can respond to user inputs.
- Program an Arduino-based algorithm that interacts with electrical circuitry to perform higher-order functionalities.
- Apply design principles and/or tools towards human problems in technical designs.
- Discuss possible societal considerations of technologies, both others' and their own, including subjective realities, embedded values, unintended consequences, how technologies may shape social reactions, and how technologies can exert cultural power dominance.
- Apply team-working and communication tools towards the achievement of a group design project at the end of the course.

Course Materials:

Students will need to:

- Have a laptop computer with programs capable of word processing, presentation building, and creating/reading pdf documents.
- Download TinkerCAD and apply for an academic license through AutoDesk's website.
- Download the Arduino programming environment.
- Obtain a makerspace kit from the Interplanetary Initiative, which must be returned at the end of the semester.

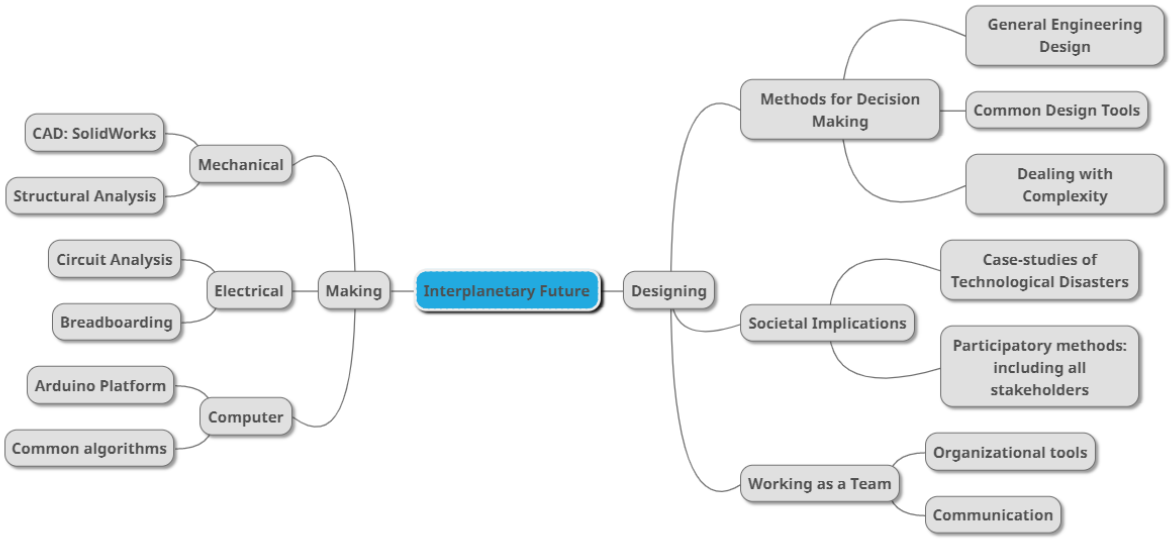
Assignment Formatting:

For all written assignments, it will be expected that students include the names of all group members and a boldened title at the top of the page or in the title slide of a presentation, and cite any outside resource using APA style. Also please be advised that this is a university course, and you are expected to submit assignments free of grammatical or spelling errors. ASU offers writing support at the

Writing Center: https://tutoring.asu.edu/student-services/writing-centers or call (480) 965-9072. Please don't hesitate to take advantage of this free student resource.

Course Structure:

Like most courses, to successfully complete this course you must complete a series of assignments. Unlike other courses, this course offers students a degree of choice in which assignments they choose to complete. This course is designed as a choose-your-own adventure. There are six basic fundamental pathways (Mechanical, Electrical, Computer Programming, Methods for Decision Making, Societal Implications, and Working as a Team), as indicated by the chart below:



Each pathway contains a variety of branching modules divided into two categories: Level 1 Basic modules, which introduce students to core skills and concepts from the pathway, and Level 2 Advanced modules, which dive deeper into their content focus, allowing students to specialize in an area of interest or relevance to their group project.

Students in this course are required to complete at least one Level 1 Basic module in each of the six pathways, but in many cases there will be several Level 1 Basic modules for them to choose from. Students are free to choose the number and subject matter of Level 2 Advanced modules they wish to pursue during the course. Rather than having final course grades being an average of assignments, final grades are earned cumulatively, as described in the following section.

Grading Breakdown:

Level 1 Modules (Basic proficiency)*	7,500 pts * 6 exercises = 45,000 max points
Choose-your-own Level 2 Modules (Advanced topic)	15,000 points for each exercise
Group Project	45,000 max points
YellowDig Participation	2,000 pts/week * 7 weeks = 14,000 max pts
Return of <u>complete</u> Student Kits at the end of semester**	45,000 max points

* Six Level 1 Modules must be attempted for final grades above C.
** Return of student kits are required for a passing grade in the course.

Grades will be assigned based on the score you accumulate during the class✢.

A+:	over 159,000 (over 97%)
A:	154,000 (97 - 94%)
A- :	148,000 (94 - 90%)
B+:	143,000 (90 - 87%)
B:	138,000 (87 - 84%)
B-:	131,000 (84 - 80%)
C+:	126,000 (80 - 77%)
C:	115,000 (77 - 70%) or if six Level 1 Modules are not attempted.
D:	98,000 (70 - 60%)
E:	below 98,000 points (below 60%)
I:	Incomplete may be given if kits are not returned by the end of the semester.
XE:	Failure due to Academic Dishonesty

✢ Percentages are based on 164,000 total points, which assumes students choose to complete one Level 2 Module; however, students are encouraged to choose their own path towards their final grade, based on their interests and the needs of their final group project.

Example Final Grade Strategies:

<u>A+ Strategy:</u>

- Earn 90% in all Level 1 modules [6,750 * 6 = 40,500 points]
- Earn 90% in two Level 2 modules [13,500 * 2 = 27,000 points]
- Earn 90% on Group Project [40,500 points]
- Full participation on YellowDig for 4 weeks [8,000 points]
- Turn in complete kit at end of semester [45,000 points]

Total final score = 161,000 points = A+

<u>C Strategy:</u>

- Earn 80% in all Level 1 modules [6,000 * 6 = 36,000 points]
- Complete no Level 2 modules [0 points]
- Earn 90% on Group Project [40,500 points]
- Forget about YellowDig after posting self-introduction in Week 1 [2,000 points]
- Turn in kit at end of semester that is missing minor components [40,000 points]

Total final score = 118,500 points = C

Course Assignments

Basic Level 1 Modules: Level 1 Modules constitute the most basic knowledge for each of the six pathways in this course (Mechanical, Electrical, Computer Programming, Methods for Decision Making, Societal Implications, and Working as a Team). Students are required to attempt one module in each pathway in order to receive a final class grade higher than a C. The course is designed for Level 1 modules to be completed in the first six weeks of the course.

Advanced Level 2 Modules: Level 2 Modules teach maker skills that build on the foundations of Level 1 modules and require the completion of pre-requisite Level 1 modules before they can be accessed. Level 2 modules can be completed at any time during the course.

Each module will have an introductory video and then be subdivided into smaller exercises, either a video, reading, research, small project, writing reflection, or technical drawing. At the end of each module, the results of all exercises should be submitted together in a single PDF document to Canvas. Occasional exercises will require additional posts to Yellowdig to facilitate discussion and technical feedback. Modules are expected to require nine total hours for completion.

Group Projects: Students will be randomly assigned to groups that will be given an open-ended technical problem. Group members will self-organize and divide projects into individual tasks that can be submitted both to team members and submitted to the professor through Canvas at regular intervals during the final four weeks of the course. Team members will use foundational knowledge from the first modules of the course to organize as a team, formulate technical designs, build prototypes, construct theoretical models, and create supporting tools. Groups will be expected to design using the Technical Inquiry Cycle and associated tools and also to incorporate societal and ethical concerns, even to the point of critiquing their own design choices.

YellowDig: Yellowdig is an online sharing platform. Sort of an academic version of Facebook, you can accumulate points for posts, comments, and likes that contribute towards your final grade in the class. Each week, you can earn up to a maximum of 2,000 points.

We will use YellowDig in this class for:

1) Posting self-introductions during the first week
2) Showing off inventions that we have created
3) Asking for feedback or troubleshooting from our peers and the professor
4) Posting discussion prompts, as indicated by certain Modules.
5) Posting any other interesting thoughts or topics that pertain to designing or making.

Turn in complete kit at end of semester: Students will be mailed kits containing the items listed in the Component List below. Students are responsible for keeping the box and packaging during the course and returning the complete kit back to the Interplanetary Institute after course completion, with the exception of broken or consumed (like string or filament) items. Missing items will result in a reduction of points for the assignment. Return of student kits are required for a passing grade in the course.

Student Kits – Component List

- ELEGOO "Uno Most Complete Starter"
- Spare ELEGOO UNO R3
- Mini Hot Glue Gun Kit with 30 Hot Glue Sticks (Gorilla Dual Temp)
- Pack of Springs
- Vernier Caliper
- Mini screwdriver kit
- Soldering kit
- Helping Hands
- AstroAI Multimeter 2000
- Monoprice Mini 3D Printer
- HATCHBOX PLA 3D Printer Filament
- 4 Yellow Hobby Motors w/ wheels
- 8Ohm Speakers
- Screws set
- Pulleys x 2
- String (cotton)
- Box Cutter
- Protoboard
- Safety glasses

COURSE CALENDAR

First six weeks: It is recommended that students complete one Basic Level 1 Modules per week during the first six weeks. One Basic Level 1 Module from each of the six pathways must be attempted to achieve a final grade above C. Students should also be organized into groups, with instructor-approved projects, by the end of week 6.

Next eight weeks: Students will use the next eight weeks to run through four iterations of the Technical Inquiry Cycle. It is also recommended that students attempt one or two Advanced Level 2 Modules during this time, preferably in topics that will be of use for the final group project.

Last week: Students should pack their Student Kit early during the final week of class, so that kits can be returned to Tempe by the final day of class. Late kits will result in an "I" Incomplete for the course. Return of student kits are required for a passing grade in the course.

COURSE MODULES

Introductory Video: Elkins-Tanton, Lindy and Stribling, Eric. (2021). What do we mean by an interplanetary future? Made for IPI294. [Canvas]

Basic Level 1 Modules (One Module Required per Pathway)

MECHANICAL MODULES

3D Printing for Beginners:
At the end of this Level 1 module, students should have knowledge of the TinkerCAD environment, how to create and manipulate basic forms, and how to set-up and operate the Monoprice Mini 3D Printer.

Mechanical 3D Printing Level 1 Module:
Exercise 1: Install, license, and initialize TinkerCAD.
Video: D3 Technologies. (2016) A Walk Through the History of CAD. YouTube. Available at https://www.youtube.com/watch?v=mcwIMsh_g3o&t=162s
Exercise 2: Sketching, using calipers, and standard mechanical CAD drawings
Exercise 3: Basic forms in TinkerCAD (Measuring cups)
Exercise 4: Operating the Monoprice Mini 3D Printer.
Creative Project Prompt: 3D Print a personalized phone case

Advanced TinkerCAD:
At the end of this Level 1 module, students should have a better familiarity with using TinkerCAD to create physical objects, modify designs, and build parts that can be assembled together.

Mechanical Level 2 Module:

Exercise 1: Complex forms: practice exercise in TinkerCAD.
Video: Minshall, Tim. (2016) How 3D printing is enabling the '4th Industrial Revolution'. TEDxOxBridge. Available at https://youtu.be/lsJLZ1UYxGc
Exercise 2: Adapting designs from online libraries.
Exercise 3: Tolerances, thicknesses, and physical constraints.
Exercise 4: Parametric design
Creative Project Prompt: 3D Print a hinge.

ELECTRONICS MODULES

* It is recommended for students to finish the Basic Mechanical Level 1 Module prior to starting the Electronics Level 1 Module.

Circuitry for Beginners:

At the end of this Level 1 module, students should have knowledge of basic electrical concepts (electricity flow, voltage, current, power, and resistance) and their components (Batteries, Breadboards, Wires, Resistors, Switches, Capacitors, Diodes/LEDs, Transistors, and ICs)

Electronics Basic Circuitry Level 1 Module:
Exercise 1: Basic circuit (Light)
Exercise 2: Capacitors
Exercise 3: Transistors and internet research (blinking light)
Exercise 4: Integrated circuits and sensors
Creative Project Prompt: Tinker with a found object

Circuit Analysis:
At the end of this Level 1 module, students should have knowledge of basic electrical circuit analysis on DC circuits.

Electronics Circuit Analysis Level 1 Module:
Exercise 1: Circuit calculations with basic elements and formulae
Exercise 2: Series vs. parallel
Exercise 3: Capacitors and inductors
Exercise 4: RLC
Creative Project Prompt: Figure out the resistors.

COMPUTER PROGRAMMING MODULES

* It is recommended for students to finish the Electronics Level 1 Module prior to starting the Computer Programming Level 1 Module.

Basic Arduino Programming:
At the end of this Level 1 module, students should have basic proficiency in the structure, commands, and syntax of the Arduino programming language (based on C). By the end of the module, students will have created three basic programs and one self-designed program.

Programming Basics Level 1 Module:
Exercise 1: Install Arduino and get started.
Exercise 2: Basic programming structures, comments, and syntax (Blink).
Exercise 3: Variables, arrays, and iteration (Colorful blink).
Exercise 4: Input, output, and logic structures (Buttons Serial Monitor).
Creative Project Prompt: Tell a story with special effects!
Readings: Evans, Brian. (2007). Arduino Programming Notebook. Self-published. [Canvas]

Advanced Arduino Programming with components:
At the end of this Level 1 module, students will gain additional proficiency and practice in the structure, commands, and syntax of the Arduino programming language. Additionally, students will have exposure to electronics components not covered in the Basic Level 1 Electronics Module.

Programming Level 2 Module:
Exercise 1: Subroutines, coding techniques, and debugging.
Exercise 2: Digital vs Analog components.
Exercise 3: Creating sounds.
Exercise 4: More sensors!
Creative Project Prompt: Design a musical instrument (theremin).

TOOLS FOR DECISION MAKING MODULES

Technical Inquiry Cycle:

At the end of this Level 1 module, students will be exposed to the Technical Inquiry Cycle, gain a basic understanding of each step, and learn basic tools and concepts to help navigate each step in the process of technical design, which will be helpful for navigating the final group project.

Decision-Making Technical Inquiry Cycle Level 1 Module:
Exercise 1: The Technical Inquiry Cycle.
Readings: Stribling, Eric. (2021). How Engineers Think and Implications for Public Interest Technology. *Technology and Society Magazine*. Volume 40 , Issue 3. IEEE. [Canvas]
Videos: May, Sandra and Smith, Chris. (2008). BEST: Engineering Design Process Professional Development Series. NASA/Goddard Space Flight Center and NASA Exploration Systems Mission Directorate. Available at: https://svs.gsfc.nasa.gov/10341
Exercise 2: Generating design ideas and prototyping.
Exercise 3: Testi ng and assessing quality of the design.
Exercise 4: Improvement and redesign.
Video: Skolnick, Evgenia and Stribling, Eric. (2021). How do we design and redesign for space? Made for IPI294. [Canvas]
Creative Project Prompt: Apply the Technical Inquiry Cycle to the reinforcement or discouragement of a personal habit. What is quality to you? How can you test that definition of quality? Would your solution apply to other people? How could you redesign your "technology" for different users?

Engineering Design Tools:

At the end of this Level 1 module, students will have a series of tools common in engineering design that help organize and streamline the Technical Inquiry Cycle, which will be helpful for navigating the final group project.

Decision Making Engineering Design Tools Level 1 Module:
Exercise 1: Requirements / Constraints and Prioritization using Functional Design mapping.
Video: Vane, Deborah. (2015) NGSS Engineering at JPL: K-2-ETS1-1. NASA JPL Edu [YouTube] Available at: https://youtu.be/dFJZOUjXTrA
Exercise 2: Optimizing design ideas using the "House of Quality".
Exercise 3: Prototyping using a Pugh chart.
Exercise 4: Improvement and redesign.
Reading: Marsh, Jenni. (2018) Chinese smartphone giant Tecno is dominating the African market with $40 phones. CNN.com Available at: https://www.cnn.com/2018/10/10/tech/tecno-phones-africa/
Creative Project Prompt: Apply Engineering Design Tools to an appliance in your kitchen. Use a functional map to answer: What functions are essential? What functions are non-essential? Use a

HoQ to answer: What subjective customer needs are addressed by the design decisions? Whose needs are not? Use a Gantt chart to explore other design possibilities. And finally, synthesize this analysis and answer how the appliance could be redesigned to meet the needs of a different user?

SOCIAL IMPLICATIONS OF TECHNOLOGY (SIT) MODULES

Societal Values into Technology:

At the end of Level 1, students will explore different ways that societal values can intentionally or unintentionally go into technology through design decisions.

SIT Societal Values into Technology Level 1 Module (the Podcast Module):

Exercise 1: Can Technologies have Values?

Readings: Pitt, Joseph. (2014). "Guns Don't Kill, People Kill"; Values in and/or Around Technologies.

Winner, Langdon. (1980). Do Artifacts Have Politics? Daedalus, Vol. 109, No. 1, Modern Technology: Problem or Opportunity? MIT Press. pp. 121-136.

Exercise 2: Technology and the Future of Society

Readings: Okarafor, Nnedi. (2018). Mother of Invention. Slate. Available at: https://slate.com/technology/2018/02/mother-of-invention-a-new-short-story-by-nnedi-okorafor.html

Podcast: Okarafor, Nnedi and Stribling, Eric. (2021). Africa's future and Technology. Made for IPI294. [Canvas]

Exercise 3: Design of the Subjective Experience

Readings: Bartels, Meghan. (2019) What's for Dinner with Aliens? Plan a Feast for All of E.T.'s Senses. Space.com. Available at https://www.space.com/designing-a-sensory-meal-for-aliens.html

Spackman, Christy. (2019) First Meal. Medium.com. Available at https://medium.com/interplanetary-community-in-a-box-initiative/first-meal-406955c05a50

Podcast: Spackman, Christy and Stribling, Eric. (2021). How do technologies intersect with subjectivity? Made for IPI294. [Canvas]

Exercise 4: Participatory Design.

Reading: Vogel, Sher. (2021).Co-Creating a More Equitable World: The Transformative Benefits of Participatory Design. nextbillion.com. Article available: https://nextbillion.net/transformative-benefits-participatory-design/

Podcast: Hosman, Laura and Stribling, Eric. (2021). How can we design technologies for positive social outcomes? Made for IPI294. [Canvas]

Creative Project Prompt: YellowDig writing/podcast response: Do your favorite technologies have societal impacts? Who do they benefit? Were they intentional? Post an example to YellowDig and respond to a classmates' post. Then submit a succinct precis of each article.

Societal Values out of Technology:

At the end of Level 1, students will explore different ways that society is shaped intentionally or unintentionally by technology.

SIT Societal Values out of Technology Level 1 Module (the Podcast Module):

Exercise 1: Can Values have Technologies?

Wetmore, Jameson. (2007). Amish Technology: Reinforcing values and building community. Technology and Society Magazine. 10, 21. IEEE.

Podcast: Wetmore, Jamie and Stribling, Eric. (2021). Culture and Technology. Made for IPI294. [Canvas]

Exercise 2: Scary Technological Stories: Frankenstein!

Reading: Doctorow, Cory. (2018) I've Created a Monster! (And So Can You). Frankenbook. Available at https://www.frankenbook.org/pub/ive-create-a-monster/release/1

Podcast: Guston, Dave and Stribling, Eric. (2021). Frankenstein and the Industrial Revolution. Made for IPI294. [Canvas]

Exercise 3: The Assembly Line: Technology shaping the Workplace

Reading: Volti, Rudy. (2014/1995). Technological Change and Life on the Job. in Society and Technological Change. [Chapter 11.]

Exercise 4: Praxis.

Reading: Karwat, Darshan; Eagle, Walter; Wooldridge, Margaret; and Prince, Thomas (2015) Sci Eng Ethics. 21:227–239. Available at DOI 10.1007/s11948-014-9525-0

Podcast: Karwat, Darshan and Stribling, Eric. (2021). What is praxis and how should the makers of technologies change the way they think? Made for IPI294. [Canvas]

Creative Project Prompt: YellowDig writing/podcast response: In what ways do you use technologies in ways the designers did not intend? Post an example to YellowDig and respond to a classmates' post. Then submit a succinct precis of each article.

WORKING AS A TEAM MODULES

Technical Teamwork:

At the end of Level 1, students will learn key components for working as a team on a technical project, with specific applicability to the group project to be completed during the second half of the semester.

Teamwork Technical Teamwork Level 1 Module:

Exercise 1: Introduction to Technical Teamwork.
Exercise 2: Technical Communication.
Exercise 3: Giving Feedback: the Critical Response Process.
Exercise 4: Managing Time as a Group.
Creative Project Prompt: Build a Group Gantt Chart

Technical Write-ups:

At the end of this Level 1 module, students will learn a process for writing technical documents that are clear and concise for a variety of audiences.

Teamwork Technical Write-ups Level 1 Module:

Exercise 1: Questions to ask before writing a technical document.
Exercise 2: Structuring Technical Communication.
Exercise 3: Writing concisely and clearly.
Exercise 4: Editing and Revision.
Creative Project Prompt: Write a technical user guide for a non-expert.

Advanced Level 2 Modules

Before a student can submit a Level 2 Module, they must first have submitted a Level 1 Module from the same pathway.

SOLDERING: ELECTRONICS PATHWAY

At the end of Level 2, students should have basic knowledge of soldering and repeated practice on electrical components.

Electronics Level 2 Module:
Exercise 1: Introduction to soldering.
Exercise 2: Setting up the work environment and basic safety
Exercise 3: Learning basic methods and different ways to solder.
Exercise 4: Practice, practice, practice!
Creative Project Prompt: Build a compact circuit using all soldered connections.

DESIGN FOR X: TOOLS FOR DECISION MAKING PATHWAY

At the end of Level 2, students will be exposed to a variety of design tools that emphasize different end goals, including performance, manufacture, and sustainability.

Decision Making Level 2 Module:
Exercise 1: Design to cost vs. Design to quality (or reliability)
Exercise 2: Design for Manufacturability / Assembly
Exercise 3: Sustainability: Life-cycle design
Exercise 4: Design considerations for space
Creative Project Prompt: Apply one of the design tools to your group project.

THE TECHNOLOGICAL FIX: SOCIAL IMPLICATIONS OF TECHNOLOGY PATHWAY

At the end of Level 2, students will understand the meaning of a "technological fix", have been exposed to several examples, and reflect upon instances where technology may not always be the solution to a problem.

Social Implications of Technology Level 2 Module:
Exercise 1: Philosophical biases in technology
Exercise 2: The technological fix
Exercise 3: Technology gone wrong!
Exercise 4: A short history of academic disciplines and interdisciplinarity.
Creative Project Prompt: Find an example of a popular belief that technology can solve a societal problem, and then reflect on their unstated assumptions. What are some alternative ways of solving the same problem? Find ideas from non-STEM fields that offer a different point-of-view.

Modules and module contents are subject to change. It is your responsibility to read email updates from the instructor as well as check the Canvas site for alterations made as events occur.

Academic Integrity
Academic honesty is expected of all students in all examinations, papers, laboratory work, academic transactions and records. The possible sanctions include, but are not limited to, appropriate grade penalties, course failure (indicated on the transcript as a grade of E), course failure due to academic dishonesty (indicated on the transcript as a grade of XE), loss of registration privileges, disqualification and dismissal. For more information, see https://provost.asu.edu/academic-integrity/policy.

If you fail to meet the standards of academic integrity in any of the criteria listed on the university policy website, sanctions will be imposed by the instructor, school, and/or dean. Academic dishonesty includes borrowing ideas without proper citation, copying others' work (including information posted on the internet), and failing to turn in your own work for group projects. Please be aware that if you follow an argument closely, even if it is not directly quoted, you must provide a citation to the publication, including the author, date, and page number. If you directly quote a source, you must use quotation marks and provide the same sort of citation for each quoted sentence or phrase. You may discuss assignments with other students, however, all writing that you turn in must be done independently. If you have any doubt about whether the form of cooperation you contemplate is acceptable, ask the TA or the instructor in advance of turning in an assignment. Please be aware that the work of all students submitted electronically can be scanned using plagiarism software, which compares them against everything posted on the internet, online article/paper databases, newspapers and magazines, and papers submitted by other students. Turning in an assignment (all or in part) that you completed for a previous class is considered self-plagiarism and falls under these guidelines. Any infractions of self-plagiarism are subject to the same penalties as copying someone else's work without proper citations. Students who have taken this class previously and would like to use the work from previous assignments should contact the instructor for permission to do so.

Incompletes
A mark of "I" (incomplete) can be given by the instructor when you are otherwise doing acceptable work but are unable to complete the course because of illness or other conditions beyond your control. You are required to arrange with the instructor for the completion of the course requirements. The arrangement must be recorded using the form at https://students.asu.edu/forms/incomplete-grade-request. Students should be proactive and discuss this with their instructor and TA before the end of the semester. Students who do not complete this form before the end of the semester cannot be given an incomplete and will be awarded a grade based on the work they have completed. Students have one calendar year to make up the work. After that the "I" grade becomes a permanent "E" (failing) grade.

Grade Appeals
The College of Liberal Arts and Sciences and ASU have informal and formal channels to appeal a grade. If you wish to appeal any grading decisions, please see https://thecollege.asu.edu/academic-grievance for more information.

Student Standards
Students are required to read and act in accordance with university and Arizona Board of Regents policies, including: The ABOR Code of Conduct: Arizona Board of Regents Policies 5-301 through 5-308: https://eoss.asu.edu/dos/srr/codeofconduct.

Disruptive, Threatening, or Violent Behavior

All incidents and allegations of violent or threatening conduct by an ASU student (whether on- or off-campus) must be reported to the ASU Police Department (ASU PD) and the Office of the Dean of Students. If either office determines that the behavior poses or has posed a serious threat to personal safety or to the welfare of the campus, the student will not be permitted to return to campus or reside in any ASU residence hall until an appropriate threat assessment has been completed and, if necessary, conditions for return are imposed. ASU PD, the Office of the Dean of Students, and other appropriate offices will coordinate the assessment in light of the relevant circumstances. See: SSM 104-02 (https://www.asu.edu/aad/manuals/ssm/ssm104-02.html).

Professionalism in the Classroom
While learning happens throughout ASU, the classroom is a particularly important focal point. Students are asked to contribute to a collegial atmosphere where ideas can be exchanged, discussed, and debated freely by avoiding disruptions through their own behavior and the distractions of their technology. Disruptive, threatening or violent behavior will be dealt with according to the policies in the Student Services Manual, SSM 104–02 (https://www.asu.edu/aad/manuals/ssm/ssm104-02.html). Students wishing to record lectures electronically must first get permission from the instructor.

Absences
It is impossible to learn from your fellow students when you or they are not there. As such attendance is required in this course. Should you have to miss a class, contact your instructor as far in advance as possible to discuss making up assignments and/or tests. If you have an emergency and are unable to give advanced notice, please notify the instructor as quickly as possible to discuss options. Depending on the nature of the absence the instructor may elect to deduct points from your overall grade. Absences can be excused for religious observances or practices that are in accord with ACD 304–04 (https://www.asu.edu/aad/manuals/acd/acd304-04.html) or university sanctioned events/activities that are in accord with ACD 304–02 (https://www.asu.edu/aad/manuals/acd/acd304-02.html).

Prohibition of Commercial Note Taking Services
In accordance with ACD 304-06 Commercial Note Taking Services (https://www.asu.edu/aad/manuals/acd/acd304-06.html), written permission must be secured from the official instructor of the class in order to sell the instructor's oral communication in the form of notes. Notes must have the note taker's name as well as the instructor's name, the course number, and the date.

Disability Accommodation
If you are a student with a disability and have need of assistance or special accommodations, contact Student Accessibility and Inclusive Learning Services (SAILS) https://eoss.asu.edu/accessibility. Students requesting accommodations for a disability must register with SAILS and must submit appropriate documentation to the instructor from SAILS. For more information, please review the policy at http://www.asu.edu/aad/manuals/ssm/index.html.

Sexual Violence and Harassment
Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/faqs.

As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, https://eoss.asu.edu/counseling, is available if you wish discuss any concerns confidentially and privately.

Student Uploads to Online Course Shells
Students must refrain from uploading to any course shell, discussion board, or website used by the course instructor or other course forum, any material that is not the student's original work, unless the students first comply with all applicable copyright laws. Faculty members reserve the right to delete materials on the grounds of suspected copyright infringement.

Drop and Add Dates/Withdrawals
Please refer to the academic calendar on the deadlines to drop/withdraw from this course. Consult with your advisor and notify your instructor if you are going to drop/withdraw this course. If you are considering a withdrawal, review the following policies:
Withdrawal from Classes – https://www.asu.edu/aad/manuals/ssm/ssm201-08.html
Medical/Compassionate Withdrawal – https://www.asu.edu/aad/manuals/ssm/ssm201-09.html

Email Communications
All email communication for this class will be done through your ASU email account and the Canvas site. You should be in the habit of checking your ASU email regularly as you will not only receive important information about your class(es), but other important university updates and information. You are solely responsible for reading and responding if necessary to any information communicated via email. For help with your email log into your MyASU account and under the Service tab you can file a "new ticket" to get assistance.

Food Resources
With an understanding that college and graduate life can be challenging in many ways and it can be difficult to balance our studies with other needs, such as food needs, the SFIS Graduate Student Organization (GSO) has curated a list of food resources to ease this challenge. This list can be found at the SFIS GSO website: https://www.sfisgso.org/home/resources/food-resources. It includes information on food resources available in and around ASU campus. A few gift cards are available for grocery stores in Tempe, for students who believe they are in a financial need for food purposes. These can be requested using the request form provided in the GSO website. GSO also has an active Whatsapp group for students to share information on free food on campus and surroundings. Please refer to this website for exploring these resources or contact info@sfisgso.org. Follow GSO on Instagram and Facebook @sfisgso for more information.

Campus Resources
As an ASU student you have access to many resources on campus. This includes tutoring, academic success coaching, counseling services, financial aid, disability resources, career and internship help and many opportunities to get involved in student clubs and organizations.

Tutoring: https://tutoring.asu.edu/student-services/tutoring
Counseling Services: https://eoss.asu.edu/counseling
Financial Aid: https://students.asu.edu/financialaid
Major/Career Exploration: https:/students.asu.edu/programs
Career Services: https://career.asu.edu/
Student Organizations: https://eoss.asu.edu/clubs

This syllabus is subject to change. It is your responsibility to read email updates from the instructor as well as check the Canvas site for alterations made as events occur.