BOARD OF HIGHER EDUCATION

REQUEST FOR COMMITTEE AND BOARD ACTION

COMMITTEE: Assessment and Accountability **NO**.: AAC 09-17

COMMITTEE DATE: May 29, 2009

BOARD DATE: June 4, 2009

QUINSIGAMOND COMMUNITY COLLEGE
Associate in Science in Computer Science

MOVED: The Board of Higher Education hereby approves the request of **Quinsigamond Community College** to award the **Associate in Science in Computer Science**.

One year after graduating the program's first class, the College shall submit to the Board a status report addressing its success in reaching program goals as stated in the application and in the areas of enrollment, curriculum, faculty, resources and program effectiveness.

Authority: Massachusetts General Laws Chapter 15A, Section 9(b)

Contact: Dr. Francesca Purcell, Associate Commissioner for Academic and P-16 Policy

BOARD OF HIGHER EDUCATION

June 2009

Quinsigamond Community College

Associate in Science in Computer Science

Intent and Mission
Quinsigamond Community College (QCC) proposes a new Associate in Science in Computer Science (CS) program that will be housed in the Division of Business and Technology. The program is designed to prepare graduates for transfer to four-year institutions, where they can complete the baccalaureate degree prepared for careers in computer science, software engineering, and systems analysis. QCC faculty consulted with its main transfer institutions in the development of the proposed program to ensure strong transferability. The program meets requirements for the new statewide *MassTransfer* policy and has been favorably reviewed by faculty at Worcester Polytechnic Institute, University of Massachusetts Lowell, and Worcester State College.

The program goals are consistent with QCC's role as "a regional leader in education and workforce development" and will support QCC's mission "to serves the diverse educational needs of Central Massachusetts by providing affordable, accessible, and high-quality programming leading to transfer, career, or personal/professional enrichment."

The QCC Board of Trustees, at its meeting of June 11, 2008, approved the proposed program. A Letter of Intent was circulated on March 19, 2009. Massachusetts Bay Community College responded with support for the new program and noted that, while it resembles the MassBay Associate Degree Program in Computer Science, the proposed program at QCC distinguishes itself with a strong mathematics component, which will benefit program graduates.

Need and Demand
Research on regional and state labor market trends and employment opportunities for workers with computer information degrees indicated strong demand for graduates with a bachelor's degree in computer science. The *Occupational Outlook Handbook 2008-2009 Edition* predicts that "the computer scientists and database administrators occupation is expected to grow 37% from 2006 to 2016, much faster than average for all occupations." Likewise, job prospects for computer software engineers are strong with an expectation of growth by 38% through 2016.

The demand for the proposed program was identified through a recent survey of QCC students enrolled in computer systems engineering and computer information systems courses. The survey revealed that 53% percent of respondents plan to pursue a career in computer science, software engineering, or systems analysis, and 37% plan to study computer science at the bachelor's degree level.

Currently, there is no associate in science degree in computer science offered within Central Massachusetts. The proposed program intends to fill this void and offers potential transfer opportunities to baccalaureate programs at public institutions within the region, including Worcester and Fitchburg State Colleges, the University of Massachusetts Amherst, the University of Massachusetts Lowell, and independent institutions, such as Worcester Polytechnic Institute.

Curriculum (Attachment A)
Students will be required to complete 67 credits focused on computer science and mathematics, as well as general education courses. The program's learning outcomes were designed in accordance with accepted principles for undergraduate computer science programs and were crafted toward establishing articulation agreements with bachelor of science programs in computer science and for seamless transfer to four-year institutions. Table A correlates program learning outcomes with program courses:

Table A

Learning Objective	Required Course(s)
1. Acquire an intellectual understanding of and an appreciation for the central role of algorithms and data structures; recognize and use in practical programs the canonical algorithms and data structures; and evaluate their efficiency and effectiveness.	Programming with Data Structures (CSC 211)
2. Identify computer hardware from a software perspective – for example, use of the processor, memory, disk drives, display, etc. – and create low-level programs that use the hardware.	• Programming I (CSC 107) • Programming with Objects (CSC 207); • Introduction to Architecture and Assembly Language (CSC 208)
3. Understand and use design principles and programming paradigms, such as abstraction, decomposition, modularity, encapsulation, generics and inheritance.	• Programming I (CSC 107) • Programming with Objects (CSC 207) • Programming with Data Structures (CSC 211)
4. Design programs decomposed into communicating modules, and analyze and design the interfaces of these modules.	• Programming I (CSC 107) • Programming with Objects (CSC 207) • Programming with Data Structures (CSC 211)
5. Apply object-oriented design and basic software engineering principles to create robust software, and test their programs.	• Programming with Objects (CSC 207) • Programming with Data Structures (CSC 211)
6. Understand the possibilities and limitations of what computer technology (software, hardware, and networking) can and cannot do.	• Introduction to Architecture and Assembly Language (CSC 208) • Programming with Data Structures (CSC 211)
7. Understand and apply the concept of the lifecycle, including the significance of its phases (planning, development, deployment, and evolution); and the implications for the development of all aspects of computer-related systems (including software, hardware).	• Introduction to Architecture and Assembly Language (CSC 208) • Analytical Thinking with Programming (CSC 106) • Programming I (CSC 107) • Programming with Objects (CSC 207)
8. Understand and use the basic mathematical concepts and skills underlying the computer science field.	• Calculus I (MAT 233) • Calculus III (MAT 235) • Probability and Statistics for Engineers and Scientists (MAT 237) • Discrete Mathematics (MAT 125) • Lab Science I
9. Understand the basic principles of the scientific method.	Lab Science I
10. Use effective communication skills in documenting programming projects.	• English Composition and Literature I (ENG 101) • English Composition and Literature II (ENG 102)

Admission and Enrollment

Applicants must submit an official high school transcript or General Equivalency Diploma (GED) and several courses require prerequisites such as Introduction to English Composition, College Mathematics II: Trigonometry, and Introduction to Microcomputer Applications. Applicants who do not meet the minimum prerequisites may still be admitted to the program, but first need to take the necessary prerequisite courses. In addition, applicants must submit an official high school transcript or General Equivalency Diploma (GED).

In order to graduate, students must successfully complete all required course work and complete the program with a 2.0 GPA. Students seeking to transfer may be required to meet higher standards, based on the admissions criteria at the transfer institution.

QCC expects to enroll 20 FTE in the first year with a goal of 40 FTE annually. Enrollment of Asian, Black, and Hispanic students in the proposed program's engineering counterpart—the Associate in Science in Basic Engineering—has increased from 22 percent in fall 2006, to 33 percent in fall 2008. QCC anticipates a similar trend for the proposed CS program, thereby broadening participation and completion by underrepresented and underserved groups.

Program Enrollment Projections

	# of Students Y1	# of Students Y2	# of Students Y3	# of Students Y4
New Full Time	20	20	20	20
Continuing Full Time		18	18	18
New Part Time				
Continuing Part Time				
Totals	20	38	38	38

Resources and Budget (Attachment B)

The proposed CS program will be housed in the Division of Business and Technology, which currently administers twelve degree and certificate programs. QCC proposes to hire one full-time faculty member to meet the instructional demands of the proposed program. He/she will share instructional responsibilities for computer science and upper-level mathematics courses with Professor Rafael Vicente, Professor of Mathematics and principal architect of the proposed Computer Science program. This new faculty member will serve as the Program Coordinator and report to the Dean for Business and Technology. Costs for adjunct instructors and tutoring are also included in the budget. Necessary administrative staffing is in place and sufficient to meet the demands of the new program.

The proposal requests a start-up investment for library materials. In the four-year horizon, library acquisitions and on-going marketing efforts are included in order to support the program. The College's IT infrastructure and facilities will support the new program and new students.

In concert with Dr. Michael Gennert of Worcester Polytechnic Institute, QCC is exploring the feasibility of employing upper-division computer science students from WPI to provide subject matter tutoring in related QCC Computer Science courses. While these discussions have been preliminary to date, the potential may include both on-ground and on-line tutorial assistance.

The revenue assumptions in the attached budget are based upon an enrollment of 20 students per year; that is, QCC expects 20 students in Year 1 and an additional cohort of 20 students joining in Year 2, totaling 40 students enrolled in the program. The proposal incorporates a 10 percent withdrawal rate, resulting in 18 continuing students in the second year of the program. Each student will enroll in 34 credits per year. The current tuition rate of $24 per credit is assumed to continue. Each student will pay an educational service fee, projected at $128 per credit; an annual program fee of $700; and other fees (e.g., registration, student ID, technology), totaling $245 per year. While no revenue is projected from "Grants" in the initial budget, QCC expects to pursue grant funding to supplement and enhance the introduction and on-going development of the Computer Science program.

Program Goals and Objectives
The primary goal of the proposed CS program is to prepare students for transfer to four-year institutions, where they will complete the baccalaureate degree, leading to careers in computer science, software engineering, and systems analysis.

Goal	Measurable Objective	Strategy for Achievement	Timetable
Pursue recruitment of underrepresented students to Computer Science program *(Relevance; Effectiveness)*	Achieve demographic distribution similar to the Basic Engineering program, over a five-year period. Refer to previous table, titled *"Race/Ethnicity of QCC Students Overall and Basic Engineering Students"*	Work with Enrollment Management team to identify specific outreach/ recruitment strategies and to develop a work plan to meet recruitment goal	**Spring 2010**
Achieve positive graduation rate *(Effectiveness)*	35% of incoming freshmen will graduate within three years of enrolling in CSC 106 (25% in 2013; 30% in 2014; 35% in 2015)	Deliver rigorous course content in all areas Work with Institutional Research Office to measure student success in entry-level/gateway CS courses Revise courses as necessary to ensure students attain necessary skills, knowledge, and abilities Provide strong academic advising and tutorial/other support services to ensure academic success	**August 2013; Ongoing** **2010-2011; Ongoing** **2010-2011; Ongoing** **2010-2011; Ongoing**
Achieve positive transfer rate *(Continuing Quality; Relevance)*	70% of QCC CS graduates will transfer to bachelor degree program within one year of graduation	Develop seamless transfer agreements and articulations in order to maximize student success in transfer	**September 2014**

Maintain curricular relevancy and rigor *(Continuing Quality; Relevance)*	Hire full-time Computer Science faculty member Develop relevant outcomes assessment measures and methods; document outcomes assessment results and actions planned/taken to improve student success as necessary Demonstrate actions recommended/taken via advisory committee and/or faculty meetings by regular publication of meeting minutes Participate actively in research and review during academic program review; publish CS academic program review document with recommended three- to five-year action plan	Initiate faculty search process in fall 2009 Develop and utilize outcomes assessment measures by course and for program Convene CS program advisory committee; utilize input of program advisory committee on a regular basis; schedule annual faculty meeting to review course/curriculum delivery Participate in regular academic program review (3-5 years)	**Fall 2009; Appointment January 2010** **2010-2011; Ongoing** **2010-2011; Summer 2011 (first faculty meeting)** **January-December 2013**
Seek external resources, partnerships and/or funding to supplement and enhance CS program *(Continuing Quality, Relevance, Effectiveness)*	Demonstrate actions recommended/taken via advisory committee and/or faculty meetings by regular publication of meeting minutes Demonstrate ongoing collaboration with grants development team via advisory committee meeting reports and other venues as appropriate Develop/submit proposals in concert with grants development team and/or external partners, as appropriate	Work with advisory committee and other partners, as appropriate, to identify needs and opportunities Meet regularly with grants development team to identify appropriate resources, partnerships and/or funding Work with grants development team to develop successful proposals	**AY 2011; Ongoing** **AY 2011; Ongoing** **AY 2011; Ongoing**

External Review

The proposed program was reviewed by Dr. Jesse Heines, Department Head of Computer Science at the University of Massachusetts Lowell, and Dr. Michael Gennert, Department Head of Computer Science and Director of the Robotics Engineering Program at Worcester Polytechnic Institute. Both reviewers considered the program to be consistent with QCC's academic mission and strategic plan, fully supported by the College, and designed to meet a clearly demonstrated need for computer science majors locally and in the nation. They concurred that the program has a coherent design philosophy and felt that the overall curriculum and

individual courses should accomplish the goal of preparing students well for transfer to four-year institutions and provide a balanced two years of study toward a four-year degree and future professional practice. Overall, they predicted this program will prove highly successful in meeting its own mission and that of QCC.
Dr. Heines expressed concern that the breadth of some courses was very wide, and QCC faculty agreed to revise them accordingly. Both reviewers recommended higher compensation than planned for the new faculty hire. QCC responded that the compensation for the role of the new CS instructor is determined based upon union-based contractual guidelines. However, successful applicants for position will necessarily have significant relevant working experience beyond the educational requirements and thus will be offered a salary that includes additional rank and a measure of salary dollars for experience. Additionally, contractual provisions exist that allow the College to compensate faculty members based upon market-driven criteria should QCC fail to attract qualified candidates as a result of the current salary calculations.

Staff Analysis and Recommendation
After careful review and consideration of the proposal and all supporting documentation, staff recommendation is for approval of the Associate in Science in Computer Science at Quinsigamond Community College.

One year after graduating the program's first class, the institution shall submit to the Board a status report addressing its success in reaching program goals, as stated in the application, and in the areas of enrollment, curriculum, faculty, resources, and program effectiveness.

Attachment A: Curriculum Outline

Quinsigamond Community College Associate in Science in Computer Science

Required (Core) Courses in the Major (Total # courses required=13)		
Course Number	Course Title	Credit Hours
CSC 106	Analytical Thinking with Programming	3
CSC 107	Programming I	3
CSC 207	Programming with Objects	3
CSC 208	Introduction to Architecture and Assembly Language	4
CSC 211	Programming with Data Structures	4
MAT 233	Calculus I	4
MAT 234	Calculus II	4
MAT 235	Calculus III	4
MAT 125	Discrete Mathematics	3
MAT 237	Probability and Statistics for Engineers and Scientists	3
ENG 101	English Composition and Literature I	3
ENG 102	English Composition and Literature II	3
SPH 101	Speech Communication Skills	3
	Subtotal Required Credits	**44**
Elective Courses (Total # courses required = *7* ***)*** *(attach list of choices if needed)*		
	Humanities Elective	6
	Social Science Elective	9
	Laboratory Science Elective	4
	Laboratory Science Elective	4
	Subtotal Elective Credits	**23**

Distribution of General Education Requirements Attach List of General Education Offerings (Course Numbers, Titles, and Credits)	# of Gen Ed Credits
Arts and Humanities, including Literature and Foreign Languages	15
Mathematics and the Natural and Physical Sciences	26
Social Sciences	9
Subtotal General Education Credits	**50**

Curriculum Summary	
Total number of courses required for the degree	**20**
Total credit hours required for degree	**67**
Prerequisite, Concentration or Other Requirements:	

Attachment B: Budget

	Year 1	Year 2	Year 3	Year 4
Revenue Sources				
Grants	0	0	0	0
Tuition	16,320	31,008	31,008	31,008
Fees [5]	105,940	201,286	201,286	201,286
Total Revenue	122,260	232,294	232,294	232,294
Expenditures				
Full-Time Faculty (Salary and Fringe) [1, 4]	103,125	106,219	109,405	112,687
Part-Time/Adjunct Faculty (Salary and Fringe)[2, 4]	0	9,000	9,270	9,548
Staff	15,000	15,450	15,914	16,391
Instructional Materials, Library Acquisitions	10,000	5,000	5,000	5,000
Marketing	2,000	2,000	2,000	2,000
Total Expenditure	130,125	137,669	141,589	145,626
Net Program Revenue	(7,865)	94,625	90,705	86,668
General Administrative Cost [3]	36,435	38,547	39,645	40,775
Net Revenue	**(44,300)**	**56,078**	**51,060**	**45,892**
Assumptions				
[1] One and one-half FT Faculty @ $68,750				
[2] Two Part-Time Faculty @ $4,500 (Year 1)				
[3] Administrative OH @ 28%				
[4] 3% annual salary adjustment				
[5] No grant funding projected				