ENGINEER YOUR WORLD
THE UNIVERSITY OF TEXAS AT AUSTIN

2016-2017 Scaffolded Course Framework	Fall Semester					Spring Semester		
	Introduction to Engineering; Class Norms	Customer Needs	Discovering Design	Understanding Data	Data Acquisition and Analysis	Reverse Engineering and Redesign	Programming	Systems Engineering
Engineering Practice								
Engineering's Societal Impacts - *Students learn about engineering's societal impacts through exploration of past accomplishments (greatest achievements); current and future challenges (grand challenges); and the interplay between science, technology, customer needs and evolving designs.*								
Greatest Engineering Achievements			Imaging is a Greatest Engineering Achievement		**Unit Project:** Exploring the Impact of Engineering Achievements on Our World			
Impact of Engineering on Individuals' Daily Lives	Introduction	Universal Design	Design for People with Varying Abilities			Universal Design		
Innovation and design evolution (emphasis on impacts of innovation on society and vice versa)		Design Iteration	**Unit Project:** Innovation and Design Evolution Timeline		Design Iteration	Redesign for Customers		
The Practice of Engineering - *Students learn about engineering disciplines and careers, the multidisciplinary nature of practice, and professional codes and standards to which engineers adhere.*								
Engineering disciplines and careers (emphasis on the multidisciplinary nature of practice)	Present Different Engineering Fields and Professions	Applying Universal Design Principles Across Engineering Professions		Chemical Engineering	Civil and Mechanical Engineering	Manufacturing and Industrial Engineering Practices	Electrical Engineering	Aerospace Engineering
Engineering ethics and codes of practice					**Unit Project:** Design for Engineering Codes, Placing Emphasis on Human Life and Safety	**Unit Project:** Ethical Implications of Reverse Engineering		**Unit Project:** Ethical Obligations of the Engineer
Safety considerations with respect to the system, the engineer and the user					Safety Considerations in Design	**Unit Project:** Design Liability		Safety of the System; FMEA
Engineering standards and regulations including the role of government					**Unit Project:** Data-Based Standards and Regulations			
Legal aspects including intellectual property, patents, and trademarks						**Unit Project:** Patent Infringement		
Engineering Process								
The Engineering Design Process – *Students learn and employ the multi-step, iterative process that engineers use to design a product for specific customer needs.*								
Design Process			Discovering the Engineering Design Process		Using the Engineering Design Process	Using the Engineering Design Process		Nested Engineering Design Processes
Design Approaches		Introduction to Design Modification	New Design		Design Modification	Reverse Engineering and Product Redesign		New Design/ Design Modification
Engineering Skills and Habits of Mind								
Systems Thinking – *Systems thinking is a set of habits or practices in a framework based on the belief that the parts of a system can best be understood in the context of relationships with each other and with other systems, rather than in isolation. Emphasis is placed on a top-down perspective, the system environment, and critical interfaces.*								
Understanding the system context for a problem; taking a top-down perspective								Challenge Presented in Terms of a System
System decomposition (*i.e.* , system, subsystem, element, component)								Listing Subsystems; System Hierarchy; Subsystem Design and Integration
Activity diagrams/ Concepts of operations		Develop Activity Diagram	Develop Activity Diagram			Reconsider Previously Developed Activity Diagram		Develop Concept of Operations
Functional models (*e.g.* , black box, function list, flowchart)		Develop Action/Function/ Question Table	Develop Action/Function/ Question Table			Black Box; Predictive Sketch; Predictive FM; Disassemble/ Document/ Reassemble Actual FM; Predicted/Actual Comparison	Pseudocode	Functional Model; Flow Charting
System Understanding and Quantification – *Students learn to characterize the system using quantitative techniques common in the practice of engineering, enabling a deeper understanding of the system* .								
Developing Specifications		Gather Customer Needs and Develop Design Requirements	Analyze and Interpret Requirements to Develop Specifications	Determine Requirements from Variables	Analyze and Interpret Requirements	Benchmark and Develop Design Constraints		Analyze and Interpret Requirements
Instrumentation and Experimentation				Design of Experiments	Design of Experiments; Appropriate Instrumentation and Experimentation Techniques	Appropriate Instrumentation and Experimentation Techniques		Appropriate Instrumentation and Experimentation Techniques
Acquiring, Analyzing and Representing Data				Acquire and Analyze Small Data Set; Create Graphs	Acquire, Analyze and Represent Moderately Complex Data Set; Create Graphs	Acquire, Analyze and Represent Moderately Complex Data; Create Tables		Acquire, Analyze and Represent Simple Data
Creativity – *Engineers think creatively within well-defined constructs. Students experience a variety of design approaches using concept generation and selection techniques employed by engineers.*								
Techniques for concept generation			Brainstorming. Mind Mapping, C-Sketching		Research Existing Approaches; Option to Use Brainstorming, Mind Mapping and C-Sketching	Brainstorming. Mind Mapping, C-Sketching		Brainstorming. Mind Mapping, C-Sketching
Techniques for concept selection			Intentionally Unstructured		Use Six Thinking Hats; Describe Rationale for Final Decision	Simple Decision Matrix (Pugh Chart)		Decision Matrix: Complex (Weighted) Using Six Thinking Hats
Verification – *Engineers must verify that their selected concept satisfies the design constraints, requirements, and customer needs* .								
Design embodiment (*e.g.* , modeling, prototyping)			Build, Test and Refine a Physical Object		Scaled Physical Prototype; Represent Data, Create a Technical Drawing	Create a Technical Drawing with Major Dimensions and Materials		Build, Test and Refine Subsystems; Integrate Subsystems; Test and Refine Integrated System
Verifying Performance			Evaluate Performance Against a Provided Rubric		Develop a Rubric as a Class; Evaluate Performance Against that Rubric		Demonstrate Successfully Coded Solution	Develop a Rubric as a Class; Evaluate Performance Against that Rubric
Communication - *Students learn good communication skills and unique aspects of how engineers document and present design ideas and analytical results. Emphasis is placed on creating communication artifacts to ensure accurate interpretation by others (with an eye toward clarity, detail, precision of process, and completeness.)*								
Engineering notebooks and configuration management	Develop Documentation Norms	Document Work in an Engineering Notebook	Document Work in an Individual Engineering Notebook	Document Work in an Individual Engineering Notebook	Document Work in an Individual Engineering Notebook	Document Work in an Individual Engineering Notebook	Document Work in an Individual Engineering Notebook	Document Work in a Team Engineering Notebook
Formal documentation (*e.g.* , reports, presentations)		Create Poster	Develop Manufacturing Instructions and User Instructions	Write Internal Memorandum; Give Informal Presentation of Professions	Develop a Technical Report to Client Describing Methodology, Documenting Performance, Making Recommendations	Develop Technical Report to Manager (Describe Methodology, Explain and Defend Recommendations, Suggest Next Steps	Give Informal Presentation; Give Informal Presentation of Professions	Develop and Deliver a Technical Presentation
Collaboration – *Students learn the importance of working on multidisciplinary teams and understand what type of team member they are. Emphasis is placed on engineering personality types, integrated product teams, and examples of successful engineering teams* .								
Approaches to Teaming (*e.g.* , MBTI, Six Thinking Hats)	Intentional Random Teaming	Intentional Random Teaming	Teaming using True Colors - Homogeneous [or Heterogeneous] (2 students)	Teaming using True Colors - Heterogeneous [or Homogeneous] and Reflecting on Results (3 students)		Teaming using Six Thinking Hats and Reflecting on Results (4 students)	Let Students Select Technique, Distribute Experts (3 students)	Teaming Using MBTI, Heterogeneous (9 students, three subteams of 3 students each)
Teamwork	Developing Collaboration Norms	Reflect on Possible Need for Structured Teaming Method	Compare Structured Teaming Approach (True Colors) to Unstructured Approach		Compare Homogenous to Heterogeneous (True Colors) to Unstructured Approaches	Delegating Roles and Responsibilities		Students reflect on challenges of subsystem team communication and collaboration
Self-Review and Peer Review			Evaluate performance of self and team members		Evaluate performance of self and team members	Evaluate performance of self and team members		Evaluate performance of self and team members
Common Engineering Tools and Techniques – *Students learn to use common tools and techniques that engineers employ to approach and solve problems and to manage projects* . *Approach and application are based on the design challenge at hand.*								
Project management techniques (*e.g.* , system cost and schedule estimation)					Managing Costs	Managing Costs		Scheduling Work to Meet Milestones
Risk analysis techniques (*e.g.* , failure modes and effects analysis)					Worst Case Testing			Failure Modes and Effects Analysis
Electronic hardware				Using Sensors (Conductivity)	Using Sensors (Accelerometers)	Using Sensors (Light, Force and Other Characteristics)	Microcontroller	Microcontroller, Interfacing Hardware, Sensors (Altimeter, Ultrasonic Range Finder, Optional Bluetooth Release Mechanism)
Software tools			Software for Scanning and Inverting Images	Spreadsheets	Using Pre-Programmed Software (LabVIEW); Spreadsheets	Using Pre-Programmed Software (LabVIEW)	Microcontroller Integrated Development Environment	Implementing/Adapting Simple Code
Measurement tools			Handheld Measurement Tools	Tools to Measure Intrinsic Properties	Data Acquisition System	Data Acquisition System		Tools to Measure Intrinsic Properties
Application of domain-specific math/science knowledge			Optics, Geometry of Similar Triangles, Safe Use of Chemicals	Proportional Analysis	Seismology, Standard Deviation, Proportions and Scaling Principles	Standard Deviation	Frequencies and Durations of Musical Notes, Scaling, Variables	Free Fall, Drag Force, Aerodynamics, Ideal Gas Law, Velocity, Acceleration, Buoyancy

Introduction of Concept

Focus on Concept

Reinforcement of Concept