University of Arkansas, College of Education and Health Professions
Department of Curriculum and Instruction

1. Program Affiliation: Career and Technical Education: Technology and Engineering Education and Childhood Education STEM Graduate Certificate

1.1 Course Number and Title: STEM 5023: Creativity and Innovation in STEM Education

Prerequisites: STEM 4033

Meets: T/TH 2:00-3:15pm
Peabody Hall 317

1.2 Instructor: Vinson Carter, Ph.D.
vcarter@uark.edu
575-3076
314 Peabody Hall

1.3 Textbooks and/or Supplementary Materials:

Whiting, G. & Hickey, M. (2009) *Children's engineering: A handbook for elementary educators*. Richmond, VA: Children's Engineering Educators LLC.

Whiting, G. & Hickey, M. (2010) *Beyond the basics: Highlighting the T & E in STEM education*. Richmond, VA: Children's Engineering Educators LLC.

Safety Glasses

- The can be purchased at bookstore, hardware stores (Harbor Freight), online, etc.
- Will be needed the second week of class

Puppet Pals App

- This will be used during the marionette design challenge unit

Research Base:

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

Hallerman, S., Larmer, J., & Mergendoller, J. R. (2011). *PBL in the elementary grades: Step-by-step guidance, tools and tips for standards-focused K-5 projects*. Novato, CA: Buck Institute for Education.

Britton, E., De Long-Cotty, B., & Levenson, T. (2005). *Bringing technology education into K-8 classrooms: A guide to curricular resources about the designed world*. Thousand Oaks, CA: Corwin Press.

2. Course Description/Justification

2.1 Catalog Description: This introductory course in technology and engineering education focuses on the development and introduction of technology and engineering-based activities to support science and mathematics instruction in the elementary classroom. Through hands-on, problem based learning challenges, students will develop an understanding of the design process and the integration of science, technology, engineering, and mathematics (STEM) often used to solve real-world problems.

2.2 Relationship to Knowledge Base: This course supports the "Specialty Studies" component of the Scholar-Practitioner model by providing the teacher education candidate with a set of technological problem solving tools that can be used to develop curricula, deliver instruction, and guide learning in the STEM education classroom. The course will model the methods expected in a contemporary technology and engineering education facility and expose the candidate to instructional strategies utilized throughout exemplary programs in the field.

3. Goals and Objectives

3.1 Goals

This course is designed to provide knowledge and methods for solving technological problems and teaching engineering design. Elements of design and theory will be applied through the development of design briefs.

All candidates pursuing degrees in the College of Education and Health Professions are expected to apply the principles of the conceptual framework as *Scholar Practitioners.* The scholar practitioner reflects a professional who is knowledgeable about subject matter and pedagogy; skillful in teaching and managing classrooms and schools; caring about students, families, school staff and the community; and constantly inquiring to better the profession and increase the success of students, schools and the community. The scholar practitioner is **knowledgeable, skillful, caring and inquiring** and is defined by the following tenets:

1. One who accesses, uses, or generates knowledge
2. One who plans, implements, and models best practices
3. One who understands, respects, and values diversity
4. One who is a developing professional and a lifelong learner
5. One who communicates, cooperates, and collaborates with others
6. One who makes decisions based upon ethical standards and professional criteria
7. One who is knowledgeable about teachers and teaching, learners and learning, and schools and schooling

Technology: As with all teacher preparation coursework, students are expected to demonstrate technological competence in this course. This technological competence will be demonstrated through the use of the appropriate technological hardware and software as well as other web-based applications. Scholar-practitioners will utilize technology that enhances the instructional process during the completion on this course.

3.2. Objectives

Upon the completion of this course, students will be able to:

3.2.1. Understand the historical background and development of the fields of design and engineering;

3.2.2. Describe the goals, objectives and organization of the Standards for Technological Literacy (National Standards);

3.2.3. Apply technical tools and resources toward solving human and environmental problems;

3.2.4. Develop confidence in the use and development of design models and engineering constraints;

3.2.5. Develop the ability to work in collaborative design teams to meet given criteria and solve engineering-related problems;

3.2.6. Utilize the fundamentals of design and engineering in the development and delivery of curriculum;

3.2.7. Utilize the vocabulary, primary concepts, definitions, and models applicable to engineering and design;

3.2.8. Demonstrate the ability to communicate engineering and design concepts with colleagues and students using oral, written, artifact-based, and graphic channels of communication;

3.2.9. Develop innovative and alternative teaching methods and learning activities that promote the teaching of engineering, design and the national standards for technology; and,

3.2.10. Develop and deliver lessons related to the content of this course while paying special attention to standards, behavioral or performance objectives, lesson content, teaching strategies, lesson activities, and assessment strategies.

4. Student Activities and Experiences

4.1. Assignments/Tasks

Grades for each student will be based on the following assignments:

4.1.1. Daily and weekly assignments (30 points)
Candidates will participate in ongoing daily and in-class design and engineering activities, assignments, readings, and discussion. Candidates develop an engineering notebook that will be used throughout the semester to formally document, in chronological order, all work that is associated with the course.

4.1.2. Design Challenges (60 points)
Throughout the semester, candidates will work in engineering design teams to use tools, techniques, and materials to design within established constraints. Candidates will rotate from design team to design team as they work to solve technical problems/challenges.

These challenges will include: maglev vehicles, marionette plays, electronics (Snap Circuits and LittleBits), robotics, 3D printing, and CO2 laser technologies.

4.1.3. Final Project (10 points)

5. Content Outline

5.1. Introduction to engineering and design

a. The history of design
b. The history of the engineering profession
c. The vocabulary of engineering and design
d. Engineering & design as a tool for teaching technology
e. The relationship between adjoining disciplines (science, technology, engineering and mathematics)

5.2. The Standards for Technological Literacy

a. The role of the standards
b. The relationship between the standards and engineering
c. Delivering the standards through engineering and design
d. Using standards to develop curriculum

5.3. Solving human and environmental problems

a. A search for a more comfortable life
b. Technology problem solving
c. Unexpected results/unintended consequences

5.4. Fundamentals of engineering and design

a. Foundational concepts
b. Form, function, balance, texture, etc.
c. Adhering to design parameters and constraints
d. Technological assessment

5.5 Tools of engineering and design

a. Questioning/clarifying the problem
b. Identifying constraints/limitations
c. Gathering research
d. Quantifying/mental modeling
e. Visioning and graphic representation
f. Drawing and modeling (including software usage)
g. Prototyping and assessment
h. Artifact development
i. Communicating the results of engineering/design

5.6 Fundamental techniques

a. Engineering design (innovation)
b. Experimentation
c. Research and development
d. Troubleshooting
e. Invention

5.7 Teaching with engineering and design

a. Teaching with the end in mind
b. The role of design and engineering in the classroom
c. Curricular assessment procedures, tools, and techniques
d. Developing curriculum and activities
e. Instructional methods for teaching engineering and design
f. Collaboration strategies

6. Evaluation Policies

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

A=100-93; B=92-85; C=84-78; D=77-70; F-below 69.

7. 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.

8. Academic Policies

8.1 Accommodations

Students with disabilities requesting reasonable accommodations must first register with the Center for Education Access (CEA). The CEA is located in the Arkansas Union, Room 104, and on the web at http://cea.uark.edu/. The CEA 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 CEA is approximately one to two weeks.

8.2 Academic Integrity

The application of the University of Arkansas Academic Integrity Policy 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 Integrity Policy. Academic dishonesty involves acts, which may subvert or compromise the integrity of the educational process.

"As a core part of its mission, the University of Arkansas provides students with the opportunity to further their educational goals though programs of student and research in an environment that promotes freedom of inquiry and academic responsibility. Accomplishing this mission is only possible when intellectual honesty and individual integrity prevail."

"Each University of Arkansas student is required to be familiar with and abide by the university's Academic Integrity Policy' which may be found on the UA website. Students with questions about how these policies apply to a particular course or assignment should immediately contact their instructor."

Please review the description of the Academic Integrity Policy is located at:
http://provost.uark.edu/245.php

Please review the description Academic Integrity Sanction Rubric is located at: http://provost.uark.edu/246.php

8.3 Inclement Weather

For information regarding whether the university is closed or an inclement weather day is declared check the UA website and sign up for the RazALERT Emergency Notification System at http://emergency.uark.edu/16735.php.

8.4 Instructor Policies

Attendance

This course is reserved for candidates preparing to become professional teachers. Subsequently, the ethics and responsibilities of professional teachers will be expected of all participants. Candidates must attend class to receive the maximum benefit and to avoid leaving their professional responsibilities in the hands of classmates. Candidates will be allowed two "sick" days regardless if excused or unexcused, if needed. Additional absences will result in the lowering of one letter grade per absence in your final grade. Furthermore, two occasions of coming late to class or leaving early will be counted as one absence.

Candidates are expected to arrive early, stay focused and attentive during the class, and submit all required materials prior to the due date. Late work will not be accepted for full-credit.

Professionalism

All candidates are to complete their own work during the semester. Although candidates are allowed to share ideas and learn from one another throughout the semester, students are not allowed to copy another person's work. All assignments must be original and completed individually. All citations must be documented using the 6th edition of the APA manual (http://www.apastyle.org/, http://psychology.vanguard.edu/faculty/douglas-degelman/apa-style/)

Candidates are required to maintain professional decorum during class. Cell phones and other electronic devices must be turned off and out of sight during class unless permission has been given to use them. Inappropriate and disruptive classroom behavior (including the use of cell phones, iPads, laptops, and other electronic devices) will not be tolerated, and will result in the loss of points from daily and weekly assignments.