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## **DESIGNING AN ARTICULATION-AGREEMENT DATABASE FOR THE COLLEGE OF SCIENCE AND ENGINEERING AND TECHNOLOGY ADVISING CENTER**

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During their academic careers, some college students transfer to different universities. To allow students to transfer seamlessly to other colleges, advisors at Minnesota universities create articulation agreements that list the classes that transfer between two universities. To use these documents, students and advisors must search through binders to find the correct articulation agreement and then manually review it. This is a time-consuming process for both students and advisors.

To make this information more accessible, we created a web-based database that instantly produces a list of equivalent classes for majors offered at Minnesota State University, Mankato (MSU) and other Minnesota universities. We designed the system for majors in the College of Science and Engineering and Technology (CSET); however, the system can be expanded to include all MSU majors. To design this system, we used a rapid application development strategy that emphasized using prototypes to develop and to refine the system's functions and user interfaces.

The primary users include CSET advisors, MSU faculty advisors, and transfer students. For advisors, the database provides fast access to data, and a reliable, centralized location to store the articulation agreements. These features allow advisors to spend less time searching for information, and more time working with students. Transfer students also benefit because they can access up-to-date articulation agreements at their convenience.

## **Introduction**

During their academic careers, some college students transfer to different universities. To allow students to transfer seamlessly, advisors at Minnesota universities create articulation agreements that list the classes that transfer between two universities or community colleges and allow students to complete Bachelor degrees. To use these documents, students and advisors must search through binders to find the correct articulation agreement and then manually review it. This is a time-consuming process for both students and advisors.

To make this information more accessible, we created an online database that instantly produces a list of equivalent classes for majors offered at Minnesota State University, Mankato (MSU) and other Minnesota universities. We designed the system for majors in the College of Science and Engineering and Technology (CSET); however, the system can be expanded to include all MSU majors and universities. To design this system, we used a rapid application development strategy that emphasized using prototypes to develop and to refine the system's functions and user interfaces.

The primary users include CSET advisors, MSU faculty advisors, and transfer students. For advisors, the database provides fast access to data, and a reliable, centralized location to store the articulation agreements. These features allow advisors to spend less time searching for information, and more time working with students. Transfer students also benefit because they can access up-to-date articulation agreements at their convenience.

This paper outlines the background and purpose of the project, the methodology used to develop the system, and an analysis on the system and the methodology. We also discuss our future goals for the system, which include expansion to serve the needs of international students.

## **Background**

When students have questions about academic issues, they talk with their advisors. Advisors provide students with information about graduation requirements, scholarships, majors, and academic planning. At Minnesota State University, Mankato (MSU), first-year students enrolled in majors in the College of Science and Engineering

and Technology (CSET) meet with advisors Angie Bomier, Lynnelle Freiderich, and Cathy Gjerde when they need assistance with academic issues. (More information about CSET advising can be found at their website [1].)

In addition to advising first-year students, these advisors also work with transfer students to determine how their completed coursework will transfer to MSU majors. To do this, advisors review articulation agreements, which are documents that show how classes will transfer between colleges. Articulation agreements differ from transfer agreements because they show how classes transfer for Bachelor degrees; transfer agreements show how individual courses transfer between colleges. Students who complete the courses and meet the conditions in the articulation agreements receive transfer credits and have a guaranteed pathway to a Bachelor degree. (See Appendix A for a sample articulation agreement.)

Every college at MSU has developed articulations agreements with other Minnesota universities. CSET has articulation agreements with Rochester Community Technical College, Normandale Community College, and North Hennepin Community College; and advisors are developing additional agreements with other Minnesota community colleges.

As more agreements are created, advisors will need an accessible, centralized place to store them. Currently at MSU, they are stored in binders in the advising center and in the Office of Academic Affairs, so the agreements cannot be accessed outside of these offices. Storing the agreements in an online database would make the information more organized and accessible. Advisors could access this information anywhere there is an internet connection and a computer, which would be beneficial when they travel to other colleges. Ms. Bomier often travels to Minnesota community colleges, so she needs to access this information without bringing the articulation-agreements binder, which may be needed at CSET.

Transfer students would also benefit from an online system. When they have questions about transferring to another school, transfer students must contact an advisor at either their school or at MSU because the articulation agreements are not accessible to students. Scheduling a time to meet with an advisor can be difficult for students with busy school and work schedules. Students transferring to MSU would

also benefit because their meetings with advisors could be more productive. Having the agreements online would allow students to review the agreements and to prepare informed questions for their advisors, whether at their current college or at MSU.

When transfer students ask if their classes will transfer, advisors need a quick way to review the articulation agreements and students' transcripts. According to Ms. Bomier, this process can take anywhere from twenty minutes to an hour. Checking these documents can be a quick task when students have chosen a major; however, when students have not chosen a major, this can be time-consuming and tedious. Advisors then review multiple sections of the agreement to determine which classes will transfer for various MSU majors. This process reduces the amount of time advisors can spend advising and talking with students, and it reduces the number of students they meet with during the day.

The current method of using and storing articulation agreements causes several problems for advisors and transfer students. Advisors lack an accessible, centralized way to store the agreements and an efficient way to evaluate students' transcripts. Transfer students are inconvenienced because they cannot access articulation agreements without contacting or meeting an advisor.

## **Purpose**

We designed and implemented an online database that makes the articulation agreements more accessible to advisors and transfer students. Users search the database by typing the name of a Minnesota college, the current academic year, and the classes completed at that college. The database then returns a list of equivalent courses between MSU and the selected college.

The system began in spring semester 2004 as a project from the computer science course Systems Analysis and Design. The original scope was to design a system that evaluates a student's progress in completing the general education requirements. The evaluation would then be saved in the database so it could not be lost or misplaced. After the semester ended, students from the class continued to work on the system. The scope of this project changed to evaluating articulation agreements, and the final system was to be stored on Ms. Bomier's desktop computer. However, this

design did not allow her to access the information off-campus. Having the agreements online meant she would not have to carry the agreements with her when visiting other schools. The final scope for the project was to create a database that stores the articulation agreements and is accessible online.

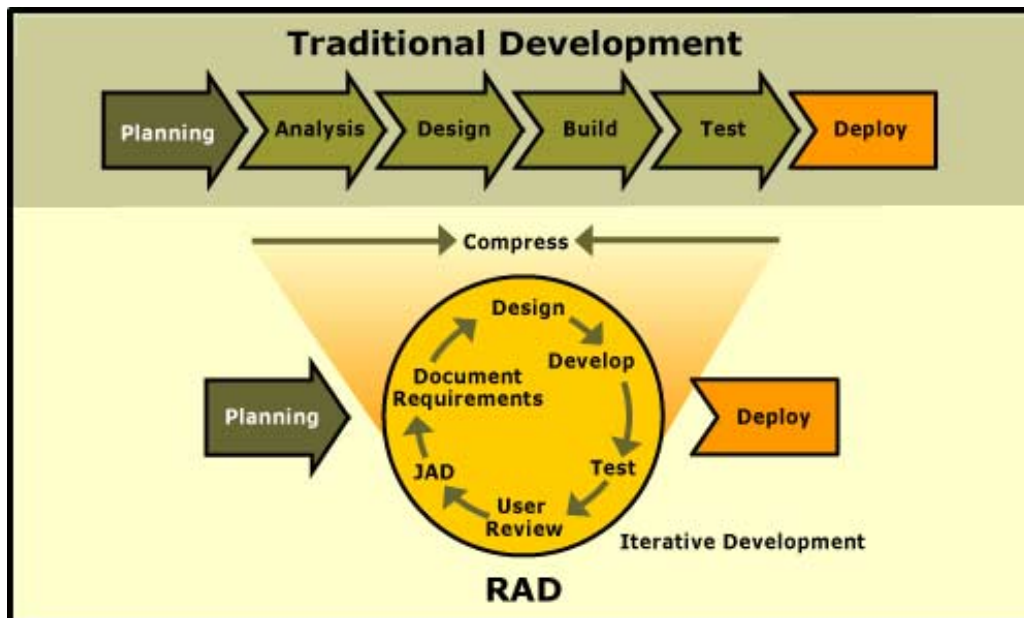
When we designed this system, we identified two goals. First, make the articulation agreements more accessible. By having the database online, users can access the agreements anywhere there is an internet connection. Second, create a database that quickly retrieves the articulation agreements and evaluates a student's transcript. Advisors benefit because the database completes the transcript evaluation so they can spend more time talking with students, and less time reviewing and searching for information.

## **Methodology**

We used a combination of a rapid-application development (RAD) strategy and traditional development. RAD emphasizes using prototypes to develop a computer system. Rapid-application development strategies derive from the idea that users can clarify and understand their needs when they can see and use prototypes of the system. When one version of the prototype is completed, users test it and provide feedback on the prototype's usability. Then, the next version of the prototype is developed using the feedback to refine and develop the next prototype. Users test this newest version and the cycle repeats. This iterative process requires frequent contact with users, which helps designers build a system that meets the users' needs. The frequent contact can also increase enthusiasm for the project because users feel like active members of the design team.

The rapid application development strategy differs from traditional system design strategies that emphasize extensive planning before implementing the system. Software designers using traditional methods typically define the system requirements, draw flow charts that show data movement, evaluate the system's feasibility, design prototypes, implement the system, and test the system. Traditional system design methods are linear and rigid, so changes are difficult to make later in the design process. We did extensive design using as much feedback as possible from CSET

advisors about the problems and potential solutions during the design process. Figure 1 shows a side-by-side comparison of the traditional and RAD strategies. Both methods work well for designing software; however, we chose the rapid application development strategy because it quickly develops a working system. Each working prototype



**Figure 1.** Traditional development of information systems compared to a rapid application development strategy. Figure from [2].

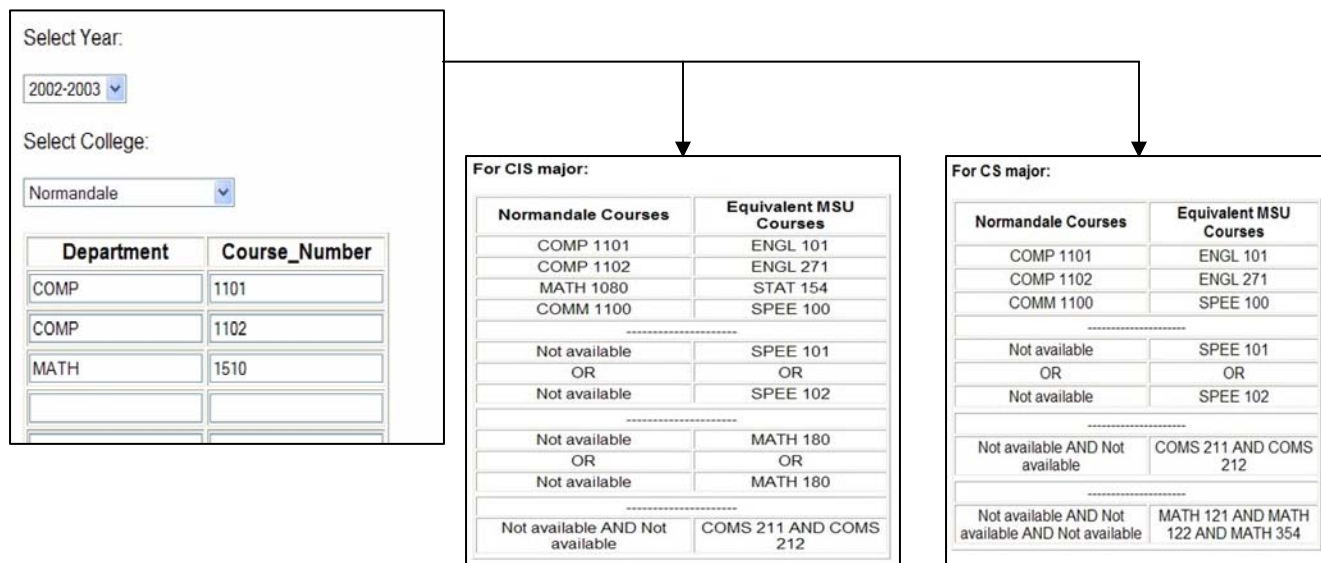
produced a small, functional portion of the system that eventually evolved into the finished system. This strategy also allowed us to adapt easily to unforeseen changes because the system's design is continually evolving. Descriptions of strategies can be found in [2] and [3].

Before we could use this strategy to design the system, we had to understand the advisors' current process of storing, modifying, and checking articulation agreements. To learn how the advisors use the agreements, we had several meetings and we asked them to answer a questionnaire. (See Appendix B for a copy of the questionnaire.) Questions focused on the problems with the current method, the rules for evaluating classes, and the format of the agreements. These three areas affected the design of the underlying database and the functions of the system.

After the initial research was completed, we analyzed the problem and designed the system. This included developing the system diagrams and choosing the functions to be implemented.

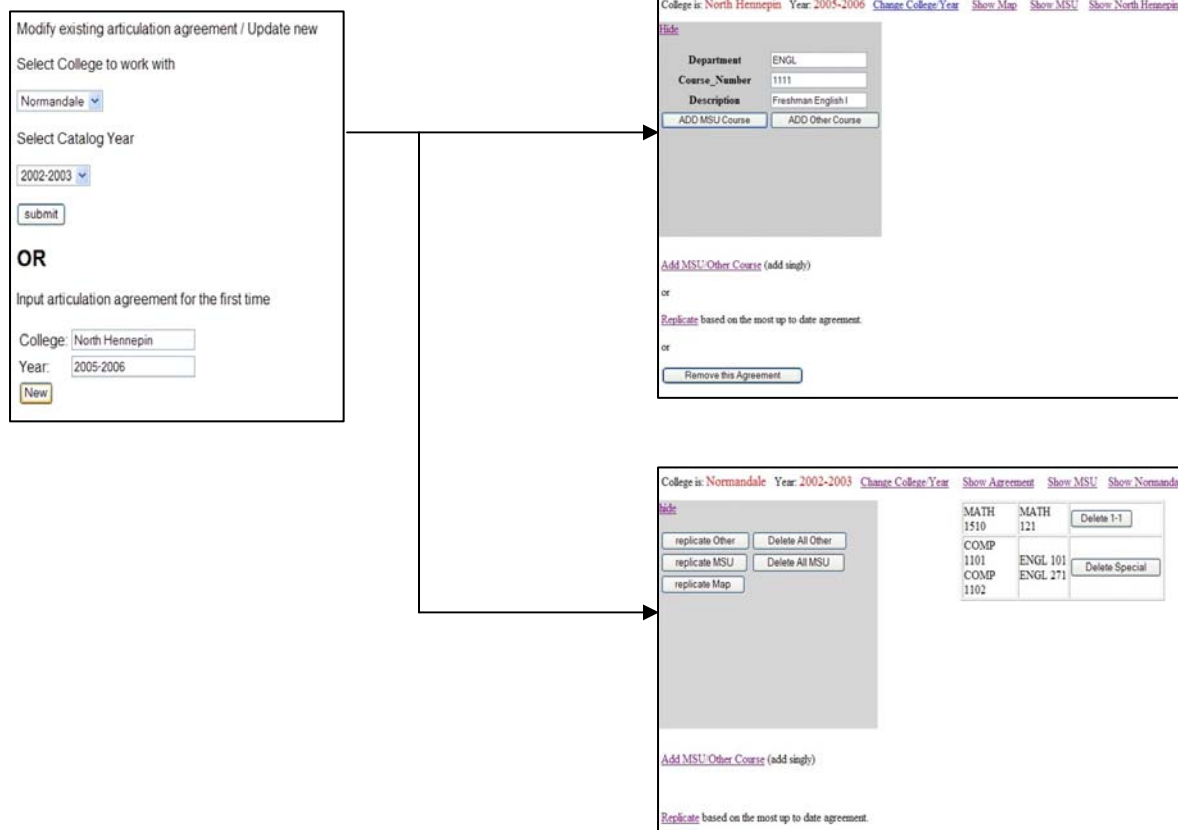
In addition to working collaboratively on the system’s design, each team member focused on building one part of the system: building the underlying database, creating the interactive system interfaces, and writing the system’s documentation. The first task was to build the database, which required several software tools. We used three key computing elements: Krypton, a linux-based system available to students at MSU [4], to host the scripts, MySQL to store the back-end database (available at [5]), and PHP, “a widely-used general-purpose scripting language that is especially suited for Web development and can be embedded into HTML” [6] to display the information. All of these tools were free and accessible to MSU students, and they were easy to use.

The second task was to design the user interfaces, which are the web pages people see when using the system. To do this, we drew sketches of the interfaces and developed flow charts to show the sequence of the pages. (See Figures 2, 3 and 4 for system flow charts.) The objective was to make the interfaces intuitive and easy to use.

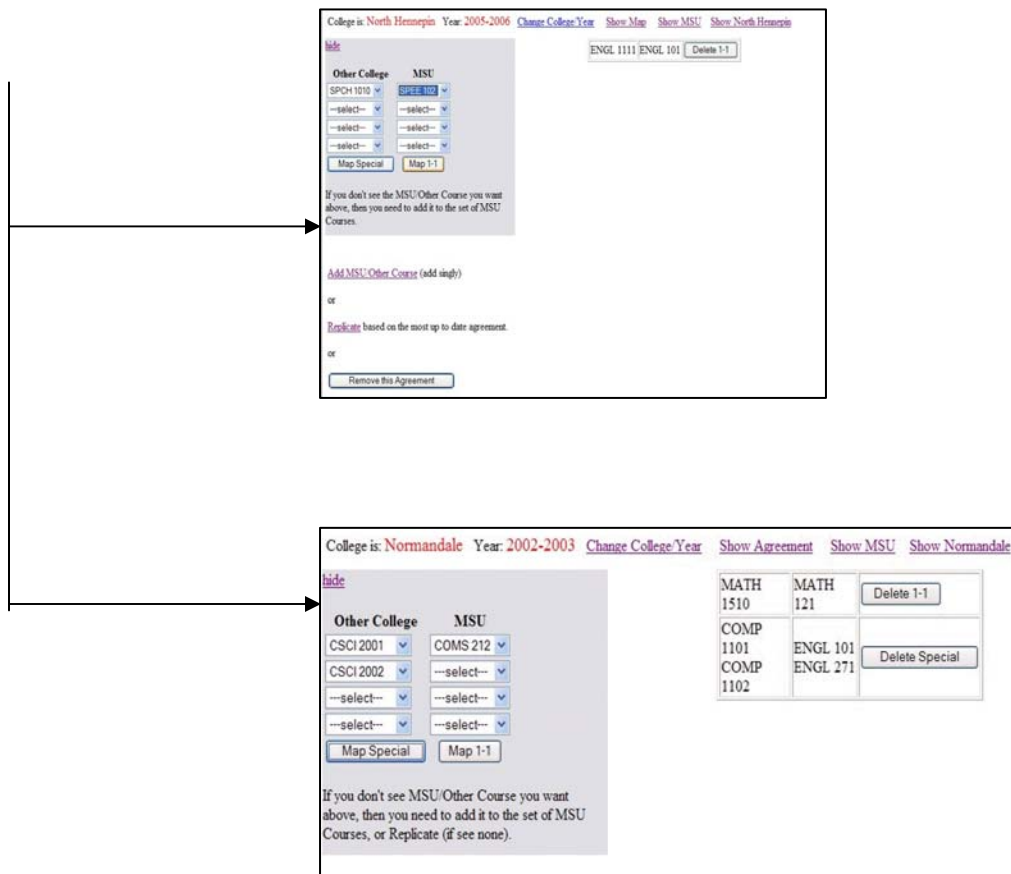


**Figure 2.** Users enter the completed coursework and the system shows how the courses will transfer to various MSU majors.





**Figure 3.** Advisors chose to modify an existing agreement or input a new agreement. They can enter classes into the database individually or copy entire agreements from a previous year.



**Figure 4.** Advisors then link classes from other schools to classes at MSU. This can be done in a simple or complex relationship.

The third task was to write the documentation. This included writing a user manual and two frequently asked questions (FAQs) lists that would be linked to the database. The user manual describes how the system is implemented, and the FAQs tell readers about how to use the system. These three documents each required writing for a different audience, which affected the content and wording for each document.

## **Assessment and Analysis**

When designing this system, we encountered several challenges. The first challenge was establishing a reasonable scope for this project. Initially, we wanted the system to be completed by the end of April so we could present the full system at Undergraduate Research Conference. However, we could not finish the system by this date. We underestimated the amount of work it would take to finish the system, and we could not allocate enough time to work on the project. Because of this, we reduced the scope of the project to focus on creating a prototype of the final.

After the scope was established, we had to design the system, which also posed challenges. When we reviewed the articulation agreements, we noticed that there was some ambiguity in the agreements, especially when the agreement lists a sequence of courses that will transfer. The format of the agreements is not standardized among schools. This affected how the user can enter and link courses in the system.

The last challenge was to find database technology that was accessible and free to students. Work on the system could not begin until a compatible database language and hosting option had been decided on. Starting the project before these decisions were finalized could have resulted in wasted effort if our options changed or were not feasible. We also had to consider the permanent location of the system and make sure our design would be functional in both temporary and permanent hosting.

Our goal for this project was to create an accessible and easy-to-use system that accurately analyzes students' transcripts. Ms. Bomier has reviewed the system and expressed enthusiasm about using the system because it reduces the amount of time it takes to evaluate a transcript. Analyzing a student's transcript previously took anywhere from twenty minutes to an hour. Now, this same process can be completed in less than ten minutes. This project is still in progress so no usability-tests have been conducted to analyze the system; however, these tests have been developed and will be conducted this summer. (See Appendix C for a sample usability test.)

## Summary and Future Goals

We established several goals for future expansion of this system. The first goal is to increase the functionality of the system. We intend to add more MSU majors to the database. The system has the capacity to store information about all majors at MSU. Because each college at MSU has articulation agreements with other schools, advisors in these colleges also need quick access to the articulation agreements.

In addition, the system could be expanded to include international articulation agreements. Students from other countries need to know if their classes will transfer to MSU and the system could quickly provide this information to them. Having the articulation agreements in one centralized location would reduce the amount of run-around students have to do.

## References:

- [1] CSET Student Advising & Coordination Center Website, <http://www.cset.mnsu.edu/sacc>.
- [2] McConnell, Steve. (1996) Rapid Development: Taming Wild Software Schedule, Redmond, WA: Microsoft Press.
- [3] Whitten, Jeffery, Bentley, Lonnie & Dittman, Kevin. (2004) *Systems Analysis and Design Methods*. Boston, MA: McGraw Hill.
- [4] MSU Krypton computing server, <http://krypton.mnsu.edu>.
- [5] Downloads available at <http://www.mysql.com/>.
- [6] PHP: Hypertext Preprocessor, <http://www.php.net/>.

## Appendix A: RCTC Curriculum to MSU, Mankato Electrical Engineering

### Associate of Science RCTC Degree:

64 semester credits total

30 (minimum) semester credits of MN Transfer Curriculum

#### I. **Engineering Core Courses - 34 credits** (14 MN Transfer Curriculum credits included):

<i>RCTC Course</i>		<i>credits</i>	<i>MSU Course satisfied</i>		<i>credits</i>
Math 1127*	Calculus I	5	Math 121	Calculus I	4
Math 1128*	Calculus II	5	Math 122	Calculus II	4
Math 2237*	Multivariable & Vector Calculus	5	Math 223	Calculus III	4
Math 2238*	Differential Equations & Linear Algebra	5	Math 321	Differential Equations	4
			AND Math 247	Linear Algebra (if <u>ALL</u> 3 previous courses completed.)	4
Physics 1127	Classical Physics I	5	Physics 221	General Physics I	5
Physics 1128	Classical Physics II	5	Physics 222	General Physics II	5

Chemistry 1127	Chemical Principles I	4	Chemistry 201	General Chemistry I	5
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**II. Additional Technical Courses - 15 credits:**

<i>RCTC Course</i>		<i>credits</i>	<i>MSU Course satisfied</i>		<i>credits</i>
Engr 1152	Logic Design	4	EE 244 + 253	Intro to Digital Systems	3
Engr 2211	Statics	3	ME 212	Statics	3
Engr 2213	Linear Circuits I	4	EE 230 + 240	Circuit Analysis I	4
Engr 2214	Linear Circuits II	4	EE 231	Circuit Analysis II	3

**III. Minnesota Transfer Curriculum for A.S. Degree – 15 credits:**

<i>RCTC Course</i>		<i>credits</i>	<i>MSU Course satisfied</i>		<i>credits</i>
English 1117 <u>OR</u> English 1118	Reading & Writing Critically I <u>OR</u> Reading & Writing Critically II	4 <u>OR</u> 4	English 101	English Composition	4
Speech 1114 <u>OR</u> English 1109	Fundamentals of Speech <u>OR</u> Technical Report Writing	3 <u>OR</u> 3	Speech 102 <u>OR</u> English 271	Public Speaking <u>OR</u> Technical Writing	3 <u>OR</u> 4
Econ 2214 <u>OR</u> Econ 2215	Principles of Economics: Micro <u>OR</u> Principles of Economics: Macro	4 <u>OR</u> 4	Econ 202 <u>OR</u> Econ 201	Microeconomics <u>OR</u> Macroeconomics	3 <u>OR</u> 3
Social Science <u>OR</u> Arts and Humanities	Electives**	4	Social Sciences <u>OR</u> Arts & Humanities	Electives	4

- A grade of “C” or above is required in each course listed in this agreement.
- A cumulative GPA of 2.5 or above is required for all science, math and engineering courses in this agreement.

\*Completion of Math 1127, 1128, 2237 and 2238 with a grade of “C” or above at RCTC (20 credits) will satisfy requirements for a mathematics minor at MSU, Mankato.

\*\*To satisfy these requirements, students should not enroll in any “skills-based” classes; e.g. studio art, music performance, service-learning, writing, speech, field studies, physical activities, etc. These courses typically WILL apply: History, Political Science, Psychology, Sociology, Art 1110, 1111, 1112; English literature, Geography, Anthropology, Philosophy, Humanities, Music 1110, 1201, 1222, 1221. For more information about specific course acceptance, please contact the department of your major at MSU.

## **Appendix B: Articulation Agreement Project Questionnaire**

### **General Information**

1. Why do you want this system?
2. What are the problems associated with the current system?
3. Who will use the system?
4. What features should be included in the new system?

### **Articulation Agreements**

5. What is the current process you use to check an articulation agreement?
6. Where is the articulation agreement information located?
7. How often do you do articulation agreement checks?
8. How long does it take you do an articulation agreement check?
9. What are the current forms that are used in articulation agreements?
10. What books, forms, or guidelines do you use when working on an articulation agreement?
11. Explain the different ways the system should check the articulation agreement. (Course-by-course, or program-by-program).
12. How often do articulation agreements change?
13. Are we checking core classes or general education classes? If we are checking general education classes, do all colleges have the same the classes?
14. Can classes be counted as pass/no credit?
15. Do some classes count for multiple categories/requirements?
16. Does more than one agreement exist with a school to cover changes in curriculum over time?
17. Under what circumstances does a new agreement need to be created?
18. How do transfers work with Arts/Humanities/Social Sciences classes that aren't explicitly stated in an agreement?

### **System Information**

19. Where is the system going to be hosted?
20. Are there any other databases the new system would have to work with?
21. Who should update the system?
22. What types of searches should be available to users?
23. What print outs will be required?
24. Should any information about the student be saved in the system?

25. What schools should be included in the system?
26. What information should be included about the universities in the database?
27. What academic years should be included in the system?
28. What information about classes should be included in the system? Example: descriptions, prerequisites, and the semester the class is offered.
29. What kind of information/results should a user get from the system? (RCTC class = MSU class, recommendations, reminders about GPA requirements, etc.)

### Appendix C: Articulation-Agreement System Evaluation

Test information	
Date:	User:

Functionality
Does the site produce the required information? <input type="checkbox"/> Yes <input type="checkbox"/> No
Should the site produce additional information? <input type="checkbox"/> Yes <input type="checkbox"/> No (If yes, please explain in the space below.)
Is the information accurate? <input type="checkbox"/> Yes <input type="checkbox"/> No (If no, please list any problems in the space below.)
Does the system quickly produce results? <input type="checkbox"/> Yes <input type="checkbox"/> No
Does the system make the articulation agreements more accessible? <input type="checkbox"/> Yes <input type="checkbox"/> No

Usability
Are the terms used for buttons and links clear? <input type="checkbox"/> Yes <input type="checkbox"/> No (If no, please list the unclear terms in the space below.)
Were you able to add agreements to the system? <input type="checkbox"/> Yes <input type="checkbox"/> No (If no, describe any problems you had in the space below)
Were you able to modify the agreements in the system? (Add or delete classes) <input type="checkbox"/> Yes <input type="checkbox"/> No (If no, describe any problems you had in the space below)
Were you able to search the system for equivalent classes? <input type="checkbox"/> Yes <input type="checkbox"/> No (If no, describe any problems you had in the space below)
Please write any additional comments in the space below.