

# Mathematics

## I. Knowing the Content

The professional education program provides evidence that Mathematics certification candidates complete a program of Mathematics studies the same as the academic area content courses and required electives of a major in a bachelors' degree. The program shall require the candidates to demonstrate a knowledge of and competence in teaching students Mathematics concepts and processes necessary for a teacher at the secondary level (7-12) including:

I.A. History of mathematics as a tool for life and the workplace, and in contexts as part of a cultural heritage.

I.B. Examination of theories, research and practices related to student learning and achievement in mathematics to increase the quality of mathematics teaching

I.C. Use of mathematical communication to:

- organize and consolidate mathematical thinking,
- explain mathematical thinking to other,
- analyze and evaluate strategies of others,
- express mathematical ideas precisely

I.D. Concepts of calculus including:

- differential and integral calculus,
- sequences and series,
- methods of integration,
- transcendental functions,
- polar coordinates,
- analytic geometry,
- multivariable derivatives and integrals

I.E. Number theory including:

- numbers, ways of representing numbers, relationships among numbers and number systems,
- meanings of operations and how they relate to one another

I.F. Functions including:

- generalize patterns using explicitly defined and recursively defined functions,
- properties of classes of functions; such as polynomial, rational, algebraic, exponential, logarithmic, and trigonometric functions,
- representing functions numerically, symbolically, graphically, and verbally

I.G. Geometry including:

- fundamental ideas of measurement and spatial visualization,
- nature of axiomatic reasoning,
- transformations, coordinates and vectors,

- trigonometry from a geometric perspective,
- use of technological tools in geometry
- Euclidean and non-Euclidean geometry

I.H. Linear algebra including:

- matrices,
- systems of linear equations,
- vector spaces,
- linear transformations,
- determinants,
- eigenvalues

I.I. Abstract algebra including:

- structures, properties and examples of groups, rings, and fields,
- relevance of algebraic properties in the study of number systems

I.J. Probability and statistics including:

- measures of central tendency and variability,
- axioms of probability,
- properties of discrete and continuous probability,
- discrete and continuous probability distributions,
- statistical inference

I.K. Discrete mathematics including:

- logic, sets, relations and functions,
- mathematical induction,
- elementary graph theory,
- permutations and combinations

I.L. Mathematical modeling of physical, biological, social, psychological or conceptual entities

I.M. Fundamental concepts and methodologies of analysis, including rigorous definitions and proofs of theorems including:

- make and investigate mathematical conjectures,
- develop and evaluate mathematical arguments

I.N. Enhancement of the learning of mathematical concepts through instructing students in the effective and appropriate use of technology (graphing calculators, computer software etc.), as well as other computational tools

## **II. Performances**

The professional education program provides evidence of the candidates participation in sequential and developmental field experiences and student teaching, under the supervision of college personnel and cooperating teachers who are well trained in mathematics, have interpersonal skills and demonstrated competence in teaching. The program also provides

evidence that the criteria and competencies for exit from the Mathematics certification program are assessed in coursework, field experiences and student teaching and require candidates to demonstrate their knowledge and competence in fostering student learning through:

II.A. Managing the instructional environment in order to:

- communicate challenging learning expectations to each student,
- establish and maintain rapport with students and promote mutual respect among students,
- instill in all students a belief that they can succeed in mathematics,
- establish and maintain consistent standards of classroom behavior,
- make the physical environment safe and conducive to learning,
- model school to career attributes and behaviors

II.B. Long-range and short-range planning of instruction, done independently and in collaboration with other educators, based upon:

- mathematics subject matter,
- students and the community,
- Pennsylvania Academic Standards, content analysis with specific objectives,
- instructional methods, including materials and activities,
- results of student assessments

II.C. Selecting, adapting and implementing a variety of instructional strategies ranging from computational exercises to complex problem solving to “essay-style” homework, class assignments, projects, and utilizing traditional tools as well as modern technologies

II.D. Selecting, analyzing, and modifying instructional materials to meet the needs of diverse learners

II.E. Assessing and evaluating student’s conceptual understanding of content through a variety of contextual settings, providing formative feedback to align instructional strategies assist to individual student needs

### **III. Professionalism**

The professional education program provides evidence that each teacher certification candidate demonstrate knowledge and competencies that foster professionalism in school and community settings including:

III.A. Professional organizations, journals, and other resources for professional development

III.B. Integrity and ethical behavior, professional conduct as stated in Pennsylvania’s Code of Professional Practice and Conduct for Educators; and local, state, and federal laws and regulations

III.C. Establish collaborative relationships with colleagues of the elementary, secondary and higher education levels to improve student learning

III.D. Communicate effectively with parents or guardians, other agencies and the community at large to support learning by all students