

Developing a Software Engineering Articulation Agreement

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Monmouth University / Ocean County College

Abstract

Monmouth University and Ocean County College recently concluded an articulation agreement that encourages students who start their college studies in one of Ocean County College's computer studies programs to complete their bachelor's degree in Software Engineering at Monmouth University. This paper describes the process that led to this agreement, the programs at each institution and how those programs were matched to provide for an efficient transition for students from Ocean County College to Monmouth University.

Introduction

Ocean County College is a public two-year community college sponsored partially by the County of Ocean and the State of New Jersey located in Toms River, New Jersey. It offers a variety of programs leading to AA (Associate in Arts) AS (Associate in Science) and AAS (Associate in Applied Science) degrees. It is accredited by the Commission on Higher Education of the Middle States Association of Colleges & Schools. Its total enrollment is approximately 8,500 students.

Monmouth University is a private comprehensive master's university with a total of approximately 6,500 students of whom approximately 4,300 are undergraduate and 1,700 are graduate students. It is located in West Long Branch, New Jersey, about 30 miles from Ocean County College's main campus. Monmouth University offers bachelor's degrees and master's degrees in a variety of professional areas as well as in the liberal arts and sciences. It is also accredited by the Commission on Higher Education of the Middle States Association of Colleges and Schools.

During 2005 the authors and several members of the administrations from Ocean County College and Monmouth University developed an articulation agreement that will ease the transition for Ocean County College students completing Ocean's Computer Studies programs into Monmouth University's Software Engineering bachelor's degree program.

Background

Monmouth University has been offering a Master of Science in Software Engineering program since 1986. In the late 1990s it became apparent to the faculty at Monmouth University and at several other institutions that much of the material that was being taught in graduate programs could be incorporated into undergraduate engineering degree programs. The Monmouth faculty developed a program and received approval to offer a BSSE program in 1999. The program was initiated in 2000 with its first freshman class. At the same time the faculties at approximately 23 other institutions throughout the United States which offer bachelors degrees in engineering began development of similar software engineering programs. To support these developments the Accreditation Board for Engineering and Technology (ABET), which is the recognized accreditation agency for all engineering programs in the United States, developed criteria for accreditation of software engineering programs. The first software engineering program was accredited by ABET in 2003. Monmouth University's program was accredited in 2005. It is the only undergraduate software engineering program in New Jersey and, as of the current date, is one of only 13 ABET accredited programs in the United States¹.

Over the past several years Ocean County College has developed and offered a variety of computer studies programs. The current offerings are: Computer Science Associate in Science, Computer Science Associate in Science - Computer Game Development and Design Option, Computer Science Associate in Science - Information Systems Option, Computer Science Associate in Science - Information Technology Option, and Computer Science/Information Technology Associate in Applied Science with tracks in Applications, Computer Game Development, Networking, Programming and Web Design.

Shortly after Monmouth University began its undergraduate software engineering program the computer industry experienced the so-called dot-com bust which had cascading effects on New Jersey's telecommunications industry. Many jobs were lost and companies in the software and telecommunications industries began to experience significant financial difficulties. Both directly and indirectly these negative industrial impacts began to be felt in the academic world. There have been declining student enrollments in virtually all academic programs that are associated with computers and software. The Computer Research Association, which annually tracks student enrollment in academic programs, reports that the number of new undergraduate majors entering computing programs across the United States decreased by 50% during the three years from 2001 to 2004². Monmouth University's and Ocean County College's computer related programs experienced similar impacts.

Ironically, at the same time, the US Government's Bureau of Labor Statistics is predicting unprecedented levels of growth in industries that employ people with the ability to develop software. Earlier this year Money Magazine chose software engineering as the best job in the United States based on expected growth, ease of entry, high salaries and flexible working conditions⁶. All of Monmouth University's software engineering graduates have quickly found jobs with excellent salaries.

This situation led the authors of this paper to consider an articulation agreement that might help increase enrollments at both institutions and ease the transition for students from Ocean County College into a four-year program.

Articulation agreements have been the subject of numerous studies and promotional activities in recent years. They have also been widely publicized and some have even received grant funding in recent years^{3,4}. The number of states that have implemented statewide articulation agreements has increased to 34³, and we understand that the New Jersey Commission on Higher Education is considering changes that would make the practice more widespread within the state. An NSF funded activity called the Advanced Technological Education program has as one of its specific objectives the collaboration between 2-year colleges and universities in developing formal articulation agreements for associate degree students in various areas of technology⁷.

Table 1 – Monmouth University’s Software Engineering Program

	Number	Course Name	CR		Number	Course Name	CR
		Semester 1				Semester 2	
Freshman	CS 102	Sci. Computer Apps.	3		CS 175	Intro. to CS I	4
	SE 120	Foundations of SE	3		EN 102	College English II	3
	EN 101	College English I	3		A/Th/Mu/D	Aesthetics	3
	HS 101	Western Civ. I	3		HS 102	Western Civ. II	3
	MA 120	Discrete Math	3		SE 104	Intro. To Software Engr	3
			15				16
		Semester 3				Semester 4	
Sophomore	EN 201	Literature I	3		EN 202	Literature II	3
	CS 176	Intro to CS II	4		CS 305	Comp. Algorithms I	4
	SE 205	Software Requirements	3		SE 207	Software Design & Arch.	3
	MA 125	Calc. Anal. Geo I	4		MA 126	Calc. Anal. Geo II	4
	HU 201	Critical Discourse	3		CS 286	Computer Arch. I	3
			17				17
		Semester 5				Semester 6	
Junior	SE 312	Software V., V. and M.	3		SE 403	Software Process Imp.	3
	BE 201	Microeconomics	3		SE 418	Software Proj. Mgmt.	3
	MA 319	Probability and Stat. I	3		CC Elec.	Cross Cultural Elective	3
	SE XXX	SE Elective	3		SE XXX	SE Elective	3
	PH 111	Physics with Calc. I	4		PH 112	Physics with Calc. II	4
	PH 111L	Physics with Calc. I Lab.	1		PH 112L	Physics with Calc. II Lab.	1
			17				17
		Semester 7				Semester 8	
Senior	MA/SCI	Math/Science Elective	3		CS 438	Oper. Systems Anal.	4
	BM 250	Prin. of Mgmt. & OB	3		BM 311	Management Info. Sys.	3
	PR 432	Ethics & Professionalism	3		MA/SCI El.	Math/Science Elective	3
	SE 402	Human Computer Inter.	3		SE 306	Formal Methods in SE	3
	CC Elec	Cross Cultural Elective	3		SE 485B	SE Practicum	3
	SE 485A	SE Practicum	3				
			18				16

Table 1 outlines Monmouth University's software engineering degree program. There are several issues that make it difficult to develop an articulation agreement with this program. First, there are no free electives in the program and that the total program size is somewhat larger in total credit requirements (133) than most bachelors' programs, which in New Jersey normally require 128 credits. The minimal flexibility came about for two reasons: ABET accreditation requires a minimum of 32 credits of mathematics or science and a minimum of 48 credits of engineering coursework. Monmouth University, which comes primarily from a tradition of liberal arts, requires a relatively large number of general education credits. However, one of the authors of this paper, who leads the Monmouth University software engineering program, believes that these extensive general education requirements, which are greater than those at most institutions which offer undergraduate engineering degrees give Monmouth students an advantage in industry because they are better prepared to write and speak and participate in diversified and global teams than are the engineering graduates of other institutions.

While the State of New Jersey does not have a statewide articulation agreement, one tool that we found very helpful to us, and presumably to students who take the time and make an effort to use it is the content of a web page called NJ Transfer. This is a web site lists corresponding courses that have been pre-approved for credit transfer among the state's community colleges and universities.

Agreement Development Process

The first step in developing the agreement was for both of the authors to understand each other's programs and to choose which of Ocean County College's degree programs were best matched to the Monmouth University program. One of the key factors in making this selection was to determine which programs at Ocean had enough "overlap" with Monmoth course requirements so that students would be able to complete their bachelor's degree requirements in four years. It quickly became obvious that the Ocean programs with the greatest degree of overlap were: Computer Science Associate in Science, Computer Science Associate in Science – Information Technology Option and the Computer Science Associate in Science - Game Development and Design Option. Tables 2, 3 and 4 outline the requirements of those three programs.

Table 2 – Ocean County College’s Computer Science Associate in Science							
		Semester 1	CR		Semester 2	CR	
Freshman	CSIT 171	Computer Programming I	3		CSIT 172	Computer Programming II	3
	CSIT 140	Intro. to Computer Org.	3		CSIT 174	Computer Systems	3
	MATH 265	Calculus I	4		MATH 266	Calculus II	4
	ENGL 151	English I	3		ENGL 152	English II	3
		Soc. Science Elective	3			Social Science Elective	3
			16				16
		Semester 3			Semester 4		
Sophomore	CSIT 271	Data Structures and Algorithm Analysis	3		CSIT	CS Elective	3
	MATH 267	Calculus III	4		MATH 270	Discrete Math	3
	PHYS 271	General Physics I	4		PHYS 272	General Physics II	4
		Human/English Elective	3			Human/English Elective	3
		Elective	3		HEHP 110 or HEHP 225	Health	2 or 3
			17				15 or 16

Table 3 – Ocean County College’s Associate in Computer Science – Information Technology Option							
		Semester 1	CR		Semester 2	CR	
Freshman	CSIT 171	Computer Programming I	3		CSIT 172	Computer Programming II	3
	CSIT 140	Intro. to Computer Org.	3		CSIT	CS Elective	3
	MATH 265	Calculus I	4		MATH 266	Calculus II	4
	ENGL 151	English I	3		ENGL 152	English II	3
		Social Science Elective	3			Social Science Elective	3
			16				16
		Semester 3			Semester 4		
Sophomore	CSIT 271	Data Structures and Algorithm Analysis	3		CSIT 213	Database Management	3
		Concentration Requirement	3			Concentration Requirement	3
	BIOL 161 or CHEM 181 or PHYS 271	Lab Science	4		BIOL 162 or CHEM 182 or PHYS 272	Lab Science	4
		Human/English Elective	3			Human/English Elective	3
		Elective	3 or 4		HEHP 110 or HEHP 225	Health	2 or 3
			16 or 17				15 or 16

Table 4 – Ocean County College’s Associate in Computer Science – Game Development and Design Option

		Semester 1	CR			Semester 2	CR
Freshman	CSIT 171	Computer Programming I	3		CSIT 172	Computer Programming II	3
	CSIT 140	Intro. to Computer Org.	3		ARTS 159	Visual Literacy	3
	CSIT 115	Intro. to Game Development	3		BUSN 134 or BUSN 271	Prin. of Marketing or Prin. of Management	3
	ENGL 151	English I	3		ENGL 152	English II	3
		Social Science Elective	3			Social Science Elective	3
			15				15
		Semester 3				Semester 4	
Sophomore	CSIT 271	Data Structures and Algorithm Analysis	3		CSIT 213	Database Management	3
		Elective	3 or 4		CSIT 173	Game Programming	3
	BIOL 161 or CHEM 181 or PHYS 271	Lab Science	4		BIOL 162 or CHEM 182 or PHYS 272	Lab Science	4
	MATH 265	Calculus I	4		MATH 266	Calculus II	4
	HEHP 110 or HEHP 225	Health	2 or 3			Human/English Elective	3
			16 or 18				17

We found NJ Transfer to be very helpful in reconciling programs without the need for us to visit with numerous departments on both campuses to determine course equivalencies. We very systematically went through the course equivalencies on NJ Transfer and determined which electives could be chosen at Ocean County College to produce the highest degree of overlap with Monmouth course requirements.

Integrating the Programs

The next step was to determine which, if any, of the electives in Ocean County College’s programs could be chosen to match requirements in the Monmouth University program. For each of the three Ocean programs we determined that the following course selections would be most efficient:

Computer Science – Associate in Computer Science

Semester 1: Choose ECON 152 as a Social Science elective

Semester 2: Choose BUSN 271 as a Social Science elective

Semester 3: Choose ARTS 181 as free elective

Semester 4: Choose CSIT 213 as a CS elective

Semester 4: Take an additional course in math or science above the level of MATH 266 or PHYS 272

Computer Science – Associate in Science – Information Technology Option

Semester 1: Choose ECON 152 as a Social Science elective

Semester 2: Choose BUSN 152 as a Social Science elective

Semester 3: Choose ARTS 181 as an Aesthetics elective

Semester 3: Choose ENGL 255 as a Humanities elective
 Semester 4: Choose ENGL 256 as a Humanities elective

Computer Science – Associate in Science - Game Development and Design Option

Semester 1: Choose ECON 152 as a Social Science elective
 Semester 2: Choose BUSN 271 as a Social Science elective
 Semester 3: Choose ENGL 255 as a Humanities elective
 Semester 4: Choose ENGL 256 as a Humanities elective

If students choose the electives that we have recommend at Ocean County College they will be fulfilling many of the Monmouth University general education requirements. With that selection of electives they should be able to complete the requirements for Monmouth University's software engineering degree with two years of full time study.

The Agreement

After the programs and elective courses were selected the only remaining task involved writing the text of the agreement. That task was accomplished rather quickly with assistance from the administration at Ocean County College and the Monmouth University Chief Counsel's Office. A copy of the resulting agreement appears as an appendix to this paper.

Summary

The Computer Studies Department of Ocean County College and the Software Engineering Department of Monmouth University have concluded an articulation agreement. Selection of appropriate matching programs and elective course selections was a tedious process. However, the availability of the NJ Transfer system and its data made that task much simpler than it would have otherwise been. The agreement was signed on April 20, 2006. Not enough time has elapsed to determine whether the existence of the agreement will generate any additional enrollments for either institution. However, the authors are hopeful that it will help and we are waiting to see the results.

Acknowledgements

The authors wish to thank Judy Icklan and Fran Polk, from Ocean County College, Jean Judge, Grey Dimenna and Charlene Diana from Monmouth University and the administrations of both institutions for their assistance and support in developing the articulation agreement discussed in this paper.

Bibliography

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ARTICULATION AGREEMENT BETWEEN MONMOUTH UNIVERSITY AND OCEAN COUNTY COLLEGE

Ocean County College and Monmouth University enter into this Articulation Agreement so that students enrolled in eligible Associate degree programs at Ocean County College will be eligible for admission into the Software Engineering Bachelor degree program at Monmouth University provided the terms and conditions of this Agreement are met.

This agreement provides pre-approval for transferability, but does not assure transfer of every course or transfer at the same unit rate. This agreement is an acknowledgement of the overall program at Monmouth University but does not address specific areas that can be adjusted or changed each semester. A maximum of 72 credits is transferable into Monmouth University from a two-year community college. To facilitate the transfer of eligible Ocean County College graduates to Monmouth University, the parties agree to the following:

I. Monmouth University Agrees to:

1. Monmouth University will award full transfer credits for all courses listed in one of the attached sequence charts (hereinafter referred to as Information Technology Option; Computer Science Option; and Game Development Design Option) in which Ocean County College students receive a grade of C (2.0) or better.
2. Monmouth University will consider Ocean County College students who do not successfully complete all of the courses listed in the program of study or who pursue a program which does not conform to one of the programs listed in the attached sequence charts on an individual basis.

II. Ocean County College Agrees to:

1. Ocean County College will publicize this Articulation Agreement to prospective students in their admissions literature and to inform matriculation students of their conditional admission under the conditions of this agreement.
2. Ocean County College will inform students of the requirements of Monmouth University's Transfer Admission Process and applicable Deadlines.

III. Admission Requirements:

1. In order to be admitted into the Software Engineering Bachelor Degree Program, transfer students must satisfy the following requirements:
 - a. Application: Submit an Application with a non-refundable application fee as established by Monmouth University;

- b. GPA: Students must have an overall GPA of 2.0 or higher;
 - c. Transcripts: Official copy of transcripts from all colleges and universities attended must be provided to Monmouth University;
 - d. Academic Standing: Students must be in good academic standing; and
 - e. Deadlines: The Application for the Fall Semester must be submitted by July 15th, and the Application for the Spring Semester must be submitted by December 1st.
2. Any misrepresentation by a student of his/her qualifications, experience, education, or references shall immediately disqualify a student from any further participation in the Program.
 3. Ocean County College students who are accepted pursuant to the terms of this Agreement will have the opportunity to complete their bachelor's degree after two years of full-time study.

IV. Mutual Obligations:

1. Monmouth University and Ocean County College will keep each other informed regarding any/all changes in curricula.
2. Monmouth University and Ocean County College will assess this agreement and the Program in two years with the intent of continuing this agreement and making any necessary adjustments.
3. Monmouth University and Ocean County College will each designate a representative who will coordinate and monitor the Program. Monmouth University and Ocean County College agree to provide each other in writing the name and contact information of their representative. Monmouth University and Ocean County College further agree to notify each other in writing of any change in representative.
4. Monmouth University and Ocean County College will develop and implement advertising and promotional efforts to attract students to the program.

IV. Indemnification:

1. Monmouth University agrees to indemnify and hold harmless Ocean County College and its employees from and against any and all claims, demands, actions, settlements, or judgments, including attorney's fees and litigation expenses, based upon or arising out of activities described in this Agreement, to the extent that such claims, demands, actions, settlements, or judgments are occasioned by the

negligence, actions or omissions of Monmouth University, its agents, servants, or employees.

2. Ocean County College agrees to indemnify and hold harmless Monmouth University and its employees from and against any and all claims, demands, actions, settlements, or judgments, including attorney's fees and litigation expenses, based upon or arising out of activities described in this Agreement, to the extent that such claims, demands, actions, settlements, or judgments are occasioned by the negligence, actions or omissions of Monmouth University, its agents, servants, or employees.

V. General Provisions:

1. Monmouth University and Ocean County College will not discriminate on the basis of race, religion, color, sex, age, national origin, handicap, sexual preference, disabled or Vietnam era veteran status or financial status in admission or access to, or treatment or employment, in, its programs and activities.
2. The terms of this Agreement shall become effective for students entering Ocean County College in the Fall 2006 and shall continue thereafter unless terminated by either party in accordance with this Agreement.
3. This Agreement can be terminated by either party by submitting written notice to the other party at least one year before the last class entering the program at Monmouth University. The responsibilities toward students in the program at the time will be honored for the completion of the program.
4. Any and all notices or other communications required or permitted under this Agreement shall be in writing and shall be deemed to have been duly given if: (i) delivered by hand; (ii) sent by Federal Express or other commercial overnight courier; (iii) sent by telecopier, subject to confirmation of receipt; or (iv) sent postage prepaid by registered or certified mail, return receipt requested, in any event addressed as follows:

As to Ocean County College:

Frank J. Wetta
Vice President of Academic Affairs
Ocean County College
Toms River, New Jersey

As to Monmouth University:

Thomas Pearson, Ph.D.
Provost and Vice President for Academic Affairs
Monmouth University
West Long Branch, New Jersey 07764

With copy to:

Grey J. Dimenna, Esq.
Vice President and General Counsel
Monmouth University
West Long Branch, New Jersey 07764

5. It is understood that this Agreement is not intended to and shall not be construed to create the relationship of agent, servant, employee, partnership, joint venture or association between Monmouth University and Ocean County College but is rather an agreement by and between independent contractors.
6. This Agreement, its Attachments, and Addendums shall be binding on the parties and their respective successors and assigns. Neither party shall assign its duties and obligations under this Agreement without the prior written consent of the other party.
7. This agreement shall be governed by the laws of the State of New Jersey.
8. This Agreement, its Attachments, and Addendums sets forth the entire understanding between the parties and no amendments or modifications shall be made to the Agreement, except in writing signed by both parties.

IN WITNESS WHEREOF, each of the undersigned has caused this Agreement to be duly executed in its name and on its behalf.

MONMOUTH UNIVERSITY

OCEAN COUNTY COLLEGE

By: Thomas Pearson

By: Frank J. Wetta

Print: Thomas S. Pearson, Ph.D.

Print: FRANK J. WETTA

Title: Vice President of Academic Affairs/Provost

Title: Vice President, Academic Affairs

Date: 4/20/06

Date: 4-20-06

OCCIMU Sequence Chart
for IT Option at OCC

	Semester 1	Cr. MA/SC	Engr	Semester 2	Cr. MA/SC	Engr.
Freshman	CSIT 171 Comp. Programming I (CS 175)	3	3	CSIT 172 Comp. Programming II	3	3
	CSIT 140 Intro. to Computer Org. (SE Elect.)	3	3	CSIT 174 Computer Systems (CS 286)	3	3
	MATH 265 Calculus I (MA 125)	4	4	Math 266 Calculus II (MA 126)	4	4
	ENGL 151 English I (EN 101)	3	3	ENGL 162 English II (EN 102)	3	3
	ECON 152 Social Science Elective (BE 201)	3	3	Soc. Science Elective (BM 250)	3	3
		16			16	
Sophomore	Semester 3			Semester 4		
	CSIT271 Data Structures & Algo. (CS176)	3	3	Database Management (CS002)	3	3
	CSIT123 Integr. Of. Software (IT100)	4	4	Concentration Requirement	3	3
	PHYS 271 General Physics I (PH 211/211L)	4	4	General Physics II (PH 212/212L)	4	4
	ARTS181 Elective (Aesthetics)	3	3	Humanities Elective (EN202)	3	3
	ENGL255 Humanities Elective (EN201)	3	3	Health (PE001 or HE001)	2	2
		17			15	3
Junior	Semester 5			Semester 6		
	HU201 Critical Discourse	3	3	Comp. Algorithms I	4	4
	SE 120 Foundations of SE	3	3	Intro. to SE	3	3
	HST101 Western Civilization I	3	3	Western Civilization II	3	3
	MA 319 Prob. and Statistics	3	3	Software Proj. Mgt.	3	3
	SE 402 Human-Computer Interaction	3	3	SE Elective	3	3
	* CC Elective	3	3	Software Process Improvement	3	3
	WPE Writing Proficiency Exam	0	0			
		18			19	
Senior	Semester 7			Semester 8		
	SE 205 Software Requirements	3	3	Critical Discourse	3	3
	SE 312 Software Ver. Val. and Mtce	3	3	Software Des. and Arch.	3	3
	* CC Elective	3	3	Mgt. of Info Systems	3	3
	Elective Math/Science Elective	3	3	Operating Systems	4	4
	PR 432 Professionalism and Ethics	3	3	Formal Methods in SE	3	2
	SE 485A SE Practicum	3	3	SE Practicum	3	3
		18			19	
				Total Credits	138	
					63 Engineering credits (48 Required)	
					34 Math and Science credits (32 Required)	

NOTE: Monmouth University accepts 72 credits from two-year community colleges. OCC students may choose to take up to 8 additional credits prior to coming to MU.

