Foundations Hallmarks and Explanatory Notes Symbolic Reasoning (FS): 3 credits

FS Hallmarks and Explanatory Notes (Hallmarks in bold; Notes in italics)

Introduction: Courses in Symbolic Reasoning (FS) should present symbolism as a means to facilitate reasoning and not merely as a technique to represent course content. They should engage students in the active use and application of symbolic techniques, but should not present the use of symbolization strategies and techniques in a strictly mechanical way. Rather, they should focus on presenting concepts and tools of symbolic reasoning to further understanding of the course material. The majority of a FS course should address issues of symbolic reasoning, and impart an appreciation of the power and clarity that such reasoning brings to our thinking and understanding. Courses that apply for the FS designation should meet all six hallmarks.

To satisfy the Symbolic Reasoning requirement, a course will

1. expose students to the beauty, power, clarity and precision of formal systems.

- Students should understand the impact of formal or symbolic reasoning in its application to other disciplines and/or its historical place in civilization.
- An objective of the FS requirement is to enhance students' appreciation of abstraction and formal systems of analysis and to elevate their power of critical thinking through logical analysis and use of evidence.
- Students may be exposed to the power, clarity and precision of formal systems by reading and understanding proofs, derivations of formulae, or expositions of applications. Students may also be exposed to the power, clarity and precision of formal systems by constructing proofs (including symbolic proofs of validity), deriving formulas of appreciable applicability, or justifying the uses of applications in concrete context. In any of these situations, formal reasoning and/or symbolism should play a significant or essential role.
- The exposure to the beauty of formal systems can be provided by the presentation of elegant proofs, tricky, i.e., creative, applications of formulae, or the derivation of unexpected applications.

2. help students understand the concept of proof as a chain of inferences.

- A non-trivial component of the course should be deductive proof.
- Students should be required to demonstrate an understanding of the difference between a correct and incorrect proof.
- Students should understand the distinction between inductive and deductive, formal and informal reasoning.
- Students should be familiar with all aspects of basic argumentation: (1) the recognition of premises, given statements or hypothesis, (2) the recognition of the conclusion as well as noticing that a proof has appropriately come to an end since the conclusion has been justified, (3) the recognition of the application of the principles of logic to the premises, earlier steps or recognized truths to justify subsequent steps.
- Students should be able to construct formal arguments and be expected to justify most steps of an argument.

3. teach students how to apply formal rules or algorithms.

- Students should be able to correctly apply rules of a formal system.
- Students should be introduced to a process of applying formal rules, so that students will understand the importance of paying attention to detail and why precision is crucial, and how rule generation works in carrying out mechanical, logical, and/or computational procedures.
- 4. require students to use appropriate symbolic techniques in the context of problem solving, and in the presentation and critical evaluation of evidence.
 - Students should be able to recognize the elements, structure and standards of rigorous arguments and distinguish between correct and incorrect argument.
 - Students should be able to recognize appropriate and inappropriate use of words and symbolism, statements as opposed to meaningless sentences, valid and invalid arguments, as well as valid and invalid applications of symbolic reasoning.
- 5. include computational and/or quantitative skills.
 - Students should be challenged to use symbolic trails of reasoning not only minimally but in maximally efficient and elegant ways.
 - Students should not be simply trained in mechanical, computational or formulaic techniques.
 - The course will not focus solely on computational skills, i.e., the application of algorithmic processes leading to determinant answers.
- 6. build a bridge from theory to practice and show students how to traverse this bridge.
 - Students should be able to abstract from a real-world situation to formal, symbolic representation.
 - Students should be able to translate word problems or arguments into an appropriate symbolic formalism.
 - Students should see the development of a "useful" application from a theoretical or formal idea. In that development it should be made especially clear that the use of symbolism facilitated the exposition that lead from theory to practice.
 - Students will learn that arguments and procedures expressed in ordinary language can be checked with great precision by placing the reasoning patterns in symbolic form and manipulated via symbolic rules of inference.

Approved changes by Foundations Multicampus Group, April 13, 2012 rev. 9/14/12