

University of Arkansas, College of Education and Health Professions
REHABILITATION, HUMAN RESOURCES, AND COMMUNICATION DISORDERS

I. Program Affiliation: Vocational Education, Technology Education concentration

Course Number and Title: TEED 4103: Engineering Design for Technology Education Capstone

Catalog Description: Analysis of engineering design, focus on design processes, physical and computer modeling, & materials processing.

Prerequisite: TEED 1103, TEED 3103

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II. Relationship to knowledge Base:

This capstone course supports the “Specialty Studies” component of the Scholar-Practitioner model by providing the technology teacher education candidate with a capstone experience related to technology education and engineering design. The course will model the methods expected in a contemporary technology education facility and expose the candidate to instructional strategies expected of exemplary programs in the field.

III. Goal:

This course is designed to provide advanced knowledge and methods for teaching engineering design. Elements of design and theory will be applied through design problems, physical and computer models, prototypes, and advanced simulations. Significant time is dedicated to equipment and tool usage/management, material processes, facility maintenance and safety for teacher preparation.

IV. Competencies:

Upon successful completion of this course, students will demonstrate knowledge, skills and competencies in the following areas:

1. Describe the history and significant social, cultural, and political events that have shaped the fields of engineering and design (SP 1, 4) (PW: A);
2. Describe and be conversant with the role that technological design has on societal evolution (SP 1, 3, 4) (PW: A);
3. Utilize the principles and elements of engineering and design to solve advanced design problems (SP 3, 7) (PW: A);

4. Compare and contrast between differing engineering and design problem solving models (SP 1, 2) (PW: A);
5. Demonstrate the ability to utilize knowledge technology, engineering and design to develop engaging curriculum for secondary students (SP 1, 2, 5, 7) (PW: A);
6. Demonstrate the ability to solve advanced simulations that result in computer generated models of technological products or systems (SP 1, 2) (PW: A);
7. Demonstrate the ability to develop physical models of technological product or systems using materials and equipment often found in secondary programs (SP 5, 6, 7) (PW: A);
8. Analyze the traits of a fully functional engineering or design studio at the secondary level (SP 6) (PW: A, B);
9. Clearly describe the safety issues and procedures for tools and equipment in a fully functional secondary school site (SP 4, 6) (PW: A, B, C);
10. Clearly describe the procedures for maintaining the tools, equipment and materials in a fully functional secondary school site (SP 4, 6, 7) (PW: A, B, C);
11. Demonstrate the ability to develop and teach engineering and design-based curriculum materials secondary students (SP 1, 4, 5, 7) (PW: A, B, C, D); and,
12. Demonstrate the ability to develop a secondary program of study that is reflective of the state and national standards for technology education (SP 4, 6) (PW: A, B, C, D).

V. Content:

1. **The engineering and design professions (PW: A, D)**
 - a. A brief history of design and engineering
 - b. Design and engineering solutions
2. **Engineering design – A process (PW: A)**
 - a. Foundational skills & mental models
 - b. Need identification and problem definition
3. **The design problem solving process (PW: A)**
 - a. Problem definition
 - b. Concept generation
 - c. Concept selection/judgment
 - d. The Pugh Method
 - e. Solution implementation
 - f. Solution testing
4. **Representation of technical information (PW: A)**
 - a. Visualization
 - b. Mental models
 - c. Mental blocks

d. Modeling and simulation

5. Design ideation and documentation (PW: A)

- a. Materials selection and materials in design
- b. Materials processing and design
- c. Communication procedures

6. Engineering fundamentals (PW: A)

- a. Newton's Laws
- b. Introduction to thermodynamics
- c. Introduction to rate processes
- d. SI System of Units
- e. Unit Conversions
- f. Introduction to static's and dynamics
- g. Introduction to electricity
- h. The mechanics of materials
- i. Applying engineering statistics and quantitative measures
- j. Engineering estimations and approximations

7. Development processes and organizational structures (PW: A)

- a. Product planning
- b. Product specifications & constraints
- c. Design for manufacturing

8. Intellectual Property (PW: A)

- a. Patents and trademarks
- b. Legal and ethical issues in design and engineering
- c. Research and development
- d. Risk, reliability, and safety
- e. Technological assessment

9. Managing the engineering design laboratory (PW: A, B)

- a. The learning environment
- b. Tool procurement and management
- c. Plant layout and laboratory design
- d. Human subjects management

10. Applying engineering and design in the classroom (PW: A, B, C)

- a. Teaching methods
- b. Curriculum development
- c. Assessment techniques
- d. Resources

VI. Evaluation:

Learning assessments (portfolio, assignments, experiments, and exams/quizzes) are designed to prepare the student to deliver course(s) related to technology and engineering design in the secondary technology education classroom. These assessments will also serve as continued professional preparation to teach general technology education as well as

technical courses in the field. Grades for participating students will be calculated based on completion of the following assignments and activities:

1. **Engineering Studio Project (PW: A, B)**: Students will be required to work as a member of a design team throughout the duration of this course. This design team will pursue an engineering design problem from initial ideation, through mental modeling and concept generation, to modeling and prototyping, to intellectual property protection and communication. The final report will be submitted in a curricular format suitable for use in the elementary or secondary technology education classroom and should be submitted electronically (**300 points**).
2. **Laboratory Management Portfolio/Guide (PW: A)**: Students will be required to develop a portfolio/guide of materials and procedures necessary for the development and management of a secondary school engineering design laboratory. This guide will include sections related to design fundamentals/teaching tools, machinery and equipment safety and use, Laboratory layout plans, techniques for maintaining a laboratory, and other curricular suitable for use in the technology education/engineering design laboratory. The guide will be submitted in a curricular format suitable for use by elementary or secondary technology education teachers and should be submitted electronically (**200 points**).
3. **Daily Assignments (PW: A)**: Students will be required to participate in ongoing daily and in-class design and engineering activities and assignments. Full participation in these activities will result in **300 points**.
4. **Examinations (PW: A, B)**: Mid-term Examination (**100 points**). Final Examination (**100 points**).

VII. Syllabus Change

The instructor reserves the right to make changes as necessary to this syllabus. If changes are made, advance notification will be given to the class.

VIII. Grading Scale

The following scale will be used to determine the final grade in the course:

<u>Final Percentage</u>	<u>Final Grade</u>
91% - 100%	A
81% - 90%	B
75% - 80%	C
70% - 74%	D
Below 70%	F

IX. Academic Honesty

The application of the University of Arkansas Academic Honesty Policy, as stated in the Student Handbook will be fully adhered to in this course. Grades and degrees earned by dishonest means devalue those earned by all students; therefore, it is important that students are aware of the University of Arkansas Academic Honesty Policy. Academic dishonesty involves acts which may subvert or compromise the integrity of the education process.

X. Accommodations

Students with disabilities requesting reasonable accommodations must first register with the Center for Students with Disabilities. The CSD is located in the Arkansas Union, room 104 and on the web at: <http://www.uark.edu/ua/csd/applications.htm>. The CSD provides documentation to students with disabilities who must then provide this documentation to their course instructors. Students with disabilities should notify their course instructors of their need for reasonable accommodations in a timely manner to ensure sufficient time to arrange reasonable accommodation implementation and effectiveness. A typical time frame for arranging reasonable accommodations for students who are registered with the CSD is approximately one to two weeks.

XI. Classroom Behavior

Appropriate classroom behavior is expected of the instructor and all students. Inappropriate and disruptive classroom behavior (inappropriate language and gestures, class disruptions, disrespect to other students or instructor, and other behavior as determined by the instructor) will not be tolerated and will result in possible removal from the class and /or disciplinary action as per the student handbook.

XII. Inclement Weather

In case of inclement weather, students should phone 575-4758 if they are unsure if the class will meet. In addition, information concerning University closings can be obtained by phoning 575-2000 for announcements. University closing announcements are also made on KUAF Radio, 91.3 as well as local radio and television stations. The University's inclement weather site is updated frequently on both UARKINFO and University Online at <http://pigtrail.uark.edu/info/weather.nclk>.

XIII. Course Resources

In addition to the University library, guest speakers, and journal articles distributed by the professor, the following reference materials will be used extensively:

Dieter, G. (2000). *Engineering design: A materials and processing approach* (3rd Ed.). Boston, MA: McGraw-Hill. (ISBN 007235058X).

Eide, A., Jenison, R., & Northup, L. (2002). *Introduction to engineering design and problem solving* (2nd ed.) Boston, MA: McGraw-Hill. (ISBN 0072402210).

Holtzapple, M., & Reece, W. (2002). *Concepts in engineering* (1st ed.). Boston, MA: McGraw-Hill. (ISBN 0073011770).

IX. Research Base

Required Texts

Lumsdaine, E., Lumsdaine, M., & Shelnut, J. (1999). *Creative problem solving and engineering design* (1st Ed.). Boston: McGraw-Hill (ISBN 0072360585).

International Technology Education Association. (2000). *Standards for technological literacy: Content for the study of technology*. Reston, VA: Author.