STEM - Science, Technology, Engineering, and Mathematics Education

SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS EDUCATION Courses

STEM 101. Step 1 – Inquiry Approaches to Teaching STEM. 1 Credit.
Step 1 provides mathematics and science students with the opportunity to explore teaching in a realistic classroom environment. Master teachers introduce students to examples of high-quality inquiry-based lessons and model the pedagogical concepts to which they are being introduced. In Step 1, with the guidance of the master teacher, students design, observe, critique, and then teach a lesson in a real classroom. A criminal background check will be required as part of this course.

STEM 102. Step 2 - Inquiry Based STEM Lesson Design. 1 Credit.
This course continues the exploration of inquiry-based lesson design in STEM education. In this course, students build upon and practice lesson design skills developed in Step 1 while also becoming familiar with exemplary mathematics or science curricula at the middle school level. With the guidance of the master teacher, students engage in one observation and prepare and teach three inquiry-based lessons in a middle school classroom. Students incorporate and demonstrate their content knowledge in developing the inquiry-based lessons. At the end of Step 2, students are generally ready to make a decision about whether they want to pursue a pathway to teacher licensure through the MonarchTeach program. Prerequisites: a grade of C or higher in STEM 101.

STEM 110T. Technology and Your World. 3 Credits.
An overview of the resources and systems of technology. Emphasis is on the impacts that technology has on individuals and their careers. Activities explore the evolution of technology, its major systems and their impact on individuals and their careers.

STEM 201. Knowing and Learning in STEM Education. 3 Credits.
This course is designed to expand the students’ understanding of current theories of learning and conceptual development in STEM. Students will investigate theories of knowing and learning in STEM and implications for teaching secondary mathematics and science. Students will examine their own assumptions about learning as well as critically examine the needs of a diverse student population in the classroom. Students are expected to independently register for and take the Praxis I examination while enrolled in this course. Pre- or corequisite: STEM 102.

STEM 202. Classroom Interactions in STEM Education. 3 Credits.
This course provides students with an overview of principles for teaching middle and secondary school mathematics or science through an exploration of the role of content, pedagogy, curriculum and technology as they promote learning and impact equity. Students are introduced to ways in which curriculum and technology are used in the classroom to build interrelationships among teachers and students. Frameworks for teaching students of diverse backgrounds equitably are emphasized in the course. A field component that consists of observations and teaching in the high school classroom is included. Pre- or corequisite: STEM 201.

STEM 221. Industrial Materials. 3 Credits.
A study of materials used by industry to produce products. Emphasis is on the study of ceramics, plastics, composites, and biotechnological materials. Students learn materials identification, use and processing.

STEM 231. Materials and Processes Technology. 3 Credits.
A study of the production processes used with metallic and forest product materials. Industrial resources, their location, extraction, and processing into standard stock are also covered. Students learn properties, uses and processing of metal and wood materials.

STEM 241. Energy Systems: Basic Electricity. 3 Credits.
A study of direct and alternating current and its use in contemporary technology. Activities include experiments and projects to supplement the theory of electricity.

STEM 242. Technological Systems Control. 3 Credits.
Students will develop an understanding of systems control technology for application to energy and power, manufacturing, processing and transportation systems. Emphasis will be placed on research and development, creativity and experimentation, and trouble shooting in designing control systems.

STEM 251G. Computer Literacy: Communication and Information. 3 Credits.
A guided review of communication technology and information sources to help students discern between reliable and unreliable sources and techniques. Students develop skills in computer applications, information retrieval, filtering and analyzing data, and formatting and presenting information.

STEM 301. STEMPs Writing. 1 Credit.
This course covers the elements of effective writing along with identifying editing strategies to correct errors. Prerequisite: 58 total credit hours, completion of General Education Written Communication requirement, and declared major in STEM Education and Professional Studies.

STEM 305. Curriculum for Technology Education. 3 Credits.
National and state trends in instructional content are analyzed. Course content, activities, and facilities are planned. Competency-based and standards-based educational methods are stressed. Prerequisites: STEM 251G and junior standing.

STEM 306. Methods for Technology Education. 3 Credits.
A practical study and application of recommended methods for teaching technology education. Students plan and present micro-lessons; videotaped micro-teaching demonstrations are included. They also learn to organize student organizations and plan for laboratory management. Prerequisites: STEM 251G and junior standing.

STEM 320. Manufacturing and Construction Technology. 3 Credits.
A study of production processes used in manufacturing and construction systems. Students will research and design manufactured products for mass production and constructed products for building. The social, cultural, environmental and economic impacts of manufacturing and constructed products on society are discussed. Prerequisites: STEM 221, STEM 231 or permission of instructor.

STEM 321. Manufacturing Technology. 3 Credits.
A study of the production processes used in manufacturing systems. Emphasis is placed upon planning, organizing and principles of manufacturing. Students research and design enterprise systems for mass production. Emphasis is on manufacturing design requirements and the social, cultural, and economic impacts of manufactured products on society and the environment. Prerequisites: STEM 221, STEM 231 or permission of instructor.

STEM 322. Construction Technology. 3 Credits.
A study of the production processes used in construction systems. Emphasis is placed upon planning, organizing and constructing correlated projects and activities in the study of construction. Prerequisites: junior standing or permission of instructor.

STEM 330. Medical, Agricultural, and Biological Technologies. 3 Credits.
A course for technology education majors that studies technological systems related to medical and food processing technologies. Students learn the basis of these technologies and complete activities that integrate the content with processes and products found in our technological world. Prerequisite: junior standing or permission of department.

STEM 350. Communication Technology Processes. 3 Credits.
The study of communication design principles and techniques for technology education. Emphasis is placed on the skills and equipment used in design, production, and distribution of communications. Print and electronic media are explored through technical illustration, video, audio, and other specialty processes of communications. Prerequisite: STEM 251G.
STEM 351, Communication Technology. 3 Credits.
A study of the development and impact of communication technology. Emphasis is placed on the integration of technical skills to produce information-based products such as print and telecommunications media. Prerequisite: junior standing or permission of the instructor.

STEM 355, STEM Education Grades 6 Through 8. 3 Credits.
This course prepares educators to use research-based methods for integrating science, technology, engineering, and mathematics (STEM) in the 6-8 classroom. Emphasis is placed on standards for the STEM disciplines, the development of contextual learning units, and classroom/laboratory instructional strategies. This course contains a 45-hour practicum experience at the middle school level. Prerequisite: junior standing.

STEM 360, Energy, Power, and Transportation Technologies. 3 Credits.
Study of the development of energy, power, and transportation systems and the movement of energy, power, people, and cargo. Areas of concern include vehicle systems design and support systems. Prerequisite: junior standing or permission of the instructor.

STEM 367, Cooperative Education. 1-3 Credits.
Available for pass/fail grading only. Student participation for credit based on the academic relevance of the work experience, criteria, and evaluative procedures as formally determined by the department and the Cooperative Education program prior to the semester in which the work experience is to take place. (Qualifies as a CAP experience) Prerequisites: approval by the department and Career Development Services, in accordance with the policy for granting credit for Cooperative Education programs.

STEM 370T, Technology and Society. 3 Credits.
A multidisciplinary course designed to provide insight into the fundamental, historical, and contemporary nature of technology as an area of human knowledge. Attention is given to the positive and negative aspects of technology and how they affect society. (This is a writing intensive course.) Prerequisites: grade of C or better in ENGL 211C or ENGL 221C or ENGL 231C; junior standing or permission of the instructor.

STEM 382, Industrial Design. 3 Credits.
Students will analyze and design products representative of today's industrial technological society. Emphasis will be placed upon design methodology, aesthetic value, and design thinking. Prerequisites: junior standing.

STEM 386, Architecture. 3 Credits.
A course designed to apply principles of space planning, architectural construction techniques, and energy-efficient building methods as they apply to residential and commercial structures. Prerequisite: junior standing.

STEM 401, Project Based Instruction in STEM Education. 3 Credits.
Through a dynamic process of investigation and collaboration, students aim to master techniques for project-based investigations in STEM classrooms, and teach project-based lessons in the secondary classroom. Students work in teams to formulate questions, make predictions, design investigations, collect and analyze data, make products and share ideas. The use of assessments to improve student learning is emphasized in the course. This course includes a field component that consists of two observation days and three teaching days in a secondary classroom. Prerequisite: STEM 201.

STEM 402, Perspectives on STEM. 3 Credits.
This course explores the historical, social, and philosophical implications of mathematics and science through investigations of significant episodes in their history. Students are brought to understand that science and mathematics are not merely body of facts, theories, and techniques but involve diverse processes by which they are continually generated and reformulated. Corequisite: STEM 485.

STEM 417, Exploring Technology and Modern Industry. 3 Credits.
A course designed to explore technological systems and new developments in technology education. Emphasis is on middle schools. Prerequisites: STEM 251G and junior standing or permission of the instructor.

STEM 433/533, Developing Instructional Strategies PreK-6: Mathematics. 3 Credits.
Following a theory into practice philosophy, students explore, develop, and use instructional strategies, materials, technologies, and activities to promote children's development of attitudes, behaviors, and concepts in mathematics in grades PreK-6 in support of NCTM national instructional standards and the Virginia Standards of Learning. Prerequisites: TLED 301 or TLED 290 and TLED 430.

STEM 434/534, Developing Instructional Strategies PreK-6: Science. 3 Credits.
Following a theory into practice philosophy, students explore, develop, and use instructional strategies, materials, technologies, and activities to promote children's development of attitudes, behaviors, and concepts in science in grades PreK-6 in support of AAAS national instructional standards and the Virginia Standards of Learning. Prerequisites: TLED 301 or TLED 290 and TLED 430.

STEM 453/553, Developing Instructional Strategies for Teaching in the Middle/High School: Mathematics. 3 Credits.
Following a theory/research-into-practice philosophy, students explore, develop, and use instructional strategies, materials, technologies, and activities to promote the development of attitudes, behaviors, and concepts in mathematics, grades 6-12, in support of national instructional standards and the Virginia Standards of Learning; 35 hours of teaching practicum required. Corequisite: TLED 483. Prerequisites: TLED 301 or TLED 290, TLED 430, SPED 313, passing scores on PRAXIS I or equivalent SAT scores as established by VA Board of Education, a criminal background check, acceptance into teacher education, grade requirement in the specific content area and professional education core, minimum major and overall GPA of at least 2.75.

STEM 454/554, Developing Instructional Strategies for Teaching in the Middle/High School: Science. 3 Credits.
Following a theory/research-into-practice philosophy, students explore, develop, and use instructional strategies, materials, technologies, and activities to promote the development of attitudes, behaviors, and concepts in science, grades 6-12, informed by national instructional standards and the Virginia Standards of Learning; 35 hours of teaching practicum required. Corequisite: TLED 483. Prerequisites: TLED 301 or TLED 290 and TLED 430, SPED 313, passing scores on PRAXIS I or equivalent SAT scores as established by VA Board of Education, a criminal background check, acceptance into teacher education, grade requirement in the specific content area and professional education core, minimum major and overall GPA of at least 2.75.

STEM 455, STEM Education Grades 9 Through 12. 3 Credits.
This course prepares educators to use research-based methods for integrating science, technology, engineering, and mathematics (STEM) in the 9-12 classroom. Emphasis is placed on Virginia's Standards of Learning (SOLs), technology education competencies, and program planning. This course contains a 45-hour practicum experience at the high school level. Prerequisite: junior standing.

STEM 471/571, Communication Industries. 3 Credits.
A course designed to provide career and technical education teachers, industrial technologists, counselors, and administrators an opportunity to observe and enhance their knowledge of representative communication industries from the local region. (Qualifies as a CAP experience) Prerequisite: junior standing and industrial technology major.

STEM 472/572, Construction Industries. 3 Credits.
A course designed to provide career and technical education teachers, industrial technologists, counselors, and administrators an opportunity to observe and enhance their knowledge of representative construction industries from the local region. (Qualifies as a CAP experience) Prerequisite: junior standing and industrial technology major.

STEM 473/573, Manufacturing Industries. 3 Credits.
A course designed to provide career and technical education teachers, industrial technologists, counselors, and administrators an opportunity to observe and enhance their knowledge of representative manufacturing industries from the local region. (Qualifies as a CAP experience) Prerequisite: junior standing and industrial technology major.
A course designed to provide career and technical education teachers, industrial technologists, counselors, and administrators an opportunity to observe and enhance their knowledge of representative service industries from the local region. (qualifies as a CAP experience) Prerequisite: junior standing and industrial technology major.

**STEM 475/575. Transportation Industries. 3 Credits.**
A course designed to provide career and technical education teachers, industrial technologists, counselors, and administrators an opportunity to observe and enhance their knowledge of representative transportation industries from the local region. (qualifies as a CAP experience) Prerequisite: junior standing and industrial technology major.

**STEM 485. Apprentice Teaching. 9 Credits.**
Internship in school. Available for pass/fail grading only. Offers prospective teacher candidates a culminating experience that provides them with the tools needed for their first teaching jobs. Students are immersed in a local secondary school for 10 consecutive weeks and experience the expectations, processes, and rewards of teaching. As part of their Apprentice Teaching experience, candidates will be required to attend a one hour weekly seminar that will bring them together with master teachers to share experiences and to explore issues, problems, concerns, and processes related to their teaching experiences and to entering the profession of teaching. Corequisite: STEM 402. Prerequisites: Completion of all course work in the MonarchTeach professional development sequence program and BIOL 468W or CHEM 468 or OEAS 468W or PHYS 468W or SCI 468, passing scores on PRAXIS I or equivalent SAT or ACT scores as established by VA Board of Education, passing scores on the appropriate PRAXIS II content examination and the Virginia Communication and Literacy Assessment, departmental approval, minimum major and overall GPA of at least 2.75 and a criminal background check.

**STEM 486/586. Middle School Student Teaching for Technology Education. 6 Credits.**
Classroom placement for student teaching in a middle school technology laboratory. Students apply content and methodology under the supervision of a cooperating teacher and university faculty member. Available for pass/fail grading only. (Qualifies as a CAP experience.) Prerequisites: Passing scores on PRAXIS I or State Board of Education-approved SAT or ACT scores, passing scores on the appropriate PRAXIS II content examination and STEM 305, STEM 306, SEPS 408, SEPS 450, SPED 313, and TLED 408.

**STEM 488. High School Student Teaching for Technology Education. 6 Credits.**
Classroom placement for student teaching in a high school technology laboratory. Students apply content and methodology under the supervision of a cooperating teacher and university faculty member. Available for pass/fail grading only. (Qualifies as a CAP experience) Prerequisites: STEM 305, 306; SEPS 408, SEPS 450; SPED 313; TLED 408 and passing scores on PRAXIS I or State Board of Education-approved SAT or ACT scores, and passing scores on the appropriate PRAXIS II content examination.

**STEM 495/595. Topics. 1-3 Credits.**
The advanced study of selected topics designed to permit small groups of qualified students to work on subjects of mutual interest which, due to their specialized nature, may not be offered regularly. These courses will appear in the course schedule. Prerequisite: permission of the instructor.

**STEM 533. Developing Instructional Strategies PreK-6: Mathematics. 3 Credits.**
Following a theory into practice philosophy, students explore, develop, and use instructional strategies, materials, technologies, and activities to promote children’s development of attitudes, behaviors, and concepts in mathematics in grades PreK-6 in support of NCTM national instructional standards and the Virginia Standards of Learning. Prerequisites: TLED 617.

**STEM 534. Developing Instructional Strategies PreK-6: Science. 3 Credits.**
Following a theory into practice philosophy, students explore, develop, and use instructional strategies, materials, technologies, and activities to promote children’s development of attitudes, behaviors, and concepts in science in grades PreK-6 in support of AAAS national instructional standards and the Virginia Standards of Learning.

**STEM 553. Developing Instructional Strategies for Teaching in the Middle/High School: Mathematics. 3 Credits.**
Following a theory/research-into-practice philosophy, students explore, develop, and use instructional strategies, materials, technologies, and activities to promote the development of attitudes, behaviors, and concepts in mathematics, grades 6-12, in support of national instructional standards and the Virginia Standards of Learning; 35 hours of teaching practicum required. Prerequisites: TLED 617 or TLED 677, passing scores on PRAXIS I or equivalent SAT scores as established by VA Board of Education, a criminal background check, acceptance into teacher education, grade requirement in the specific content area and professional education core, minimum major and overall GPA of at least 2.75; additional prerequisites for MCTP students are TLED 608 and TLED 616.

**STEM 554. Developing Instructional Strategies for Teaching in the Middle/High School: Science. 3 Credits.**
Following a theory/research-into-practice philosophy, students explore, develop, and use instructional strategies, materials, technologies, and activities to promote the development of attitudes, behaviors, and concepts in science, grades 6-12, informed by national instructional standards and the Virginia Standards of Learning; 35 hours of teaching practicum required. Prerequisites: TLED 617, or TLED 677, passing scores on PRAXIS I or equivalent SAT scores as established by VA Board of Education, a criminal background check, acceptance into teacher education, grade requirement in the specific content area and professional education core, minimum major and overall GPA of at least 2.75; additional prerequisites for MCTP students are TLED 608 and TLED 616.

**STEM 571. Communication Industries. 3 Credits.**
A course designed to provide career and technical education teachers, industrial technologists, counselors, and administrators an opportunity to observe and enhance their knowledge of representative communication industries from the local region. (qualifies as a CAP experience).

**STEM 572. Construction Industries. 3 Credits.**
A course designed to provide career and technical education teachers, industrial technologists, counselors, and administrators an opportunity to observe and enhance their knowledge of representative construction industries from the local region. (qualifies as a CAP experience).

**STEM 573. Manufacturing Industries. 3 Credits.**
A course designed to provide career and technical education teachers, industrial technologists, counselors, and administrators an opportunity to observe and enhance their knowledge of representative manufacturing industries from the local region. (qualifies as a CAP experience).

**STEM 574. Service Industries. 3 Credits.**
A course designed to provide career and technical education teachers, industrial technologists, counselors, and administrators an opportunity to observe and enhance their knowledge of representative service industries from the local region. (qualifies as a CAP experience).

**STEM 575. Transportation Industries. 3 Credits.**
A course designed to provide career and technical education teachers, industrial technologists, counselors, and administrators an opportunity to observe and enhance their knowledge of representative transportation industries from the local region. (qualifies as a CAP experience).

**STEM 586. Middle School Student Teaching for Technology Education. 6 Credits.**
Classroom placement for student teaching in a middle school technology laboratory. Students apply content and methodology under the supervision of a cooperating teacher and university faculty member. Available for pass/fail grading only. (Qualifies as a CAP experience) Prerequisites: STEM 573.

**STEM 595. Topics. 1-3 Credits.**
The advanced study of selected topics designed to permit small groups of qualified students to work on subjects of mutual interest which, due to their specialized nature, may not be offered regularly. These courses will appear in the course schedule.
STEM 651. Differentiation of Mathematics Instruction for Diverse Student Populations. 3 Credits.
Lecture 3 hours, 3 credits. Adapting the mathematics teaching and learning practices to accommodate diverse populations will be explored. The essential knowledge and understanding needed by mathematics specialists to assist classroom teachers in effectively utilizing differentiated instruction will be highlighted.

STEM 653. Mathematics in the Elementary/Middle School. 3 Credits.
Lecture 3 hours; 3 credits. Presents an overview of the content and structure of the various mathematics curricula. Methods of teaching mathematics in the elementary and middle school are introduced with special emphasis on technology in the mathematics classroom.

STEM 654. Science in the Elementary/Middle School. 3 Credits.
Lecture 3 hours; 3 credits. Current developments and educational research are applied to instructional methodology with an emphasis on hands-on activities in the school science curriculum.

STEM 655. Culturally Responsive Classroom. 3 Credits.
Lecture 3 hours, 3 credits. This course will focus on the following elements of effective teaching practice: understanding discipline specific content and methods, employing best-practice strategies to teach discipline specific skills and concepts, assessing student learning, legal and safety issues, use of technology, issues of diversity, engagement with the community, and strategies for continuing to grow as a teacher and learner.

STEM 660. Action Research for Mathematics Specialists. 3 Credits.
Lecture 3 hours; 3 credits. Departmental approval required. Action Research is introduced as a means to conduct classroom-based studies in the context of mathematics. The practical nature of research methods that mathematics specialists can use in conjunction with their mathematics instructional program is emphasized.

STEM 661. Mathematics Specialists as Teacher Leaders. 3 Credits.
Lecture 3 hours, 3 credits. The critical characteristics and responsibilities of Mathematics Specialists as teacher leaders will be explored. Structuring classroom assistance through peer coaching, mentoring, observations and conferencing will be highlighted to expand the prospective Mathematics Specialists' leadership capacity.

STEM 662. Mathematical Assessment for Data Driven Decisions. 3 Credits.
Lecture 3 hours, 3 credits. Selected key differences between assessment for and of learning will be examined as a means to provide rich descriptions of student learning. Designing and using quality assessment systems to inform instructional decisions and guide student learning will serve as a framework for Mathematics Specialists.

STEM 668. Internship for Mathematics Specialist. 3 Credits.
Prerequisites: MATH 303 and MATH 335. An internship experience that provides mathematics specialists an opportunity to develop the necessary knowledge, skills and dispositions to impact and improve the mathematics program of schools. Requires 150 hours of internship.

STEM 720. STEM Educational Foundations. 3 Credits.
Lecture, 3 hours; 3 credits. A multidisciplinary course designed to provide insights about the fundamental concepts and basis for STEM education programs. Standards for the school subjects of science, technology, engineering education and mathematics literacy will be reviewed. Connections between these subjects will be explored.

STEM 721. Science, Technology, Engineering, and Mathematics Connection and Integration. 3 Credits.
Lecture, 3 hrs. 3 credits. Prerequisite: STEM 720 or 820. A course designed to teach how to plan integrated STEM curriculum and instructional materials. A review of projects that have undertaken STEM integration will be made. Students will learn how to map STEM content and then design STEM integrated curriculum and instructional materials.

STEM 723. Technical Systems. 3 Credits.
3 credits. Analyze the technical concepts common and unique to the technical systems of technology.

STEM 732. Program Development for Technology Education. 3 Credits.
3 credits. Plan and develop effective program in technology related activities. Focus is on identification and development of resources, activities, and materials for classroom programs.

STEM 795. Topics. 1-3 Credits.

STEM 820. STEM Educational Foundations. 3 Credits.
Lecture, 3 hours; 3 credits. A multidisciplinary course designed to provide insights about the fundamental concepts and basis for STEM education programs. Standards for the school subjects of science, technology, engineering education and mathematics literacy will be reviewed. Connections between these subjects will be explored.

STEM 821. Science, Technology, Engineering, and Mathematics Connection and Integration. 3 Credits.
Lecture, 3 hrs. 3 credits. Prerequisite: STEM 720 or 820. A course designed to teach how to plan integrated STEM curriculum and instructional materials. A review of projects that have undertaken STEM integration will be made. Students will learn how to map STEM content and then design STEM integrated curriculum and instructional materials.

STEM 830. Introduction to Technology. 3 Credits.
3 credits. Order and structure the discipline of technology by identifying and analyzing the component parts and examining technical means as critical variables in the affairs of humankind. Based on the Standards for Technological Literacy.

STEM 831. Technical Systems. 3 Credits.
3 credits. Analyze the technical concepts common and unique to the technical systems of technology.

STEM 832. Program Development for Technology Education. 3 Credits.
3 credits. Plan and develop effective program in technology related activities. Focus is on identification and development of resources, activities, and materials for classroom programs.

STEM 895. Topics. 3 Credits.