National Academic Reference Standards For Mathematics (NARS For Mathematics)

Mathematics is one of the oldest and most fundamental sciences. It constitutes a body of established facts, achieved by reliable methods, verified by practice, and agreed on by qualified experts. Mathematicians advance mathematical knowledge by developing new principles and recognizing previously unknown relationships between existing principles of mathematics.

Mathematicians also use theories and techniques, such as mathematical modeling and computational methods to formulate and solve practical problems. Students of mathematics programs to day bring a rich diversity of experiences. This diversity challenges educators to define clear goals and standards, develop effective instructional strategies, and present mathematics in appropriate contexts. Mathematics can be offered as a single program, and also joint with other disciplines, such as statistics, computer science, physical applied mathematics, and theoretical physics.

Graduates of such programs are employed in a wide range of careers such as teaching and research jobs in a variety of educational institutions. Graduates also work with others as part of a team, in business, industry and commerce, to solve a variety of problems, such as translating mathematical situations into computational procedures, or designing mathematical models to predict the behavior of phenomena in a physical or a life science. The standards have to be built in a framework through which it will be reflected in performances to satisfy the main aims of the program. The framework of these standards should be consistent with frameworks presented in other mathematics reform initiatives and are intended to affect every aspect of a university mathematics program.

1. Attributes of a Mathematician

In addition to the general attributes of Basic Sciences graduates, the Mathematics graduates must be able to:

2.1.1. **Understand, recognize, and describe patterns and make abstractions about them.**

2.1.2. **Draw conclusions about the real world using mathematical concepts.2**

2.1.3. **Find true statements that can be made about mathematical objects.**

2.1.4. **Apply techniques, tools, and formulas to understand an object's attributes.**

2.1.5. **Recognize and use various types of reasoning and methods of proof.**

2.1.6. **Create and use representations to model and interpret mathematical ideas.**

2.1.7. **Recognize and understand how mathematical ideas inter connect and build on one another**

2. Knowledge and Understanding

The knowledge and understanding standards that follow are not meant to outline a set of courses. Rather, they are strands to be included in a mathematics program in whatever structural form it may take.

In addition to the knowledge and understanding acquired by Basic Sciences graduates, Mathematicians must acquire knowledge and understanding of:

2.2.1. **Numerical mathematics, and the different ways in which numerical information is used.**

2.2.2. **Abstract algebraic structures and their roles in solving problems expressed with symbols and in developing mathematical theories and techniques.**

2.2.3. **Mathematical methods and techniques that deal with differential equations and their applications.**

2.2.4. **Geometrical concepts, and processes used in measuring attributes of objects.**

2.2.5. **The concept of function, and its role in mathematical analysis.**

2.2.6. **Discrete mathematics, algorithms, and combinatorial abilities in order to solve problems of finite character and enumerate sets without direct counting.**

2.2.7. **Probability and statistical models to make inferences about real-world situations.**

2.2.8. **Modeling and symbolic representations of problem situations**

2.2.9. **The deductive nature of mathematics, and the roles of definitions, axioms, and theorems to identify and construct valid deductive arguments.**

2.2.10. **Theories and applications of other mathematical trends and/or applied mathematics and/or mathematical statistical and/or computer science.**

3. Practical and Professional skills

Graduates of Mathematics program must be able to:

2.3.1 **Apply reasoning techniques to build convincing mathematical arguments.**

2.3.2. **Develop conjectures and draw appropriate conclusions, and test these conjectures.**

2.3.3. **Identify required mathematics and other technical information independently.**

2.3.4. **Use technology to enhance mathematical thinking and understanding Conduct independent nontrivial exploration in mathematics.**

2.3.5. **Develop and reinforce tenacity and confidence in their abilities to use mathematics.**

4. Intellectual skills

Graduates of Mathematics program must be able to:

2.4.1. **Formulate mathematical ideas and procedures using appropriate mathematical vocabulary and notation.**

2.4.2. **Construct symbolic forms of problem situations through modeling real-world situations, develop and use the models to make predictions and informed decisions.**

2.4.3. **Recognize, compare, and transform mathematical objects.**

2.4.4. **Represent, abstract and interpret problems.**

2.4.5. **Develop connections within branches of mathematics and between mathematics and other disciplines.**

2.4.6. **Utilize appropriate processes in applied mathematical studies.**

2.4.7. **Judge the validity of mathematical arguments and the reasonableness of results.**