

UMBC UGC New Course Request: EDUC435 - Integrated STEM Content and Pedagogy

Date Submitted: 3/28/2016

Proposed Effective Date: 8/1/2017

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|-------------------|-----------------|------------------------|--------|-----------|
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COURSE INFORMATION:

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| Course Number(s) | EDUC435 |
| Formal Title | Integrated STEM Content and Pedagogy |
| Transcript Title (≤30c) | Intg STEM Content and Pedagogy |
| Recommended Course Preparation | None |
| Prerequisite NOTE: Unless otherwise indicated, a prerequisite is assumed to be passed with a "D" or better. | EDUC412M (Introduction to Middle Level Teaching and Learning) with a C or better |
| Credits | 3 |
| Repeatable? | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Max. Total Credits | <small>3 This should be equal to the number of credits for courses that cannot be repeated for credit. For courses that may be repeated for credit, enter the maximum total number of credits a student can receive from this course. E.g., enter 6 credits for a 3 credit course that may be taken a second time for credit, but not for a third time. Please note that this does NOT refer to how many times a class may be retaken for a higher grade.</small> |
| Grading Method(s) | <input checked="" type="checkbox"/> Reg (A-F) <input type="checkbox"/> Audit <input type="checkbox"/> Pass-Fail |

PROPOSED CATALOG DESCRIPTION (no longer than 75 words):

Students will review the integrated approaches to teaching Science, Technology, Engineering, and Mathematics (STEM). Integrated STEM pedagogies include project/problem-based (PBL), design-based, and inquiry-based approaches to teaching.

RATIONALE FOR NEW COURSE:

The Maryland State Department of Education (MSDE) has added middle school (grades 4-9) to its areas of teacher certification. In order to be competitive within the State and serve the UMBC students who want to specialize in STEM education at the middle school level, the education department is proposing a new Middle School STEM Education degree. In order to meet rigorous standards for middle grades teachers established by the Association for Middle Level Education, EDUC435 - Integrated STEM Content and Pedagogy, will be offered annually as an upper level course taken to prepare students for the 100-day internship required for Maryland teaching certification.

Middle level teacher preparation programs are expected to prepare candidates to "demonstrate their ability to assist all young adolescents in understanding the interdisciplinary nature of knowledge" (AMLE, Standard #2). EDUC 435 will help students to meet this standard by providing them with a conceptual understanding of the interdisciplinary nature of knowledge in the STEM fields.

ATTACH COURSE OUTLINE (mandatory): (See attached)

**Department of Education
University of Maryland Baltimore County
EDUC 435
Integrated STEM Content and Pedagogy**

THE UMBC DEPARTMENT OF EDUCATION MISSION is to research teaching and learning, and to develop caring, thoughtful, knowledgeable, and skilled teachers who are responsive to children, families and the community. We expect our graduates to be leaders in their schools as well as advocates for democracy and social justice.

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This course provides students with a conceptual understanding of the fields within STEM and the careers within the STEM arena. The students will develop an understanding of the similarities and differences between the individual fields in terms of the nature and scope of the work and requirements. The students will review the integrated approaches to teaching Science, Technology, Engineering, and Mathematics (STEM). Integrated STEM pedagogies include project/problem-based (PBL), design-based, and inquiry-based approaches to teaching. Students in this course will review the standards and critique curriculum in middle grades across the STEM disciplines and gain an understanding of the premise behind STEM education and its link to real world applications to better prepare middle grades students in the 21st century.

Next Generation Science Standards, Principles and Standards for School Mathematics, International Technology Education Association Standards and the Maryland State Department of Education STEM Standards of Practice are all introduced and reviewed in this course.

Association for Middle Level Education Standards (AMLE)

This course directly addresses the following standards:

PRINCIPLE B: CONTENT

Standard 2: Middle Level Curriculum

Middle level teacher candidates understand and use the central concepts, standards, research, and structures of content to plan and implement curriculum that develops all young adolescents' competence in subject matter. They use their knowledge and available resources to design, implement, and evaluate challenging, developmentally responsive curriculum that results in meaningful learning outcomes. Middle level teacher candidates demonstrate their ability to assist all young adolescents in understanding the interdisciplinary nature of knowledge. They design and teach curriculum that is responsive to all young adolescents' local, national, and international histories, language/dialects, and individual identities (e.g., race, ethnicity, culture, age, appearance, ability, sexual orientation, socioeconomic status, family composition).

Element a. Subject Matter Content Knowledge: Middle level teacher candidates demonstrate a depth and breadth of subject matter content knowledge in the subjects they teach (e.g., English/language

arts, mathematics, reading, social studies, health, physical education, and family and consumer science). They incorporate information literacy skills and state-of-the-art technologies into teaching their subjects.

Element b. Middle Level Student Standards: Middle level teacher candidates use their knowledge of local, state, national, and common core standards to frame their teaching. They draw on their knowledge of these standards to design, implement, and evaluate developmentally responsive, meaningful, and challenging curriculum for all young adolescents.

Element c. Interdisciplinary Nature of Knowledge: Middle level teacher candidates demonstrate the interdisciplinary nature of knowledge by helping all young adolescents make connections among subject areas. They facilitate relationships among content, ideas, interests, and experiences by developing and implementing relevant, challenging, integrative, and exploratory curriculum. They provide learning opportunities that enhance information literacy (e.g., critical thinking, problem solving, evaluation of information gained) in their specialty fields (e.g., mathematics, social studies, health).

Course Objectives and Outcomes

During this course, you will:

- become familiar with STEM and STEM education and the corresponding standards for middle grades teaching and learning
- Consider the careers that are STEM focused and what the middle grades students need to know and be able to do in those careers
- Develop a deep understanding of the nature of science, technology, engineering, and mathematics and how they are similar and different. How the nature of STEM reflects real world problems and solutions
- Gain experience in various types of learning and assessments through the course assignments and in reviewing middle grades curriculum

Course Reading Material/BlackBoard

There is no textbook for this course. Course readings can be found in Blackboard, course documents.

All readings will be posted on BB and you will be expected to access it frequently to post your own assignments and to post and read your classmates in the discussion board section.

Overarching principles of the Course

- This class is a community. To make it work, we ALL must be prepared and ready to participate every time we meet.
- Teachers need to learn to manage time both in and out of class. Therefore, you will be expected to hold to time constraints when presenting or contributing in class.
- Teachers are expected to be in school nearly every day and to be on time. Therefore, one excused absence is allowed under normal circumstances. After that, each absence will lower your grade, as will excessive lateness or leaving early.

Academic Integrity

By enrolling in this course, each student assumes the responsibility of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty and they are wrong. Academic misconduct could result in disciplinary action that may include suspension or dismissal.

Classroom Accommodations for Students with Disabilities

If you are a student with a documented disability who requires an academic adjustment, auxiliary aids, or similar accommodations, please contact the Office of Student Support Services at 410-455-3250.

Description of Assignments

Technical Paper on STEM Careers and Skills (20 pts.)

In this assignment, students will learn the difference between writing styles including creative writing, content specific writing, research papers, and technical writing. For this course, technical writing is defined as a means to convey specific information about a technical subject to a specific audience for a specific purpose. The words and graphics of technical writing are meant to be practical: that is, to communicate a body of factual information that will help an audience understand a subject or carry out a task (Markel, 1994).

This paper should be no less than 5 pages and no more than 7 pages and should focus on STEM careers in general and then focus on one specific career and present the information on 1) educational requirements, 2) salary projections, and 3) a review of the people who fill these careers both historically and presently. The successful paper will include all required content and be written in a clear, concise style.

Argument Paper on Nature of STEM (30 pts.)

An argument paper is specific to introducing a topic and presenting information from a variety of sources to defend a position about that topic. The topic for this paper is the nature of STEM. Class resources from the topics of the nature of science, technology, engineering and mathematics should be the starting point and a minimum of 5 additional resources must be used to defend the position. The conclusion of the paper needs to specifically define the nature of STEM education. The paper must be a minimum of 5 pages and a maximum of 7 pages.

Research Paper on Issues in STEM Education (30 pts.)

This paper should present information about a specific issue in STEM education. The paper should show all perspectives on the issue and conclude with the writer's own perspective. The research paper should have a minimum of 10 references. The final paper should be a minimum of 7 pages and a maximum of 10 pages. The issue must be approved by the instructor.

Concept Map on STEM Teaching and Learning (25 pts.)

For this assignment, students will be presented with concept mapping as a way to show learning on a specific topic. Students will work in pairs to construct a concept map on a topic that has been discussed in class. The topics must pertain to the teaching and learning of STEM in the middle grades classroom.

Critique of STEM Lesson Plan (30 pts.)

Students will have the opportunity to find published STEM lesson plans for middle grades and by using the Maryland State Department of Education's STEM Centric Lesson and Unit Checklist, each student will choose one lesson to critique based on the checklist. The final product for this assignment will be the completed checklist and a 2-page reflection on what was learned about published STEM lessons and criteria for the development of STEM lessons specifically at the middle grades level.

Reflection Paper on Implementation of STEM Education (15 pts.)

The reflection paper is a personal and subjective paper that includes students' own thoughts and understandings. This 2-page paper will provide students an opportunity to reflect on what they have learned in the course and what issues they feel they might have to address in terms of implementing STEM lessons in their own middle grades classrooms. The paper should be academic in tone and should be cohesive and organized.

Evaluating and Grading

Assignments and point distributions:

| <u>Assignments</u> | <u>Point Value</u> |
|--|--------------------|
| Technical Paper on STEM Careers and Skills | 20 points |
| Argument Paper on Nature of STEM | 30 points |
| Research Paper on Issues in STEM Education | 30 points |
| Concept Mapping on STEM teaching and learning | 25 points |
| Critique of STEM Lesson plan | 30 points |
| Reflection Paper on Implementation of STEM Education | 15 points |
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| Total Points | 150 points |

Class Schedule

| | In-class discussion and activities | Readings (To be discussed in class) |
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| Week 1 | What is STEM? What is the S – T – E – M? How is STEM different than the individual components? | Overview of Course Syllabus and assignments STEM Integration in K-12 Education: Status, Prospects, and an Agenda for Research Ch. 1 Introduction to STEM and STEM Education |
| Week 2 | What is science? What is the nature of science? How do scientists do science? What are the K-12 standards? | Teaching the nature of Science through process skills activities for grades 3-8 Chapter 1 What is Science? |
| Week 3 | What is engineering? What is | Engineering in K-12 Education: |

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| | the nature of engineering? How do engineers do engineering? What are the K-12 standards? | Understanding the Status and Improving the Prospects Chapter 2 What is Engineering? |
| Week 4 | What is mathematics? What is the nature of mathematics? How do mathematicians do math? What are the K-12 standards? | Concepts of Modern Mathematics Chapter 1 Mathematics in General |
| Week 5 | What is technology? What is the nature of technology? How do technologists do technology? What are the K-12 standards? | Technology Education: Learning by Design – Middle Grades Unit 1 The Nature of Technology |
| Week 6 | What are the careers in STEM? What real world applications and careers are in Middle Grades curriculum? Why does it matter? | |
| Week 7 | What are the similarities and differences of science and engineering? Why does it matter? | STEM lesson essentials, grades 3-8: Integrating Science, Technology, Engineering, and Mathematics Chapters 1&2 Integrating Engineering + Science in your classroom Chapters 1 & 2 |
| Week 8 | What is STEM education? Why STEM education? What are the K-12 standards? | STEM lesson essentials, grades 3-8: Integrating Science, Technology, Engineering, and Mathematics Chapter 3 |
| Week 9 | What are the 21 st Century Learning Skills? What are the MSDE STEM Standards of Practice? How do the standards come together? | Handouts Next generation Science Standards for States, by States: Volume 1: The Standards-arranged by disciplinary core ideas and by topics Introduction and various middle grades standards |
| Week 10 | How do we do STEM education? How were you taught in K-12 schools? What do you know about adolescents and how they learn? | Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics Chapters 1& 2 Integrating Engineering + Science in your classroom Chapter 2 |
| Week | What is inquiry-based | STEM lesson essentials, grades 3-8: |

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| 11 | teaching? What are levels of inquiry-based teaching and learning? | Integrating Science, Technology, Engineering, and Mathematics Chapter 6 |
| Week 12 | What is project-based learning? How is it different? | STEM Integration in K-12 Education: Status, Prospects, and an Agenda for Research Chapters 2 -4 Article: Seven Essentials for Project-Based Learning Educational Leadership 2010 |

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| Week 13 | Challenge-Based teaching and learning – how is it different from PBLs? | Article: Challenge Based Learning A Classroom guide 2011 |
| Week 14 | What is reflective teaching? Facilitator as teacher? | STEM lesson essentials, grades 3-8: Integrating Science, Technology, Engineering, and Mathematics Chapter 14 |
| Week 15 | Bringing it all together | |

References of Course Materials:

Bell, R. L. (2008). *Teaching the nature of Science through process skills activities for grades 3-8*. New York, NY: Pearson Education.

Brunsell, E. (ed.). (2012). *Integrating Engineering + Science in your classroom*. Arlington, VA: ASTA Press.

Enderle, P. J., Bickel, R., Gleim, L., Granger, E., Grooms, J., Hester, M., ... Southerland, S. A. (2015). *Argument-driven inquiry in life science: Lab investigations for grades 6-8*. Arlington, VA: ASTA Press.

Hacker, M. & Burghardt, D. (2004). *Technology Education: Learning by Design –Middle Grades*. Pearson Publishing.

Markel, M. (1994) *Writing in the Technical Fields: A Step-by-Step Guide for Engineers, Scientists, and Technicians*. Wiley Interscience.

NGSS Lead States. (2013). *Next generation Science Standards for States, by States: Volume 1: The Standards-arranged by disciplinary core ideas and by topics*. Washington, DC: The National Academes Press.

NGSS Lead States. (2013). *Next generation Science Standards for States, by States: Volume 2: Appendixes*. Washington, DC: The National Academes Press.

Steward, I. (2015) *Concepts of Modern Mathematics*. Dover Publications.

Vasquez, J. A., Sneider, C. & Comer, M. (2013). *STEM lesson essentials, grades 3-8: Integrating Science, Technology, Engineering, and Mathematics*. Portsmouth, NH: Heinemann.

Zorfass, J. M. & Copel, H. (1998). *Teaching middle school students to be active researchers*. Alexandria, VA: ASCD.