



monarch

Curriculum Catalog

Career and Technical Education Series

Engineering and Design

Table of Contents

ENGINEERING AND DESIGN COURSE OVERVIEW	1
UNIT 1: INTRODUCTION TO ENGINEERING AND DESIGN AND THE DESIGN PROCESS	1
UNIT 2: FLUID SYSTEMS: ENERGY AND POWER TECHNOLOGIES IN ENGINEERING.....	2
UNIT 3: MODELING AND SKETCHING.....	2
UNIT 4: REVERSE ENGINEERING.....	2
UNIT 5: ENGINEERING TO IMPROVE SUSTAINABILITY.....	3
UNIT 6: COURSE PROJECT, REVIEW, AND EXAM.....	3

Engineering and Design Course Overview

Engineering and Design is part of the STEM (Science, Technology, Engineering, and Mathematics) education and career path. By building real-world problem-solving and critical-thinking skills, students learn how to innovate and design new products and improve existing products. Students are introduced to the engineering design process to build new products and to the reverse engineering process, which enables engineers to adjust any existing product.

Parallels and analogies from Scriptural examples will firmly seat the course in Bible truth, since God is the master engineer, designer, and creator of everything. Popular topics and issues that are politically controversial will be explored from a Biblical perspective.

A second and equally important emphasis will address how fluid power is used by engineers to make difficult maneuvers easier, increasing efficiency and minimizing effects on the environment. Students will then identify how engineering and design have a direct impact on environmental sustainability and economic greening, with Bible principles incorporated when appropriate. Finally, students will incorporate the engineering design process, environmental life cycle, and green engineering principles to create a decision matrix to learn how to solve environmental issues, while identifying how following God’s original principles would have avoided producing those issues in the first place.

Objectives

- Understand the basic STEM requirements of engineers and the skills required for the occupation.
- Define and understand how forces are transmitted with fluid systems to build efficiency and increase sustainability. With this knowledge, students can solve a problem with a new design solution using fluid power.
- Utilize sketching skills and techniques to produce detailed sketches of components in the design of a real-world object to scale. This allows students to determine the feasibility of a product or design.
- Use the engineering design process and reverse engineering techniques and apply them to a design. They will be able to create and use decision matrices to make design decisions based on logic and analysis. Students will be able to identify and research environmental issues and challenges with respect to energy and air quality.
- Identify and analyze the environmental life cycle of a product or process to solve sustainability challenges for social and industrial environmental issues.

It is helpful if students are familiar with renewable and nonrenewable resources.

Many of the principles discussed in this course can be better addressed through the use of broken machines, toys, and electronics. Collection of these materials prior to the course will greatly help the student in the course.

Unit 1: Introduction to Engineering and Design and the Design Process	
Assignments	
Engineering and Design	1. Course Overview
	2. Design Opportunities All Around Us
	3. Design Improvements
	4. Project: Creating a Product Discussion Forum
	5. Improvements of Everyday Items
	6. Project: Model or Prototype Suggestion Presentation
	7. Quiz 1: Introduction to Design Opportunities
	8. Basic Engineering Concepts
	9. Choosing Materials for Design
10. Project: Researching Materials Designs	
11. Application of Materials	
12. Project: Designing a Destructive Test	
13. Quiz 2: Fundamentals of Engineering	
14. Special Project*	
15. Test	
16. Course Project Part 1: Identifying the Product or Process*	
17. Glossary and Credits	

Unit 2: Fluid Systems: Energy and Power Technologies in Engineering		
Assignments		
Engineering and Design	1. Fluid Power Systems	9. Efficient Fluid Power Designs
	2. Fluid Power Devices	10. Designing a Fluid Power Lifting System
	3. Project: Researching a Fluid Power System Goal	11. Project: Designing a Fluid Power Lift System
	4. Designing Fluid Power Systems for Future Developments	12. Quiz 2: Fluid Power Applications and Capabilities
	5. Project: Creating a Fluid Power System for the Future	13. Special Project*
	6. Quiz 1: Introduction to Fluid Power	14. Test
	7. Common Applications for Fluid Power Systems	15. Course Project Part 2: Incorporating a Fluid Power System*
	8. Project: Identifying Fluid Power in Daily Life	16. Glossary and Credits

Unit 3: Modeling and Sketching		
Assignments		
Engineering and Design	1. Introduction to Technical Sketching and Drawing	9. Project: Researching Model Uses in Remote or Dangerous Locations
	2. Project: Interview an Engineer About Sketching	10. Designing a Sketch Model
	3. Geometric Shapes and Solids in Engineering	11. Project: Presenting a Sketch Model of a Designed Pet Toy
	4. Drawing to Scale	12. Quiz 2: Sketch Modeling
	5. Project: Creating a Technical Sketch of an Everyday Object to Scale	13. Special Project*
	6. Quiz 1: Introduction to Design and Technical Sketches	14. Test
	7. The Applications for Modeling in Engineering	15. Course Project Part 3: Designing a Sketch Model*
	8. Modeling and Prototypes	16. Glossary and Credits

Unit 4: Reverse Engineering		
Assignments		
Engineering and Design	1. Reverse Engineering: Visual Analysis	10. Calculating the Process: Materials, Time, and Cost for Improvement
	2. Reverse Engineering: Functional Analysis	11. Project: Researching Materials, Time, and Cost for Product Modifications
	3. Project: Creating a Function Structure Diagram or Product Teardown Chart	12. Quiz 2: Using Reverse Engineering for Product Improvement
	4. Reverse Engineering: Structural Analysis	13. Special Project*
	5. Project: Creating a Morphological Matrix	14. Test
	6. Quiz 1: Introduction to Reverse Engineering	15. Course Project Part 4: Calculating the Process: Materials, Time, and Cost Analyses*
	7. Finding the Product: The Reverse Engineering and Design Process Applied	16. Glossary and Credits
	8. Implementing the Procedure: Reverse Engineering a Product	
	9. Project: Reverse Engineering Documentation and Presentation	

Unit 5: Engineering to Improve Sustainability	
Engineering and Design	Assignments
	1. Environmental Engineering Introduction
	2. Project: Researching a Local Sustainability Issue
	3. Energy and Air Quality
	4. Green Buildings and Green Initiatives
	5. Project: LEED Ratings for Building Construction
	6. Quiz 1: Introduction to Environmental Engineering
	7. Environmental Assessment and Impacts
	8. Project: Researching Life Cycles for Assessment
	9. Green Design Principles: Systems and Environment
10. Incorporating Green Engineering Principles	
11. Project: Creating a Decision Matrix for an Environmental Issue	
12. Quiz 2: Environmental Life Cycle and Green Engineering Design	
13. Special Project*	
14. Test	
15. Course Project Part 5: Incorporating Green Engineering Principles*	
16. Glossary and Credits	

Unit 6: Course Project, Review, and Exam	
E&D	Assignments
	1. Course Project Part 6: Conducting a Life-Cycle Analysis*
	2. Course Review
	3. Exam

(*) Indicates alternative assignment