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**University of Hawai'i at Manoa**  
**General Education Committee**  
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November 1, 2011

FROM: Joseph T. Jarrett  
Chair, General Education Committee

TO: Multi-Campus Foundations Board

Re: Proposal to include "Quantitative Skills" in explanatory notes for FS Hallmarks

The General Education Committee at UH Manoa requests that the Multi-Campus Foundations Board consider the attached proposal to change the explanatory notes for the FS Hallmarks to include an explicit requirement that an FS course must include a quantitative skills component.

There has been considerable concern and discussion within the UHM General Education Committee and Foundations Board regarding the fact that the Foundations Hallmarks do not explicitly require that FS courses include quantitative or computational skills. The faculty at UH Manoa have observed that incoming students often lack basic quantitative and mathematical skills, and the UHM GEC maintains that proficiency in quantitative skills should be a core educational requirement for all undergraduate students.

Moreover, during the recent WASC re-accreditation process, it became clear that WASC standards also require that all baccalaureate programs involve instruction in "college-level quantitative skills." To address this discrepancy, and to help improve the quantitative and mathematical skills of our graduates, we are proposing a minor change in the explanatory notes to the FS Hallmarks.

The effect of this change will be that future proposed FS courses must include a significant quantitative skills component before they will be recommended for approval by the UHM foundations board. There should be very little effect on our current course offerings, but we hope that the proposed change will influence future course proposals.

Since FS courses at all UH campuses must be articulated as specified in the UH Inter-Campus Articulation Agreement (E5.209), the Multi-Campus Foundations Board must review this proposal, and if approved, this change will apply to all participating campuses.

Please review the attached documents and let me know if you have any questions. We would appreciate a response by March 31, 2012 so that any approved changes could be made prior to the end of the academic year.

## **Proposal**

### Addition of an Explanatory Note to the FS Hallmarks Requiring “Quantitative Skills”

#### I. Proposed Changes

- A. The current FS Hallmarks will not be changed.
- B. The following additional explanatory note will be added as the first explanatory note under FS Hallmark 5:

**•The course must include college-level quantitative skills**

#### II. Rationale

Incoming students often are deficient in basic quantitative and mathematical skills. Quantitative skills are increasingly important in our technology driven world, with applications that include the obvious fields of mathematics, science, and engineering, but also include diverse fields such as economics and business, medicine, biostatistics and public health, social sciences, and education. Incoming students at UHM often have as little as two years of high school mathematics, which is not sufficient to prepare these students for the application of quantitative skills to their chosen vocation.

The current foundations requirements at UH Manoa include a requirement for one course that fulfills the Foundations – Symbolic Reasoning (FS) requirement. Although the FS Hallmarks are intentionally general to allow some interpretation of how courses can fulfill this educational mission, there is an implicit assumption that courses will teach mathematical principles and quantitative skills, in addition to advanced concepts such as proofs, rules and algorithms, and symbolic reasoning. This assumption is illustrated by the wording of FS Hallmark 5, which states that FS courses should “not focus solely on computational skills.”

The UH Manoa GEC and Foundations Board recognized that our current FS Hallmarks do not explicitly require quantitative skills, and courses that teach solely symbolic reasoning and logic with no quantitative component are currently approved as FS courses. However, after much discussion we agreed that an FS course could and should include exposure to quantitative skills *and* formal systems, proofs, rules and algorithms, and symbolic techniques. All of these requirements could be taught in a single, well-constructed foundations course.

Instruction in quantitative skills is also required by national accrediting agencies. The Western Association of Schools and Colleges (WASC) is the accrediting body for UH Manoa. WASC accreditation criteria explicitly state that:

Baccalaureate programs... ensure the development of core learning abilities and competencies including, but not limited to, college-level written and oral communications; **college-level quantitative skills**; information literacy; and the habit of critical analysis of data and argument. (*WASC CFR 2.2a, full text attached*)

We propose that a simple change in the explanatory notes to the FS Hallmarks, along with the appropriate enforcement of these Hallmarks and explanatory notes, will have the desired effect.

### III. Consequences

- A. Existing FS course designations will not be affected until those courses come up for 5-year re-approval.
- B. New course proposals and courses up for re-approval will need to include a significant quantitative component in the course syllabus and textbook or reading materials. Wherever possible, the Foundation Board will work with the instructor or department to counsel them on meeting the FS criteria. Courses that do not meet the FS Hallmarks and explanatory notes will not be approved.

## Foundations Hallmarks and Explanatory Notes

### Symbolic Reasoning (FS): 3 credits

#### FS Hallmarks & 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. not focus solely on computational skills.**

- ***The course must include college-level 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.*


**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.*

## **WASC CFR 2.2a - Baccalaureate Program Requirements**

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- Baccalaureate programs engage students in an integrated course of study of sufficient breadth and depth to prepare them for work, citizenship, and a fulfilling life. These programs also ensure the development of core learning abilities and competencies including, but not limited to, college-level written and oral communication; college-level quantitative skills; information literacy; and the habit of critical analysis of data and argument. In addition, baccalaureate programs actively foster an understanding of diversity; civic responsibility; the ability to work with others; and the capability to engage in life-long learning.
  - Baccalaureate programs also ensure breadth for all students in the areas of cultural and aesthetic, social and political, as well as scientific and technical knowledge expected of educated persons in this society. Finally, students are required to engage in an in-depth, focused, and sustained program of study as part of their baccalaureate programs.

### **2.2.2 General Education Requirements**

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- General Education requirements are integrated throughout the curriculum, including at the upper division level, consisting of a minimum of 68 quarter credits (see five domains outlined below), together with significant study in a given area of knowledge (typically described in terms of a major).
  - Undergraduate preparation (General Education and major) prepare students for citizenship and civic responsibility, appreciation for diversity, ability to work with others, quantitative skills, critical analysis, and life long learning. Program demonstrates how students acquire breadth of understanding in cultural, aesthetic, social and political areas.

### **2.2.3 General Education Domains**

- General Education Domains:
- Domain 1: Spiritual and Cultural Heritage (28-32 quarter credits)
- Domain 2: Scientific Inquiry and Analysis (24-32 quarter credits)
- Domain 3: Communication (9-13 quarter credits)
- Domain 4: Health and Wellness (2-6 quarter credits)
- Domain 5: Electives
- (Electives from the previous four domains may be selected to complete the general education minimum requirements of 68 quarter credits.)

## **WASC CFR 2.2b - Graduate Program Requirements**

Graduate programs are consistent with the purpose and character of their institutions; are in keeping with the expectations of their respective disciplines and professions; and are described through nomenclature that is appropriate to the several levels of graduate and professional degrees offered. Graduate curricula are visibly structured to include active involvement with the literature of the field and ongoing student engagement in research and/or appropriate high-level professional practice and training experiences. Additionally, admission criteria to graduate programs normally include a baccalaureate degree in an appropriate undergraduate program.

### **2.2.4 - International Programs Only**

International programs demonstrate that the curriculum is rooted in LLU's mission-focused learning as demonstrated by the LLU student learning outcomes.

### **2.2.5 - Program Alignment with University**

The program demonstrates how the university's mission is integrated/reflected in the mission, goals, objectives, and student learning outcomes of the program.