Oakland Community College

Curriculum Review Committee

Reports Supporting the Review of the Robotics/Automated Systems Program

Prepared by the Office of Assessment & Effectiveness
April 2008

OAKLAND
COMMUNITY
COLLEGE

2007-08 Robotics Automated Systems Technology (Extended)
Program Assessment

Benchmark ID 921 B1

Learning Outcome
Students will program the motion and logic for an automated system to correctly execute the application.

Benchmark
Eighty (80%) percent of the students will complete to specifications the final robotic application programs in the ROB 1620 for motion and logic program structure.

Assessment Method
Execution for evaluation of the motion and logic items as defined in the rubric of specifications.

Benchmark ID 921 B2

Learning Outcome
Students will demonstrate critical thinking by programming the motion and logic for an automated system to correctly execute the application.

Benchmark
Eighty (80%) percent of the students will complete the robot program documentation with a grade of C or higher.

Assessment Method
Execution of the application and supporting documentation of the program print-outs for the labs in ROB 2400 including process documentation and description of programming solution based on a program and narrative format standards required for the course.

Benchmark ID 922 B2

Learning Outcome
Students will master problem analysis and solving skills in order to complete assignments.

Benchmark
Eighty (80%) percent of the students will complete the troubleshooting questions on the ROB 2500 final with a grade of C or higher.

Assessment Method
Final exam.

Benchmark ID 922 B3

Learning Outcome
Students will master problem analysis and solving skills in order to complete

assignments.

Benchmark
Eighty (80%) percent of the students will complete eighty (80%) percent troubleshooting problems on the controllers in the ROB 2500 final lab practical.

Assessment Method
Determining the problem on the robotic system and identifying based on the supporting documenting the observable cause in their field service report as defined in the standard.

Benchmark ID **923** **B1**

Learning Outcome
Students will develop written technical communications skills.

Benchmark
Students will achieve an average of 80% in the evaluation by faculty against the assignments criteria and technical writing standards.

Assessment Method
Student will submit narrative reports in the following courses: ROB 1520 on maintenance procedures based on the requirements defined in the assignment's rubric.

For ROB 2400, see Robotics Automated Systems Technology, Benchmark ID 921 B2.

3. Based on these assessment findings, modifications/changes will be made:

___ to the way in which information is delivered to students
_X_ to the curriculum
___ to the Benchmark
_X_ to the Assessment Method
___ to the Learning Outcome
___ other

Please explain:

To the Curriculum:

In ROB 1620, have students submit documents on separate applications, one in the first third of the semester, the second in the second third of the semester.

To the Assessment Method:

Student will submit narrative reports in the following courses: ROB 1520 on maintenance procedures and ROB 1620 on robotic applications, based on the requirements defined in the assignment's rubric.

Delete reference to ROB 2400 to eliminate duplication to revised Robotics Automated Systems Technology, Benchmark ID 921 B2.

4. At what point will these actions be implemented?

Month: _January_____Year: __2008_____

5. Please explain if there are any budgetary implications stemming from these actions.

Note: When completed, please send a copy of this form to your dean, program assessment facilitator and Marty Orlowski (maorlows@oaklandcc.edu) in the Office of Assessment & Effectiveness. Thank you.

Robotics Automated Systems Technology (Extended)
Program Assessment Feedback Form
Benchmark ID 923 B1

Learning Outcome
Students will develop written technical communications skills.

Benchmark
Students will achieve an average of 80% in the evaluation by faculty against the assignments criteria and technical writing standards.

Assessment Method
Student will submit narrative reports in the following courses: ROB 1520 on maintenance procedures, ROB 1620 on robotic application, and ROB 2400 for application programming.

Benchmark Scheduled To Be Assessed: 5/1/2007
Assessment Results Sent To Office of Assessment and Effectiveness: 6/1/2007

Enter the total number of students who were assessed	Enter the number of students who performed at or above the level indicated in the benchmark	Enter the percent of students who performed at or above the level indicated in the benchmark
44	44	100%

1. The above results indicate that the benchmark:

   _X_ was met
   ____ was not met

2. What was learned through the assessment of this benchmark?

   Students in the above robotics course were able to demonstrate a level of technical communications for the assignments.

   In the ROB 1520, students at the start of the course had problems in providing a synopsis of a specific maintenance procedures derived from various sources in the supplied manufacture's documentation. As students became familiar with interpreting the documentation, the written submission provided the precise information pertaining to the repair procedure and did not include unnecessary steps.

   Students in the ROB 1620 submitted three progressive documents on changing requirements based on a single application. The students in their final submission included the requirements of the assignment detailing the data within and structure of the program to complete the application. The problems which occurred in the earlier submissions are due to the assignment being in the last half of the semester. This did not provide the students with sufficient time to demonstrate improvement between the first and second submission.

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3. Based on these assessment findings, modifications/changes will be made:

___to the way in which information is delivered to students
___ to the curriculum
_X_ to the Benchmark
_X_ to the Assessment Method
___ to the Learning Outcome
___ other

Please explain:

To the Benchmark:

Eighty (80%) percent of the students will complete eighty (80%) percent troubleshooting problems on the controllers in the ROB 2500 final lab practical.

The change to percentage of problems id for consistency of tracking in future assessments as technology replacements may change the exact number problems the student will complete.

To the Assessment Method:

Correctly determining the problem on the robotic system and identifying based on the supporting documenting the observable cause in their field service report.

The practical controller fault troubleshooting assessment requires the student to record their observations, identify the problem, and sources of information. The fourth requirement is for the student to explain the reason for the observed condition of the robot controller caused by the fault.

While the majority of the students provided satisfactory explanations, some did not provide complete details. The assessment directions will reflect the requirement to provide in the explanation of observable conditions in relationship to the board, component, and/or connection identification and function in the controller architecture.

4. At what point will these actions be implemented?

Month: __January_____Year: ____2008_____

5. Please explain if there are any budgetary implications stemming from these actions.

None

Note: When completed, please send a copy of this form to your dean, program assessment facilitator and Marty Orlowski (maorlows@oaklandcc.edu) in the Office of Assessment & Effectiveness. Thank you.

Robotics Automated Systems Technology (Extended)
Program Assessment Feedback Form
Benchmark ID 922 B3

Learning Outcome
Students will master problem analysis and solving skills in order to complete assignments.

Benchmark
Eighty (80%) percent of the students will complete seven out of nine troubleshooting problems on the controllers in the ROB 2500 lab practical.

Assessment Method
Correctly determining the problem on the robotic system and identifying supporting documenting in their field service report.

Benchmark Scheduled To Be Assessed: 5/1/2007
Assessment Results Sent To Office of Assessment and Effectiveness: 6/1/2007

Enter the total number of students who were assessed	Enter the number of students who performed at or above the level indicated in the benchmark	Enter the percent of students who performed at or above the level indicated in the benchmark
21	19	90%

1. The above results indicate that the benchmark:

   _X_ was met
   ____ was not met

2. What was learned through the assessment of this benchmark?

   Of the seventeen students, three did not complete the all ten of the practical troubleshooting problems. Two students misidentified the reasons and/or did not complete all ten of the problems, but were within the 80% benchmark. Two students did not complete all ten of the problems.

   Students were provided a schedule as to when and what robots were available during the five weeks allowed to complete the assignment. A sign-up sheet for each robot controller provided a queue for student access to the equipment. This method of implementing the assessment to ratio of equipment to students allowed for the students to individually work on the problems in the ten (10) robot controllers.

   The majority of the students correctly followed the procedures and completed the requirements of the assessment. Identification of the fault is the primary concern of the assessment, of the completed fault identifications, 98% of the faults were successfully diagnosed.

Note: When completed, please send a copy of this form to your dean, program assessment facilitator and Marty Orlowski (maorlows@oaklandcc.edu

3. Based on these assessment findings, modifications/changes will be made:

___to the way in which information is delivered to students
_X_ to the curriculum
___ to the Benchmark
___ to the Assessment Method
___ to the Learning Outcome
___ other

Please explain:

To the Curriculum:

The connection and the function between boards and/or components is part of the lecture on controller architecture. Create exercises, which are part of their study guide materials, to provide the students with additional resources on the connection on the boards/components and the relationship between the boards/components in the operations of the system.

These additional exercises based on print-outs will include:

- Board connections and interconnections.
- Pin-out of connectors to identify voltages or signals.
- Operational characteristics from the absence of the voltage or signal.

4. At what point will these actions be implemented?

Month: __January_____Year:___2008_____

5. Please explain if there are any budgetary implications stemming from these actions.

None

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Robotics Automated Systems Technology (Extended)
Program Assessment Feedback Form
Benchmark ID 922 B2

Learning Outcome
Students will master problem analysis and solving skills in order to complete assignments.

Benchmark
Eighty (80%) percent of the students will complete the troubleshooting questions on the ROB 2500 final with a grade of C or higher.

Assessment Method
Final exam.

Benchmark Scheduled To Be Assessed: 5/1/2007
Assessment Results Sent To Office of Assessment and Effectiveness: 6/1/2007

Enter the total number of students who were assessed	Enter the number of students who performed at or above the level indicated in the benchmark	Enter the percent of students who performed at or above the level indicated in the benchmark
21	21	100%

1. The above results indicate that the benchmark:

   _X_ was met
   ____ was not met

2. What was learned through the assessment of this benchmark?

   Troubleshooting questions on the comprehensive final are divided into the following sections for two robot systems: indicators, fuses, and connections. The majority of students correctly answered the questions in the indictor and fuses sections. The questions in the indicator and fuse sections requires the student to correctly identify the indicator/fuse function or symptom on the controller based on previous lab exercises.

   On the questions concerning connections, a number of incorrect answers occurred in those sections. These questions require a higher order of thinking for the student to interpret the controller's prints to define the operational characteristics of the connection in the system.

Note: When completed, please send a copy of this form to your dean, program assessment facilitator and Marty Orlowski (maorlows@oaklandcc.edu

3. Based on these assessment findings, modifications/changes will be made:

___to the way in which information is delivered to students
___ to the curriculum
_X_ to the Benchmark
___ to the Assessment Method
___ to the Learning Outcome
___ other

Please explain:

To the Benchmark:

Discard benchmark and replace with specific requirements within the programming assignments.

New Benchmark:

Eighty (80%) percent of the students will complete ROB 2400 programming requirements rubrics of industrial standards for performance for the applications in the courses by meeting to the standard eighty (80%) of the items defined in the rubric.

4. At what point will these actions be implemented?

Month: __January_____Year: __2008_____

5. Please explain if there are any budgetary implications stemming from these actions.

None

Note: When completed, please send a copy of this form to your dean, program assessment facilitator and Marty Orlowski (maorlows@oaklandcc.edu) in the Office of Assessment & Effectiveness. Thank you.

Robotics Automated Systems Technology (Extended)
Program Assessment Feedback Form
Benchmark ID 922 B1

Learning Outcome
Students will master problem analysis and solving skills in order to complete assignments.

Benchmark
Eighty (80%) percent of the students will complete ROB 2400 programming within 4 major revisions.

Assessment Method
The number of revisions based on the original flowchart submitted prior to programming their application solution to complete the minimum specified requirements for the application program.

Benchmark Scheduled To Be Assessed: 5/1/2007
Assessment Results Sent To Office of Assessment and Effectiveness: 6/1/2007

Enter the total number of students who were assessed	Enter the number of students who performed at or above the level indicated in the benchmark	Enter the percent of students who performed at or above the level indicated in the benchmark
9	Not measurable	N/A

1. The above results indicate that the benchmark:

___ was met
_X_ was not met

2. What was learned through the assessment of this benchmark?

Software use by students does not have automatic revision tracking or change tracking. The instructor cannot authenticate student progress in the number of major revision to the program.

Flowcharting is discontinued in the robotics curriculum.

Note: When completed, please send a copy of this form to your dean, program assessment facilitator and Marty Orlowski (maorlows@oaklandcc.edu

3. Based on these assessment findings, modifications/changes will be made:

_X_to the way in which information is delivered to students
___ to the curriculum
___ to the Benchmark
_X_ to the Assessment Method
___ to the Learning Outcome
___ other

Please explain:

To the way in which information is delivered to students:

Provide students with grading rubric on the requirements and the format required for the program and process documentation.

To the Assessment Method:

Documentation of the program print-outs for the labs in ROB 2400 including process documentation and description of programming solution based on a program and narrative format standards required for the course.

Eliminate the flow chart requirement in the benchmark. Flowcharting is discontinued in the robotics curriculum.

4. At what point will these actions be implemented?

Month: __January_____Year: ___2008_____

5. Please explain if there are any budgetary implications stemming from these actions.

Note: When completed, please send a copy of this form to your dean, program assessment facilitator and Marty Orlowski (maorlows@oaklandcc.edu) in the Office of Assessment & Effectiveness. Thank you.

Robotics Automated Systems Technology (Extended)
Program Assessment Feedback Form
Benchmark ID 921 B2

Learning Outcome
Students will program the motion and logic for an automated system to correctly execute the application.

Benchmark
Eighty (80%) percent of the students will complete the robot program documentation with a grade of C or higher.

Assessment Method
Documentation of the program print-outs for the labs in ROB 2400 including flowchart, process documentation, and description of programming solution.

Benchmark Scheduled To Be Assessed: 5/1/2007
Assessment Results Sent To Office of Assessment and Effectiveness: 6/1/2007

Enter the total number of students who were assessed	Enter the number of students who performed at or above the level indicated in the benchmark	Enter the percent of students who performed at or above the level indicated in the benchmark
9	9	100%

1. The above results indicate that the benchmark:

   _X_ was met
   ____ was not met

2. What was learned through the assessment of this benchmark?

   An effort in the previous courses to have students include program documentation is evident in the results of the assessment. Students provided documentation on positional data, numeric data, and branching structures in their programs.

   Process documentation expanded on the data with process descriptions and an explanation of the program structure.

   The program documentation is based upon specific requirements on format. The process documentation, a narrative paper, is based on an outline of requirements. Although the functional requirements were meet, the format varied from student to student. A narrative research paper, for example in a composition class, is based on recognized standards to provide consistency in format. Requiring the students to follow a format in the process document would provide uniformity for grading the program structure description.

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3. Based on these assessment findings, modifications/changes will be made:

___to the way in which information is delivered to students
___ to the curriculum
_X_ to the Benchmark
_X_ to the Assessment Method
___ to the Learning Outcome
___ other

Please explain:

To the Benchmark:

Eighty (80%) percent of the students will complete the final robotic application programs in the ROB 1620 motion ad logic program structure.

The change from the ROB 2400 to ROB 1620, the first programming applications course, will measure the students' abilities to determine from the application process requirements the motion and logic instructions to complete the assignment. This assessment for knowledge usage compliments the Robotics Automated Systems Technology Assessment Benchmark ID 922 B1, the "capstone" programming course ROB 2400 measure for applying the knowledge for problem analysis and solving.

To the Assessment Method:

Eighty (80%) percent of the students will complete ROB 1620 final application rubric of programming instruction usage and structure of for the application, by meeting eighty (80%) of the items defined in the rubric as to specification.

4. At what point will these actions be implemented?

Month: __January_____Year: ___2008_____

5. Please explain if there are any budgetary implications stemming from these actions.

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Robotics Automated Systems Technology (Extended)
Program Assessment Feedback Form
Benchmark ID 921 B1

Learning Outcome
Students will program the motion and logic for an automated system to correctly execute the application.

Benchmark
Eighty (80%) percent of the students will complete the four robotic application programs in the ROB 2400.

Assessment Method
Robotic programming labs in ROB 2400, will be completed within the minimum specifications identified in each lab for the motion and logic requirements of the application.

Benchmark Scheduled To Be Assessed: 5/1/2007
Assessment Results Sent To Office of Assessment and Effectiveness: 6/1/2007

Enter the total number of students who were assessed	Enter the number of students who performed at or above the level indicated in the benchmark	Enter the percent of students who performed at or above the level indicated in the benchmark
9	9	100%

1. The above results indicate that the benchmark:

   _X_ was met
   ____ was not met

2. What was learned through the assessment of this benchmark?

   Students completed the within minimum specifications the motion and logic requirements of the applications.

Note: When completed, please send a copy of this form to your dean, program assessment facilitator and Marty Orlowski (maorlows@oaklandcc.edu

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students would be provided with a grading rubric on the requirements and the format required for the program and process documentation. Curriculum changes include creating exercises, which are part of the study guide materials, to provide the students with additional resources on the connection on the boards/components and the relationship between the boards/components in the operations of the system. In addition, a change to the curriculum would occur for ROB 1620 where students will submit documents on separate applications, one in the first third of the semester and the next submission in the second third of the semester.

the motion and logic items defined in the rubric to specifications." The Benchmark already states this will be accomplished by 80% of the students in ROB 1620. This application is not as complex as in the ROB 2400 921 B2, at this level the application can be measured against a rubric on the logic use and execution.

For 921 B2, there are multiple standards (five pages defining the standards to be exact, not including the four pages loosely describing the application for the student to interpret as to how to accomplish based on previous courses) the student must follow in this 2000 level course for the final application. The complexity and variability of the assignment's requirements for execution, supporting documentation in the program, and process documentation does not fit into the easily into the rubric format for assessment.

For 922 B3, statement is added to note the criteria for assessment, "...as defined in the standard." There eleven systems for the students to determine the problem and submit in their 'mock' field service report. Again, the variability does not allow for a single rubric to define the eleven situations. Meeting the defined standards required for the report allows for the evaluation of the particular problem in context to the aggregate grade.

For 923 B1, eliminated ROB 2400 reference which is redundant to 921 B2. These assignments in ROB 1520 have a rubric because of the procedural nature of the assignments.

3. SAGE findings from Office of Assessment & Effectiveness.

   - In terms of program assessment, the previous Robotics/Automated Systems Technology assessment plan had three unique Learning Outcomes and a total of 6 Benchmarks. In March 2008, the plan was modified and now has four unique Learning Outcomes and a total of 6 Benchmarks, which is in accordance with the guidelines established by the Student Outcomes Assessment Committee.

   - Between April 2007 and March 2008, all 6 benchmarks were assessed, although one of the benchmarks was determined to be unmeasurable so the result was unknown. This was part of the plan modifications and this particular benchmark was changed. Overall, 83% of the 6 Benchmarks were met.

   - Various action strategies were identified as a result of recent assessment activities. These include making modifications to several plan benchmarks and assessment methods which were completed and submitted to the Office of Assessment. Also, proposed changes to the way in which information will be delivered to the students and to the curriculum were proposed. For the way in which information will be delivered to students, it was suggested that

G. OUTCOMES ASSESSMENT - DATA ANALYSIS

1. How has the findings from the Program Assessment been used to improve the program.

   Findings from the 2006-7 academic year Program Assessment. See pages 139 to 150 for Program Assessment Feedback

   The two courses, ROB 1620 Industrial Robotic Applications, and the program's capstone course, ROB 2400 Automated Systems Applications, are for applications programming. The findings were used to determine the deficiencies in the capstone course ROB 2400 and where the foundation of programming structures are to be implemented in the ROB 1620.

   Develop a consistent guideline for the student's program documentation in the ROB 1620 and ROB 2400. Variations for other robotic courses.

   In the ROB 2500 Automated Controller Maintenance, restructured the order of the lecture and labs and created additional circuit diagram and connections instructional materials.

   Troubleshooting of controllers in ROB 2500 were 98% of the students correctly identified the malfunctions and then explain the reasons for the observed symptoms caused by the malfunction.

   In the 1520 Robot Manipulator Drives and Linkages course the student developed a technical document providing a synopsis of a specific maintenance procedure derived from various sources in the supplied manufacture's documentation.

   In the ROB 1620 progressive labs detailing the data within and structure of the program to complete the application documentation.

2. Suggested revisions to Program Assessment Plan.

   See pages 151 to 152 for 2007-08 Assessment Plan.

   Five Learning Outcomes are defined for the 2007-8 academic year to assess the maintenance (ROB 1520 and 2500) and application (ROB 1620 and ROB 2400) aspects of the curriculum at 1000 and 2000 levels of the program.

   One of the assessment plans, 921 B2, has been discontinued due to a change in instruction. Flowcharting is no longer used and has been replaced with concept maps.

   For Assessment Method in 821 B1 to: "The students will meet eighty (80%) of

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOGY

Certificate Program

Engineering/ Manufacturing & Industrial Technology

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOGY
(ROB.AUT.CT)

The Robotics/Automated Systems Certificate, 51 credits, is intended for individuals who have earned a previous degree or have significant work related experience in manufacturing technology. Students without any or limited previous related experience in manufacturing technology are encouraged to enroll in the Robotics/Automated Systems Technology Associate degree.

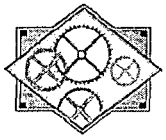
Requirements		Credits
ROB 1500	Introduction to Robotics Technology	4
ROB 1520	Robotic Maintenance	4
ROB 1620	Industrial Robotic Applications	4
ROB 1640	Interpolated/Welding Robotic Applications	4
ROB 1660	Robotic Communications and Machine Vision	4
ROB 2040	Programmable Controller Applications	4
ROB 2140	Advanced Programmable Controller Applications	4
ROB 2400	Robotic Automated Systems Applications	4
ROB 2500	Robotic Controller Maintenance	4
APP 2170	Applied Technology	4
ATF 1470	Fundamentals of Pneumatics	3
CAD 1101	Introduction to CAD	4
CIS 1300	Networking Concepts	4

Note: Computer skills are essential for the lab requirements of the courses. Students without basic computer skills are strongly encouraged to enroll in CIS 1000 Computer Literacy.

TECH PREP STUDENTS: Students who have completed articulated Tech Prep programs may apply for advanced placement. Detailed information may be obtained through your high school counselor.

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOGY

Certificate of Achievement



Engineering/ Manufacturing & Industrial Technology

PROGRAMABLE CONTROLLERS
(ROB.PCT.CA)

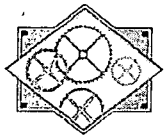
The Programmable Controllers Certificate of Achievement is intended for individuals who need to enhance their existing related experience in manufacturing technology

Requirements		Credits
ROB 2040	Programmable Controller Applications	4
ROB 2140	Advanced Programmable Controller Applications	4
CIS 1300	Networking Concepts	4

Note: Computer skills are essential for the lab requirements of the courses. Students without basic computer skills are strongly encouraged to enroll in CIS 1000 Computer Literacy.

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOGY

Associate in Applied Science (ROB.AUT.AAS)



Engineering/Manufacturing & Industrial Technology

This program is designed to prepare students for career opportunities in the robotics and automation fields and provides a background in many areas of technology:

- Robotic Programming Applications
- Computer Integrated Manufacturing
- Robotic Controllers
- Robotic Mechanical Drives
- Robotic Welding Systems
- Programmable Controllers
- Human Machine Interface
- Industrial Networks
- Vision Systems

Robotics/Automated Systems Technologies prepare students for employment in advance manufacturing and for emerging technologies.

A robotics technologist applies traditional electro-mechanical skills with knowledge of programming, controls, and networking to mechatronics concepts as related to robotic systems. Individuals in the field of robotics apply logic and reasoning to identify the strengths and weaknesses of approaches to problems, or to alternative solutions for innovations in technology leading to development of new applications and markets for robotics.

Two certificates are offered for acquiring useful credentials in robotics, enhancing current skills, or building toward an Associate degree:

- Robotics/Automated Systems Certificate, 51 credits
- Programmable Controllers Certificate of Achievement, 12 credits

Major Requirements		Credits
ROB 1500	Introduction to Robotics Technology	4
ROB 1520	Robotic Maintenance	4
ROB 1620	Industrial Robotic Applications	4
ROB 1640	Interpolated/Welding Robotic Applications	4
ROB 1660	Robotic Communications and Machine Vision	4
ROB 2040	Programmable Controller Applications	4
ROB 2140	Advanced Programmable Controller Applications	4
ROB 2400	Robotic Automated Systems Applications	4
ROB 2500	Robotic Controller Maintenance	4

Required Supportive Courses		Credits
APP 2170	Applied Technology	4
ATF 1470	Fundamentals of Pneumatics	3
CAD 1101	Introduction to CAD	4
CIS 1300	Networking Concepts	4
ENG 1450[1]•	Writing and Reading for Problem Solving	3
MAT 1150•	Intermediate Algebra	4

General Education Requirement

See p. XXX or inside back cover.

Note: Computer skills are essential for the lab requirements of the courses. Students without basic computer skills are strongly encouraged to enroll in CIS 1000 Computer Literacy.

TECH PREP STUDENTS: Students who have completed articulated Tech Prep programs may apply for advanced placement. Detailed information may be obtained through your high school counselor.

[1] Prospective transfer students should select ENG 1510.

• Course may be used to meet General Education requirements.

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Michigan Companies

- Accubilt Inc.
- Air Way Automation Inc.
- Altron Automation Inc.
- Automated Process Equipment Corp.
- Automatic Inspection Systems
- Bosch Rexroth
- Burton Industries Inc.
- CPI Products Inc.
- Custom Manufacturing Co.
- Dunkley International Inc.
- Egemin Automation Inc.
- Ergomatic Systems Inc.
- Flexible Automation Inc.
- Frost Industries
- General Signal Corp.
- Graminex
- Hi-Tech/F P A Indocomp Systems Inc.
- J R Automation Technologies
- J. W. Holdings Inc.
- Jervis B. Webb Co.
- Lematic Inc.
- Lomar Machine & Tool Co.
- Michigan Rebuild & Automation Inc.
- Micro-Machine Co.
- Precision Devices Inc.
- Premier Industries Corp.
- Progressive Technologies Inc.
- R W C Inc.
- Spen-Tech Machine Engineering
- Tyden Group Inc.
- VIA Automation
- Xycom Automation
- Zitek Corp.

- Mika Systems Inc.
- Modernization & Development Engineering
- Morrell Inc.
- Motoman
- Multi-Contact U S A Inc.
- Nachi Robotic Systems Inc.
- Nagase America Corp.
- National Element Inc.
- Outbound Technologies Inc.
- Oxford Automotive Inc.
- Patriot Sensors & Controls Corp.
- Peaker Services Inc.
- Plymouth Wayne/Advanced Robotic Concepts
- Precise Finishing Systems Inc.
- Prince Manufacturing Corp.
- Prospects Corp.
- Pursuit Technology
- Questech Inc.
- Renzur Machine Inc.
- Resolution Technologies
- Rkt Control Support Inc.
- RLE International
- RoboHand /De-Sta-Co Industries
- Robot Fabricators
- Robotic Concepts Inc.
- Robotic Production Technology
- Sanyo Machine America Corp.
- Self-Guided Systems
- SI Systems Inc.
- Speedring Systems Inc.
- SSI Technology Inc.
- Stargate Automation
- Static Controls Corp.
- Staubli Corp.
- Sterling-Detroit Co.
- Strategic Alliance Inc.
- T A Systems Inc.
- TDS Automotive U.S. Inc.
- Thoreson-McCosh Inc.
- TKS Industrial Co.
- Traffic & Safety Control Systems
- United Industrial Engineering Corp.
- Universal Flow Monitors Inc.
- USM Systems
- Valentine Robotics
- Visual Strategies
- VSI Automation Assembly Inc.
- Weldmation Inc.
- Williams International

Southeast Michigan Companies

- Ann Arbor Technologies Corp.
- Applied Dynamics International
- Automated Production Systems
- Creative Automation Inc.
- DMI Tech Inc.
- Dominion Technologies Group
- Dynics Inc.
- Epic Equipment & Engineering
- F E C Inc.
- Fata Automation Inc.
- Fori Automation Inc. Futuramic Tool & Engineering Co.
- Invo Spline Inc.
- Kuka Flexible Production Systems Corp.
- Lapeer Industries Inc.
- Mag Industrial Automation Systems
- NCC Electronics
- Pilz Automation Safety
- Spectrum Automation Co.
- Tarpon Automation & Design Co.
- Utica International Inc.
- Worldwide Synergies

Robotics and Automation Companies
Oakland County Business Development Services

Oakland County Companies

- ABB
- Acord Inc.
- Acromag Inc.
- ADD
- Aggressive Systems Inc.
- AIC Equipment & Controls Inc.
- ALBAH Manufacturing Technologies Corp.
- Allor Manufacturing Inc.
- Ampro Inc.
- Applied Manufacturing Technology
- Argent Group
- Auteb USA
- Autoliv Asp Inc.
- Automated Systems Inc.
- Automation & Modular Components Inc.
- Behr Systems Inc.
- Best Products Inc.
- Big Dutchman Inc.
- Braintech Inc.
- Central Conveyor Co.
- Cinetic Automation Corp.
- Comau Pico
- Complete Auto-Mation Inc.
- Corrsys-Datron Sensorsystems
- Mahle Inc.
- CSC Manufacturing Inc.
- Dana Corp.
- Debron Industrial Electronics Inc.
- Dedoes Industries Inc.
- Delmia
- Denso International America
- Detroit Precision Hommel Inc.
- Diamond Automations Inc.
- Dumas Central Industries
- Durr Automation Inc.
- Dynalog Inc.
- Electro-Matic Products USA
- Fame Industries Inc.
- Fanuc Robotics America Inc.
- Federal APD Inc.
- Flow Robotic Systems
- Giffin Inc.
- Global Electronics Ltd.
- Gonzalez Production Systems
- Gse Tech Motive Tool Inc.
- Gudel Inc.
- H E L P Engineering Inc.
- Haden Inc.
- Heidel North America Inc.
- Herkules Equipment Corp.
- Hms Products Co.
- INCAT
- Incoe Corp.
- InfoTronics
- Integral Vision Inc.
- Integrated Security Corp.
- Intellisys Automotive Systems
- Iwka Holding Corp.
- JADI Inc.
- J H P Inc.
- Jay Enn Corp.
- JEM Design Inc.
- Jessup Engineering Inc.
- JMR Holdings Inc.
- Johann A. Krause Inc.
- Kawasaki Robotics
- KDS Controls Inc.
- KEBA Automation
- Koshy Specialty Products
- Kratzer Automation
- Kuntz Logic Systems
- Lebow Products Inc.
- LEONI Engineering Products
- Liberty Tool & Engineering Corp.
- Lilley Assoc Inc.
- Magnetic Products Inc.
- Maxitrol Co. Inc.
- Methods Machine Tools Inc.
- Michigan Scientific Corp.
- Midwestern Processes Inc.

SOC Code	Name	Education	Base	Five Year	Job Change	Ind Mix Effect	Nat Gro Effect	Expct Chng	Compet Effect	Earnings Average	Earnings Median
17-3024	Electro-mechanical technicians	Associate's degree	241	253	12	-8	17	8	4	$22.27	$23.64
51-2023	Electromechanical equipment assemblers	Short-term on-the-job training	957	896	-61	-151	66	-85	24	$15.36	$14.42
51-4011	Computer-controlled machine tool operators, metal and plastic	Moderate-term on-the-job training	3,719	3,689	-29	-358	255	-103	74	$16.57	$15.55
51-4122	Welding, soldering, and brazing machine setters, operators, and tenders	Moderate-term on-the-job training	2,200	2,225	26	-129	151	22	4	$20.12	$19.34
Totals:			7,117	7,063	-52						

Job Change- Column represents the addition of new jobs due to growth over the projection period. Indicates how many jobs will be added in the region over the selected time frame.

Industry Mix Effect- Column indicates how many of those jobs are due to movement within the industry at the national level. If the industry is growing across the nation, this is what is expected in the local area.

National Growth Effect- Column shows how the national economy affects the industry or occupation. This operates on the "rising tide carries all ships" assumption. If the economy is doing well, it is expected that this field in the region would benefit from that effect.

Expected Change- Column combines the Industry Mix Effect column and the National Growth Effect column to indicate how much the field is expected to grow in the region, without the input of variables within the economy. This is what is expected to happen if the local economy merely followed national trends.

By netting the Expected Change result out of the Job Change result, the Competitive Effect column shows the jobs that have been added in a field in the region due to growth specific to the region. These are the jobs created locally which aren't merely following national trends. A high Competitive Effect number indicates that the region has found some way to foster growth beyond other regions or even perhaps in spite of decline at the national level.

Thursday, April 10, 2008
Source: OCC, Office of Assessment && Effectiveness (CCSP)

Robotics/Automated Systems Technology Occupations and Projections
SOC Detail Definitions

SOC Code 17-3024
Name Electro-mechanical technicians

Definition
Operate, test, and maintain unmanned, automated, servo-mechanical, or electromechanical equipment. May operate unmanned submarines, aircraft, or other equipment at worksites, such as oil rigs, deep ocean exploration, or hazardous waste removal. May assist engineers in testing and designing robotics equipment.

Examples

SOC Code 51-2023
Name Electromechanical equipment assemblers

Definition
Assemble or modify electromechanical equipment or devices, such as servomechanisms, gyros, dynamometers, magnetic drums, tape drives, brakes, control linkage, actuators, and appliances.

Examples
Appliance Assembler, Vending Machine Assembler

SOC Code 51-4011
Name Computer-controlled machine tool operators, metal and plastic

Definition
Operate computer-controlled machines or robots to perform one or more machine functions on metal or plastic work pieces.

Examples
Numerical Control Machine Operator, Robot Operator

SOC Code 51-4122
Name Welding, soldering, and brazing machine setters, operators, and tenders

Definition
Set up, operate, or tend welding, soldering, or brazing machines or robots that weld, braze, solder, or heat treat metal products, components, or assemblies. Include workers who operate laser cutters or laser-beam machines.

Examples
Electron Beam Welder Setter, Laser-Beam Machine Operator, Ultrasonic Welding Machine Operator

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Oakland Community College
Applied Technology

Completion of Applied Technology program at EMU

Required Credits (6 credits)
A minimum of 6 credits from the courses listed on page 2 under **"Courses That May be Taken at OCC or EMU"** must be completed at EMU. A minimum of 30 credits must be completed at EMU and a minimum of 124 total credits is required to graduate.

Required Course (3 Credits)
[1]ENG 324 Principles of Technical Communication..... 3

Major Requirements (21 Credits)
**Restricted Electives (100-400 level)..... 6
**Restricted Electives (300-400 level)..... 15

Minimum Credits at EMU: 30

Minimum Credits to Graduate: 124

[1]Satisfies one of EMU's four additional general education requirements for MACRAO, see page 1, #2 for more information.
***All restricted electives must be approved by the Applied Technology Program Coordinator.*

Approved Technical Programs at Oakland Community College

Architecture
Automobile Servicing
Automation Systems Technology- All Concentrations
Ceramic Technology
Collision Auto Repair
Computer Aided Design & Drafting Technology – All Options
Computer Hardware Engineering Technology
Computer Information Systems- All Options
Control Systems Technology
Electrical Trades Technology
Environmental Systems Technology – All Options
Graphic Design
Interior Design
Machine Tool Numerical Control Technology
Manufacturing Technology
Robotics/Automated Systems Technology
Electromechanical Engineering Technology
Industrial Technology/Technical Apprentice/Skilled Trades
Other programs may be used with approval of the EMU Program Coordinator

Beginning in fall 2007, students will be able to complete the Applied Technology Program on-line. EMU will offer 30 credit hours of Applied Technology coursework over the internet. Such coursework will include the major requirements (Restricted Electives) and an additional nine credit hours of appropriate university electives.

EASTERN MICHIGAN UNIVERSITY
TRANSFER GUIDE
May 2006

Oakland Community College
Applied Technology

Oakland Community College		Eastern Michigan University
MACRAO Requirements	**(32 credits)**	**(32 credits)**
1. English Writing Requirement	**(6credits)**	**(6 credits)**
ENG 1510 Composition I	3	ENGL 120 Elective Credit 3
ENG 1520 Composition II	3	ENGL 121 English Composition II 3
2. Math/Science Requirement	**(8credits)**	**(8 credits)**
MAT 1540 College Algebra	4	MATH 105 College Algebra 4
Choose one course from the following:	4	One course: 4
CHE 1000 Introductory Chemistry (4)		CHEM 117/118 Fund of Chemistry with Lab (4)
PHY 1610 College Physics I (4)		PHY 221 Mechanics, Sound & Heat (4)
3. Social Science Requirement	**(9credits)**	**(9 credits)**
ECO 2610 Economics I	3	ECON 201 Principles of Macroeconomics I 3
PSY 2510 Introduction to Psychology	3	PSY 101 General Psychology 3
POL 1510 American Government	3	PLSC 112 American Government 3
4. Humanities Requirement	**(9credits)**	**(must be from at least two disciplines) (9 credits)**
[1]ENG 1610 Women in Literature	3	LITR BASX (or any approved cross cultural course) 3
Choose two courses: (No more than one in literature)	6	Two course: 6
ART 1510, 1520, 1560; ENG 1710, 1720, 2510, 2520, 2530, 2540, 2550, 2560; HUM 1510, 1520, 1710; MUS 1560; PHI 1510, 1610, 1710; SPE 2620; THE 1561,1571, 1900; FRE/GER/ITA/JPN/SPN 1510, 1530, 2610, 2620 or other transferable course approved by OCC for the MACRAO humanities requirement.		Courses will transfer as equivalent courses, or general education transfer credit (BAS), or general transfer credit (000) (AACR)
Additional Requirement	**(2 credits)**	**(2 credits)**
PER 1590 Physical Well-Being in a Modern Society	2	PEGN 210 Lifetime Health and Fitness 2
Technical Concentration	**(34 credits)**	**(34 credits)**
A maximum of 34 credits in technical courses from an approved OCC program/discipline may be transferred as a block for the technical concentration. If the program has less than 34 technical credits, related technical courses may be taken at either institution to make up the difference	34	Technical Concentration 34

Courses That May be Taken at OCC or EMU (32 credits)

OCC (maximum of 26 credits)	EMU (minimum of 6 credits)
[1]Choose one course: 2-4	INDT 201 Microcomputers in Technology 3
CIS 1040 Intro to Computing Concepts (2)	(substitution for INDT 201)
CIS 1050 Personal Comp. Applications (4)	(substitution for INDT 201)
CIS 1100 Fund of Information Systems (4)	(substitution for INDT 201)
ECO 2620 Economics II (3)	ECON 202 Principles of Economics II (3)
MAT 1560 Trigonometry (3)	MATH 107 Plane Trigonometry (2)
[1]MAT 1580 Statistics (4)	[1]MATH 170 Elementary Statistics (3)
PHY 1620 College Physics II (4)	PHY 222 Electricity and Light (4)
Complete the course which has not already been taken: (4)	Complete one course: (4)
CHE 1000 Introductory Chemistry	CHEM 117/118 Fund of Chemistry with Lab
PHY 1610 College Physics I	PHY 221 Mechanics, Sound & Heat
Open Electives (not to exceed 94 credits at OCC) (10-13)	Univ Electives to bring the program total to124 (10-13)
Maximum Credits at OCC: 94	**Credits that transfer to EMU 94**

**Students who cannot place into MAT 1540 must complete MAT 1150 Intermediate Algebra. The additional course may be used as an elective under "Additional Courses that may be taken at OCC or EMU".*

[1] Satisfies one of EMU's four additional general education requirements for MACRAO, see page 1, #2 for more information.

EASTERN MICHIGAN UNIVERSITY
TRANSFER GUIDE

May 2006

Oakland Community College – Associate Degree in an Approved Technical Program
Eastern Michigan University – Bachelor of Science in Applied Technology

Purpose: **Bring a copy of this transfer agreement to all advising sessions.**

This 3 + 1 agreement was developed to provide a smooth curriculum transition for students who want to earn an associate degree in an approved technical program from Oakland Community College and transfer to EMU to earn a Bachelor of Science in Applied Technology. The agreement is designed to minimize loss of credits and duplication of coursework in transferring. In addition, students may complete up to 94 credits at the community college if desired.

Requirements:

1. Complete an approved technical program or 34 hours in an approved technical discipline at Oakland Community College and the coordinated program of study for the Applied Technology program at EMU as indicated in this Transfer guide. Any course substitutions should be made with the guidance of an advisor or counselor to assure that all requirements are met.
2. Students whose transcripts are endorsed as "MACRAO Satisfied" by the community college will only be required to meet EMU's additional four general education requirements, indicated in the transfer guide with a "1" and listed below:
   (a) A course in advanced written composition, speech, or a foreign language [ENGL 324 at EMU]
   (b) A course in mathematical reasoning [MAT 1580 at OCC] or [MATH 170 at EMU]
   (c) A cross-cultural course [ENG 1610 at OCC] or [approved cross cultural course at EMU]
   (d) A course in computer literacy [CIS 1040, CIS 1050, or CIS 1100 at OCC] or [CADM 105 at EMU]

   To use MACRAO, students should request a MACRAO evaluation of their transcript in the Community College Registrar's Office. Students who do not satisfy MACRAO will have to complete all of EMU's general education requirements.
3. Only courses with a grade of "C" or better (2.0 on a 4.0 scale) will be accepted for transfer to EMU. A course completed with a grade of less than 2.0, which is counted toward graduation at the community college, may be used to satisfy MACRAO requirements. However, the course will not transfer and will have to be repeated if it is a requirement of the Applied Technology program at EMU.
4. Under this agreement, EMU will waive the 60-hour rule and require that a minimum of 30 credit hours must be taken at EMU, 21 hours of which must be in the major with 15 hours at the 300/400 level. A minimum of 124 credit hours, completed in-residence or accepted in transfer, is required for graduation.
5. Students must meet all admission requirements at the time of application for admission to EMU, including submitting transcripts from all previously attended colleges. OCC students will receive equal consideration with other EMU students for course registration and financial aide.
6. Students should contact the Applied Technology Program Coordinator early, before completing an admission application to EMU. To facilitate the evaluation of transcripts, students should enclose a copy of their transfer guide with their EMU admission application and bring a copy to all advising sessions. Copies of the transfer guide are available on EMU's webpage at www.emich.edu/ccr/artguide.htm.

Effective Dates: May 15, 2006 until May 15, 2009. In the fall semester of 2007 this agreement will be updated to be consistent with the new general education requirements that go into effect at EMU. OCC students, who began a program prior to fall 2007, may continue to follow the requirements in place at the time they started. Students who begin at OCC during or after the fall semester of 2007 will have to satisfy the new General Education requirements. If this agreement is not renewed at the end of the effective period, students who already began the program will have an additional five years to be admitted to EMU under the terms of the agreement. Students who began before the effective date may use this agreement.

Contacts:

Oakland Community College
Doug Riddering, Counselor
B-228 Auburn Hills Campus, 248-232-4350

Eastern Michigan University
Philip Rufe, Applied Technology Program Coordinator
118 Sill Hall, 487-2040, philip.rufe@emich.edu

Robert Teehan, College of Technology Advisor
109 Sill Hall, 734-487-8659, robert.teehan@emich.edu

ARTICULATION GUIDE

Oakland Community College- Robotics Automated System Technology
LTU – Bachelor of Science of Engineering Technology
Based on OCC 2005-06 Catalog and LTU 2005-07 Catalog

Oakland Community College Courses:	Transfer to LTU as:
Other Transferable Credits: Note: A maximum of 70 credits may be transferred from community colleges. MAT 1600 or 1730 Calculus ..... 4 MAT 1580 Statistics ..... 4 CHE 1000 or 1510 Chemistry ..... 4 PHY 1610 Physics ..... 4 PHY 1620 Physics II ..... 4 ECO 2610 or 2620 ..... 3 Second course in fine arts/humanities from page 1 3	MCS 2313 Tech Calculus ..... 3 MCS 2023 Statistical Methods ..... 3 CHM 3144 Fundamentals of Chemistry ..... 4 PHY 1063 Tech Physics 1 ..... 3 PHY 1100 Tech Physics 1 Lab ..... 0 PHY 1083 Tech Physics 2 ..... 3 PHY 1101 Tech Physics 2 Lab ..... 1 SSC 2303 Basic Economics ..... 3 LLT 1223 World Masterpiece 2 ..... 3 **Completion of the BSET Degree at LTU** **Technology Core .....(26 credits)** HRM 4013 Employee Management Relations ..... 3 MGT 2203 Management & Supervision ..... 3 TOM 3113 Operations Managemen ..... 3 TIE 2063 MFG Process ..... 3 TME 2163 Engineering Economics ..... 3 TME 4103 Engineering Materials 2 ..... 3 TME 2053 Dynamics OR TME 3133 Eng. Mech ..... 3 TIE 4115 Senior Project ..... 5 COM 1001 (Univ. Seminar) Excused **Additional Credits** LLT/SSC/ PSY Jr./Sr. Elective ..... 3 MCS 1023 Tech. Comp. App ..... 3 MCS 2323 Applied Diff. Equations 3
	Maximum Transferable OCC Credits .....70 **Minimum Credits at LTU: .....55** **Minimum Credits to Graduate: 125**

LAWRENCE TECHNOLOGICAL UNIVERSITY®

ARTICULATION GUIDE

Oakland Community College – Robotics Automated System Technology
LTU – Bachelor of Science in Engineering Technology

Based on OCC 2005-06 Catalog and LTU 2005-07 Catalog

Oakland Community College Courses:	Transfer to LTU as:
Degree Requirements	
Major Requirements	
ROB 1500 Intro to Robotics Tech 4	Technology Specialty 25
ROB 1520 Robot Manipulator Drives and Link 4	
ROB 1620 Industrial Robotic App 4	
ROB 1640 Interpolated/Welding Robotic App 4	
ROB 1660 Sensor Technology 4	
ROB 2040 Programmable Controller 4	
ROB 2140 Adv Programmable Cont App 4	Technology Elective 6
ROB 2400 Automated Systems App 4	
ROB 2500 Automated Controller Maint 4	Open Elective 4
Required Supportive Courses	
ATF 1400 Intro to Hydraulics 3	General Elective 3
ATF 1470 Fundamentals of Pneumatics 3	General Elective 3
CAD 1100 Intro to CAD & Drafting 3	No credit
EEC 1020 DC Fundamentals 3	EEC 1020 + 1040 TEE 3103 3
EEC 1040 AC Fundamentals 3	
ENG 1510 English Composition 3	COM 2103 English Composition 3
ETT 2700 Machines and Process Controls 4	No Credit
MAT 1150 Intermediate Algebra ..... 4 *(MAT1540 preferred)*	No Credit
General Education Requirements	
Fine Arts/Humanities ..... 3 *Select one of the following:* ART 1560, 1700, 2560, 2600, 2620, ENG 1710, 1720, 2510, 2520, 2530, 2540, 2550, 2560, 2750, 2760, 2800, 2820, FSH 1500, HUM 1510, 1520, 2720, 2900, MUS 1540, 1550, 1560, 1585, 1590, 1670, THE 1561, 1800	LLT 1213 World Masterpieces 1 3
Physical Education....(see OCC catalog) 1	PER does not transfer to LTU
POL 1510 3	SSC 2413 Foundations/ Am. Exp 3
Social Sciences ..... 3 *Select one of the following:* ANT 1540, GEO 1520, HIS 1510, 1520, 1550, 1700, 2510, 2520, 2610, 2620, SOC 2510, 2520, 2610, PSY 2510, 2630, 2710, 2810, SSC 2610, 2710	SSC 2423 Development/ Am. Exp 3
Written Communication	
ENG-2200 Professional Communication 4	MCS1123 Tech & Prof Comm 3

NOTE: See an OCC counselor for transfer information.

✓ In the following General Education categories one course may meet more than one general education requirement: Cultural Enrichment, Social Awareness, Global Consciousness, and Race-Ethnicity-Gender (REG)

Required Courses	Course Title	Pre-Requisite	Oakland CC Equiv Courses	Cr. Hr.	Substitution or Equivalent	Cr. Hr.	Grade
Communication Competence—12 Semester Hours Required							
COMM 121 or COMM 251	Fundamentals of Public Speaking or Argumentation and Debate		SPE1610	3			
ENGL 150	English 1		ENG1510	3			
ENGL 250 or ENGL 211	English 2 or Industrial & Career Writing	ENG1510	ENG1520	3			
ENGL 311, or ENGL321 or ENGL325	Advanced Technical Writing, Advanced Composition, or Advanced Business Writing	ENG1520	FSU class	3			
Scientific Understanding—7 Semester Hours Required At least one course must be a lab science *(PHYS 211 is required for the BAS major)* Select any approved science course from the following courses or subject areas: ***Biology, Chemistry, GEO 1510, Physics***							
Physics Lab	Introduction to Physics 1	MAT1560	PHY1610	4			
Scientific Understanding	Lab or Non-Lab Science		Oakland	3			
Quantitative Skills—4 Semester Hours Required This requirement can be met as follows: • Complete the courses listed below, or show math credit that is higher than FSU MATH 126, or pass the College Algebra and Trig. CLEP exam The Intermediate Algebra portion of the MATH 126 requirement can be met as follows: (1) pass the CLEP College Algebra exam, or (2) present an ACT Math subtest score of 24 or higher. ***Discuss these options with an FSU Program Advisor***							
MATH 126	Algebra and Analytic Trigonometry (also meets BAS Major requirement)	MAT1150	MAT1540 & MAT1560	4 3			
Cultural Enrichment—9 Semester Hours Required • Must complete three courses. One course must be 200-level or higher (*Oakland Community College course that transfers to Ferris at 200-level or higher)* • No more than 5 credits in Studio Art, Theatre, and/or Music courses will be applied to meeting this requirement • Select approved courses to meet "Cultural Enrichment" requirements from the following courses or subject areas: ***Art, Art History, ENG 2800, Foreign Language, History, Humanities (Except Logic), Literature, Music, PHO 1220, SPE 2620, Theatre***							
Cultural Enrichment	100- or 200-level classes		Oakland	3			
Cultural Enrichment	100- or 200-level classes		Oakland	3			
Cultural Enrichment	200-Level		Oakland	3			
Social Awareness—9 Semester Hours Required • Complete three approved courses in at least two different subject areas *(PSYC 150 is required for the BAS major)* • Complete ONE course from the following Oakland Community College courses and/or subject areas: ***Anthropology, Economics, GEO 1520, Political Science, Psychology, Sociology, Social Science*** • Choose ONE 200-level social awareness class from the following courses: ECO2610, ECO2620, **PSY2630, PSY2710,** PSY2730, SOC2560. (***Those in BOLD recommended)***							
PSYC 150	Introduction to Psychology (meets requirements for race, ethnicity & gender)		PSYC2510	3			
200 Level Social Awareness	Choose from list above		Oakland	3			
Social Awareness	Select one course from the Social Awareness category list above			3			
Global Consciousness: Select course in Cultural Enrichment or Social Awareness that meets both requirements: ANT 1540; FRE 1510, 1530, 2610, 2620; GER 1510, 1530, 2610, 2620; HIS 1520; SOC 2610; SPA 1510, 1530, 2610, 2620							
Global Consciousness	(Use same course as selected in Cultural Enrichment)			--	Met above		
Race, Ethnicity and/or Gender One course required. This requirement is met through the program requirement for Oakland Community College							
PSYC150	Introduction to Psychology			--	Met above		
							General Education Hours: 44
							Total Credits: 125

Approved by: _____ _____ Approved by: _____ _____
Program Advisor Date Program Coordinator Date

Industrial Technology and Management, B.A.S.

Oakland Community College

Articulation Guide 10-08-2007

NAME _____ DATE: _____

Admission Requirements:

1. Minimum credits for admission into the degree program will require at least 48 transferable credits or an Associate Degree. In certain circumstances, individuals may be admitted into the program without prior earned credit at the discretion of the Dean. In addition, students may be enrolled concurrently at FSU and Oakland Community College.
2. A 2.5 overall GPA and 2.5 in mathematics courses is required for admission.
3. All official college transcripts must be submitted at time of application for admission.
4. To be considered for financial aid from Ferris, students must have earned 48 transferable semester hours or an associate degree and take at least six credit hours each semester.

Graduation Requirements:

1. To graduate, students must have a 2.0 CUMULATIVE GPA in all FSU courses, a 2.50 GPA in the Math courses, and a 2.75 in the Concentration and Core (FSU courses).
2. At least 30 FSU semester hours must be completed to fulfill FSU residency requirements.
3. Students must meet the University General Education Hours requirements listed.
4. There must be a minimum of 40 total credit hours at the 300 or 400 level.
5. 125 credit hours are required for graduation.

Required Courses	Course Title	Pre-Requisite	Oakland CC Equiv Courses	FSU S.H.	Substitution Or Equiv	CH	Grade
Concentration Requirements							
APPS 305	Introduction to 3-D Modeling	See OCC Catalog	CAD 2110 or CAD 2130 or CAD 2102	4			
APPS 350	Automation, Electrical and Mechanical Design		FSU Class	3			
APPS 351	Production Flow and Plant Layout		FSU Class	3			
APPS 401	Contemporary Issues in Industrial Management		FSU class	3			
APPS 450	Manufacturing Improvement Management		FSU Class	3			
EHSM330	OSHA Laws and Regulations (online)		FSU Class	2			
MFGE 341	Quality Science Statistics		FSU class	3			
MFGE 352	Design for Manufacturing		FSU class	2			
MFGE 423	Engineering Economics	OCC MATH 1630	FSU class	2			
MGMT 370	Quality / Operations Management	FSU MFGE 341	FSU class	3			
							Total Concentration Hours Required: 27
Core Requirements							
APPS 301	Project Management		FSU Class	3			
APPS 499	Capstone Course		FSU class	2			
APPS 420	Manufacturing Certification & Standardization	Sr. Standing	FSU Class	3			
MGMT 301 Or MGMT302	Applied Management	BUS1100	BUS2530	3			
							Total Core Hours Required: 11

Related Electives

1. Credits may be fulfilled from approved courses within Oakland Community College program codes (prefixes: ACC, ADT, AET, APP, APS, ARC, ATA, ATF, ATM, ATW, AUT, BUS, CAD, CAR, CIM, CIS, DDT, ECO, ECT, EEC, EGR, ELT, ETT, GCA, GRD, IND, IPD, MEC, MTC, QAT, ROB, TED, TER)
2. Credits may be transferred from any accredited college, university or approved technical school

Course	School	Credits	Course	School	Credits	Course	School	Credits
	Total Credits			Total Credits			Total Credits	
								Minimum Related Electives: 36

Free Electives

								Free Electives: 7

or

QUAL-107 Charts & Graphs for SPC	3
ELEC-133 Electrical Circuits	3
MECH-150 Material Systems & Evaluation	3
MECH-143 Welding Processes	3

CREDIT HOURS 59-60

Plus any additional credits needed to fulfill graduation and/or General Education Requirements.

MDES-101 Modern Industrial Robotics

Credit/Contacts: 4/6

Description: In this course, students learn the features and functions of modern industrial robots and robot systems. The students will identify robotic joint types and joint motions, degrees of freedom and classify robots according to their structural configurations. State of the art techniques for programming of robots and identifying components in a lean manufacturing robotic work cell will also be studied

MSIM-200 Robotics and Simulation

Credit/Contacts: 4/6

Course Requirements: Prerequisite: MSIM-100 and MDES-101

Description: This course introduces the student to the history of robotics, definition of a robot, industrial development of robots, configurations of robots, working envelopes of robots, degrees of freedom of robots, and application and justification for robotics. The participant will use simulation software to apply end effectors, User Tool coordinate systems and robot dress to standard robot models. The participant will also create off-line robotic paths in accordance with good robot programming guidelines. After the simulation paths are created and the auxiliary settings are optimized, the participant will analyze paths for reach while taking in account variation between the simulation and the real world.

MSIM-210 Advanced Topics in Simulation

Credit/Contacts: 4/6

Course Requirements: Prerequisite: MSIM-200

Description: This course introduces the student to simulation using advanced programming techniques that allow the user to manipulate the objects in a work cell giving them motion and characteristics that simulate how they would function in the real world. The participant will create Spot and Arc Welding applications as well as paint, material handling, and pedestal robotic simulations. There are a few commonly known techniques and rules that should be followed by a robot simulation user to make sure that the paths created in the simulation are accurate to real work applications. The participant will also program the simulation to change the viewer's perspective and viewpoint during the running of the simulation and save the simulation as a movie file

Mott Community College

Manufacturing Simulation Technology
Associate in Applied Science

This program prepares the learner for computer based simulation technician positions in industry by providing core skills in math, science, communications, computer aided design (CAD), quality, manufacturing processes and materials. The program also addresses manufacturing design and robotics in order to support the integration of these systems in 3-D computer simulations of robotic manufacturing work cell design. This emerging technology is based on real-time data and allows manufacturers to simulate several scenarios without the time loss and cost of physical prototypes and/or expensive tooling. The Department of Defense, major automotive manufacturers, aircraft manufacturing, aerospace, maritime/ship building, entertainment industry and industrial equipment manufacturers are using computer simulation applications to reduce time to market and increase product quality. Development of this program has been funded by the National Science Foundation (NSF) to address the critical shortage of manufacturing simulation technicians.

Course	Credit Hours
Manufacturing Design	
MDES-101 Modern Industrial Robotics	4
MDES-110 Introduction to Manufacturing Design	3
MDES-210 Tool Design for Manufacturing	3
MDES-220 Ergonomics Design	1
Manufacturing Simulation	
MSIM-100 Introduction to Workcell Simulation CAC	4
MSIM-200 Robotics and Simulation	4
MSIM-210 Advanced Topics in Simulation	4
Related Requirement Courses	
COMM-131 Fundamentals of Communication	3
GEOG-142 World Regional Geography	4
or	
HIST-152 World History: 1500 C.E. To the Present	4
MATT-120 Technical Mathematics I	4
or	
MATH-120 Intermediate Algebra	4
MATH-140 Trigonometry	3
or	
MATT-121 Technical Mathematics II	4
CADD-187 Unigraphics-Basic Modeling & Drafting I	3
PHSM-222 Mechanics	3
PHYS-281 General College Physics I	4
QUAL-105 Global Quality Assurance	3

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Henry Ford Community College

Automation Controls Certificate - Level 2 (27 Credit Hours)

Course	Course Number	Credit Hour
Basic Electricity **	ELEC 103	4
Basic Electronics **	ELEC 106	3
AC/DC Rotating Machines	ELEC 145	3
Electronics Technology Co-op	ELEC 190	1
AC/DC Circuit Analysis	ELEC 195	3
Ladder Diagrams & Motor Controls	ELEC 200	3
Programmable Controllers	ELEC 245	3
Automation Controls and Robotics	ELEC 260	3
Technical Math (or higher level Math)	MATH 103	4
Microprocessor Systems	ELEC 295	3

Programmable Controllers ELEC 245/3
Prerequisite: ELEC 200
The course begins with a thorough discussion of the Allen Bradley PLC-5/25 programmable controller system characteristics. This is followed by a detailed presentation on how to use the programmable controller to solve the automated control problem. The ultimate objective is to prepare the student to be able to adapt to any PLC system, regardless of the manufacturer, in a minimum of time. The course consists of approximately 28 hours of classroom lecture followed by 32 hours of laboratory work. This course is equivalent to TAE 355, which is currently a required course for electrical apprentices.

Automation Controls and Robotics ELEC 260/3
Prerequisite: ELEC 245 with a grade of "C" or better
A course intended for advanced students with a basic understanding of the programmable controller. Control specifications written by the student for laboratory automation machines and industrial robots are used to implement controls for nonsynchronous and synchronous operation of the machine. Specific topics include techniques, terminology, and documentation currently used in automated manufacturing.

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INRO 6C	ANALYZING PERIPHERAL EQUIPMENT	0.33	8
INRO 6D	INTERFACING TECHNIQUES	0.50	12
	UNIT TOTAL	**1.83**	**44**
UNIT 7	**MAINT, REPAIR, TROUBLESHOOTING**		
INRO 7A	MAINTENANCE SAFETY	0.25	6
INRO 7B	ANSI SYMBOLS	0.08	2
INRO 7C	INTERPRETING SCHEMATICS	0.17	4
INRO 7D	HYDRAULIC REPAIR	0.33	8
INRO 7E	PNEUMATIC REPAIR	0.33	8
INRO 7F	ELECTRICAL REPAIR	0.33	8
INRO 7G	DRIVE REPAIR	0.25	6
INRO 7H	PERIPHERAL EQUIPMENT	0.25	6
INRO 7J	ROBOT INSTALLATION	0.25	6
INRO 7K	ROBOT RELOCATION	0.25	6
	UNIT TOTAL	**2.49**	**60**
	PROGRAM TOTAL	**16.75**	**402**

INRO 3C	PNEUMATIC SYSTEMS	0.50	12
INRO 3D	DRIVES	0.42	10
INRO 3E	MOTORS	0.42	10
INRO 3F	BRAKES	0.21	5
INRO 3G	OSHA REQUIREMENTS	0.17	4
	UNIT TOTAL	**2.72**	**65**
UNIT 4	**CONTROLS & SENSORS**		
INRO 4A	FEEDBACK SYSTEMS	0.62	15
INRO 4B	TYPES OF CONTROLS	0.62	15
INRO 4C	SENSORS	0.62	15
INRO 4D	INTRO TO TROUBLESHOOTING	0.42	10
INRO 4E	INTRO TO MAINTENANCE	0.42	10
	UNIT TOTAL	**2.70**	**65**
UNIT 5	**PROGRAMMING ROBOTS**		
INRO 5A	PROGRAMMING SAFETY	0.21	5
INRO 5B	ONLINE PROGRAMMING	1.25	30
INRO 5C	OFFLINE PROGRAMMING	0.62	15
INRO 5D	JOINT CONTROL PROGRAMMING	0.21	5
INRO 5E	PRIMITIVE MOTION PROGRAMMING	0.21	5
INRO 5F	TASK-ORIENTED PROGRAMMING	0.21	5
INRO 5G	STRUCTURAL PROGRAMMING	0.62	15
INRO 5H	LANGUAGE PROGRAMMING-BASICS	0.42	10
	UNIT TOTAL	**3.75**	**90**
UNIT 6	**INTERFACING & WORK CELL**		
INRO 6A	TYPES OF WORK CELLS	0.50	12
INRO 6B	LAYOUT OF WORK CELLS	0.50	12

Kellogg Community College

Industrial Robotics Program

PACKET NUMBER	PACKET TITLE	CRED	CONT HOURS
UNIT 1	**INTRO COMPUTER INTEGRATED MFG**		
INRO 1A	GENERAL SAFETY FOR CIM	0.17	4
INRO 1B	FUNDAMENTALS OF CIM	0.50	12
INRO 1C	ROBOT VS DEDICATED AUTOMATION	0.17	4
INRO 1D	PURPOSE & APPLICA OF ROBOTS	0.33	8
INRO 1E	MOBILE VS FIXED ROBOTS	0.08	2
	UNIT TOTAL	**1.25**	**30**
UNIT 2	**FUNDAMENTALS OF ROBOTICS**		
INRO 2A	ROBOTICS VS ROBOT	0.08	2
INRO 2B	TERMINOLOGY & DEFINITIONS	0.42	10
INRO 2C	ROBOT ANATOMY	0.08	2
INRO 2D	ROBOT GEOMETRY	0.17	4
INRO 2E	INTRO TO ROBOT POW & DRIV SYS	0.33	8
INRO 2F	ROBOT CLASSIFICATION	0.17	4
INRO 2G	INTRO TO ROBOT FEEDBACK SYS	0.17	4
INRO 2H	INTRO TO WORKPLACE LAYOUT	0.17	4
INRO 2J	INTRO TO MATCH ROBOT TO APPLI	0.25	6
INRO 2K	SAFEGUARDING DEVICES	0.17	4
	UNIT TOTAL	**2.01**	**48**
UNIT 3	**POWER & DRIVE SYSTEMS**		
INRO 3A	ELECTRICAL SYSTEMS	0.50	12
INRO 3B	HYDRAULIC SYSTEMS	0.50	12

IA 101 Introduction to Robotics/Automation
This course is designed to introduce the student to the fascinating field of robotics and automation, and to provide the student with a general overview of the technologies that are incorporated in an automated system. These technologies include hydraulics, pneumatics, electrical/electronics, machine building, PLCs, robots and computers. The student will build and automate typical robots using PLC's. Students will also work with high-level robots, machine vision, and computers. In addition to technicians, this course would be beneficial to anyone who is interested in, affected by, or is otherwise in charge of making decisions relating to robotics and automation.
Prerequisite: MTH 101 or appropriate placement by our college assessment or ACT score
3 credits, plus 3 contact hours

IA 102 Programmable Logic Controllers
This course introduces students to programmable logic controllers (PLCs). It focuses on the underlying principles of how PLCs work and provides students with the knowledge and hands-on training to install, program, modify, interface, troubleshoot, and maintain PLC systems. Programming is done both on- and off-line. No previous knowledge of PLC systems or programming is required.
Prerequisite: IA 100 or ELT 130A and ELT 130B
3 credits, plus 3 contact hours

IA 201 Advanced Robotics & Programmable Controls
This course is designed to provide the student with an understanding of how to integrate components, equipment and work cells into a completely automated system. The areas of study include computer and robot programming, PLCs, data acquisition, accessing the computer's hardware, computer communication and control, and advanced sensors such as machine vision.
Prerequisite: IA 101 and IA 102
3 credits, plus 3 contact hours

St. Clair Community College

Robotics Automation Technology
Associate in Applied Arts and Science Degree
This program of study will prepare students to work in the rapidly expanding field of robotics and automation. It incorporates technical skills from the electrical, mechanical, computer, and manufacturing disciplines. Robotics and automation in industry is providing jobs for technically trained people who can build, program, integrate, service and maintain robotic/automated equipment.

Coure	Credit Hour
FIRST YEAR - 1st Semester Semester Hours	
ELT130A Fundamentals of Direct Current Electronics	2
ELT130B Fundamentals of Alternating Current Electronics	2
IA 100 Electrical Power & Control Circuits I	3
IA 143 Fluid Power & Control Circuits I	3
MTH 110 Intermediate Algebra	4
2nd Semester Semester Hours	
ELT 131 Semiconductor Devices and Circuits	4
ELT 236 Microcontrollers: Energy Control Systems I	4
IA 101 Introduction to Robotics/Automation	3
IA 102 Programmable Logic Controllers	3
IA 243 Fluid Power & Control Circuits II	3
SECOND YEAR - 1st Semester Semester Hours	
ELT 231 Industrial Electronics	3
ENG 101 English Composition I	3
IA 201 Advanced Robotics & Programmable Controls	3
MFT 111 Machine Tools	4
WELD110A Basic Oxyacetylene Welding, Cutting & Brazing	1
WELD110B Basic Shielded Metal Arc Welding I	1
WELD110C Gas Metal Arc/Gas Tungsten Arc Welding	1
2nd Semester Semester Hours	
EG 110 Introduction to Drafting	2
EG 111 Fundamentals of Computer Aided Drafting	2
ENG 102 English Composition II	3
MFT 211 Beginning NC/CNC Programming	4
PS 101 Introduction to Political Science	3

Total Credit Hours = 63-64

- Vision coupled to robotics for dynamic control of the process.
- Applying simulation for the development and updating of robotic applications.
- Implementing networked information systems, the backbone of integration.

Technicians are required interrupt and modify programs used by the robots and other controllers within the concepts of the mechatronic framework for manufacturing systems.

The Associate Degree and Certificate were revised for the 2008-9 academic year and a Certificate of Achievement added to the program.

See page 134 for Associate Degree Robotics/Automated Systems Technology.
See page 135 for Certificate in Robotics/Automated Systems Technology.
See page 135 for Certificate of Achievement in Programmable Controllers Technology.

American manufacturing companies. When sales to companies outside North America are included, the totals rise to 17,261 robots valued at $1.15 billion .

Automotive manufacturers and suppliers accounted for 64% of all orders, robot sales in North America rose 43%.

Non-automotive markets accounted for 36% of total orders . A 16% gain in sales to life sciences/pharmaceutical/biomedical customers and an eight percent increase in sales to food and consumer goods companies.

RIA estimates 178,000 robots are now at work in U.S. factories, placing the U.S. second only to Japan in overall robot use. More than one million robots are installed worldwide.

2006 - Fourth Quarter
A total of 12,765 robots valued at $904.2 million were sold to North American companies. When sales to companies outside North America are added in, North American robotics companies' total sales were 13,791 robots valued at $958.4 million

Non-automotive orders accounted for 44% of total orders. Strong growth in industries such as beverages and tobacco, apparel, wood products, paper manufacturing, printing, machinery manufacturing, furniture, consumer goods, life sciences/pharmaceuticals/biomedical, and plastics and rubber

2005 - Fourth Quarter
A total of 18,228 robots valued at $1.16 billion were ordered by North American manufacturing companies. When orders placed by companies outside of North America are added, the final totals are 19,445 robots valued at $1.22 billion.

4. Changes to program in response to current/future employer expectations and market trends.

Robotics defines the concepts of mechatronics in manufacturing processes. Mechatronics is the intersecting of mechanics, electronics, and computer technologies; which grew out of advances from robotic kinematics, controls, communications, sensor technologies, and high-level programming.

Industry requires application-based technicians for the build, installation, and commissioning of robotic systems beyond hardware troubleshooting.

Changes in technology have driven requirements:
- Board level systems, replaced not repaired.
- Robots are involved in complex process applications.

See pages 122 to 123 for Ferris State University
See pages 124 to 125 for Lawrence Technological University
See pages 126 to 128 for Eastern Michigan University

In addition to the career path these articulation agreements provide to students, a project in conjunction with Oakland Schools Technical Campuses is being developed to bring awareness to secondary students of these oppertunities.

3. Employment opportunities in both current and future job market.

Office of Assessment & Effectiveness summary.

See pages 129 to 130.

Four occupations were identified relating to Robotics/Automated Systems Technology for the four-county region of southeast Michigan. According to EMSI, Electro-Mechanical Technicians and also Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders have very little projected growth for the next five years. In addition, Electromechanical Equipment Assemblers and also Computer-Controlled Machine Tool Operators (metal and plastic) are projected to see a slight decline in the number of jobs available in this same time period. As a whole, there are a large number of current Robotics positions in the region (7,117), but the occupations seem quite stagnant and a loss of 52 jobs is expected to occur over all Robotics occupations, which includes both new and replacement positions.

Note the conclusions above are based on Standard Occupational Classification (SOC) system which groups multiple occupations and does not specifically address specific occupation employment trends.

Oakland County Business Development Services

Nearly 20 percent of the nation's total robotics companies are located in Michigan and 50 percent of the nations robotic sales. In the Detroit Region there are more robotics companies than in any other single state.

Oakland County has identified over 150 companies in Oakland County classified in the robotics and automation business. Additional, there are 20 companies in southeast Michigan and 30 in other areas of the state.

See pages 131 to 133 for Robotics and Automation Companies.

Robotic Industries Association - Fourth Quarter Summary

2007 - Fourth Quarter
A total of 15,856 robots valued at $1.07 billion were ordered by North

F. COMPARABLE COURSES/PROGRAMS AND TRENDS

1. Program severing transferring students.

   Four area two-year colleges were surveyed. St. Clair Community College has courses and Kellogg Community College a series of units which are near equivalents to the ROB 1500 Introduction to Robotics Technology and ROB 2040 Programmable Controller Applications offered by the Robotics/Automated Systems Technology program.

   St. Clair Community College - Robotics Automation Technology offers two courses in robotics and one in programmable controls. The IA 101 Introduction to Robotics/Automation and IA 102 Programmable Logic Controllers are near equivalents to the Oakland Community College courses listed above.

   Kellogg Community College - Industrial Robotics certificate is an open entry and exit program of fractional credit hours. The Fundamentals of Robotics for 2.01 and Programming Robots for 3.75 credits are near equivalents to the ROB 1500 Introduction to Robotics Technology.

   Henry Ford Community College - combines robotics with machine tool control and the programmable controller course is based on obsolete equipment and not relevant to the second program controller course offered by Oakland Community College.

   Mott Community College - Manufacturing Simulation Technology is based on a National Science Foundation for simulation only. The Applied & Engineering Technology department is discussing an advanced manufacturing proposal which may have future transfer course equivalents.

   See pages 114 to 115 for St. Clair Community College.
   See pages 116 to 118 for Kellogg Community College.
   See page 119 for Henry Ford Community College.
   See pages 120 to 121 for Mott Community College.

2. Program's current articulation agreement.

   The Robotics/Automated Systems Technology program has three articulation agreements with four-year institutions.

   Ferris State University
   Industrial Technology and Management BAS
   Lawrence Technological University
   Bachelor of Science in Engineering Technology
   Eastern Michigan University
   Bachelor of Science in Applied Technology

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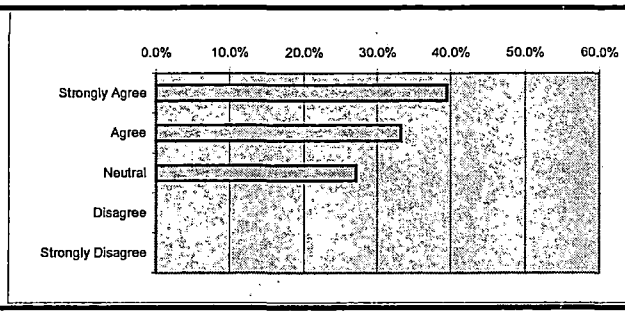
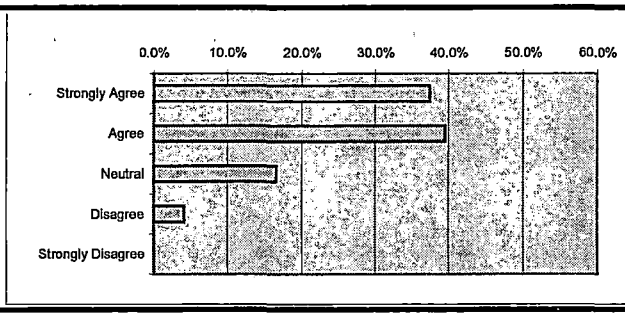
11. My instructors make the course subject-matter seem interesting.

Strongly Agree	39.6%
Agree	33.3%
Neutral	27.1%
Disagree	0.0%
Strongly Disagree	0.0%



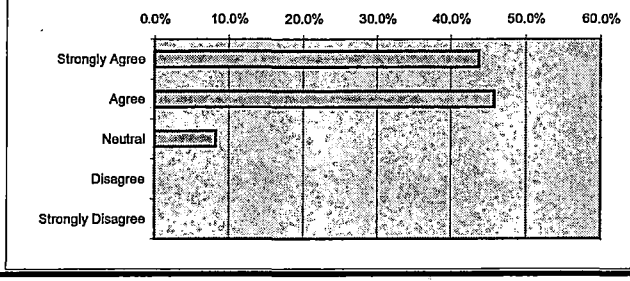
12. I am informed about what is happening in my program.

Strongly Agree	37.5%
Agree	39.6%
Neutral	16.7%
Disagree	4.2%
Strongly Disagree	0.0%



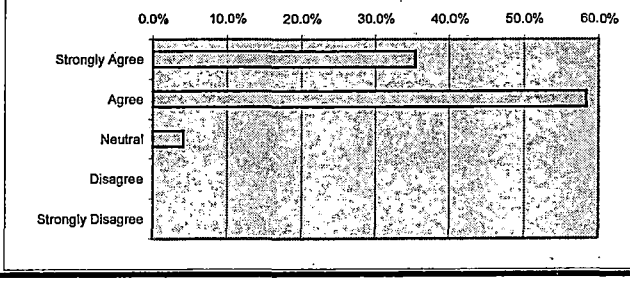
13. I think the department is committed to student success in the program.

Strongly Agree	43.8%
Agree	45.8%
Neutral	8.3%
Disagree	0.0%
Strongly Disagree	0.0%



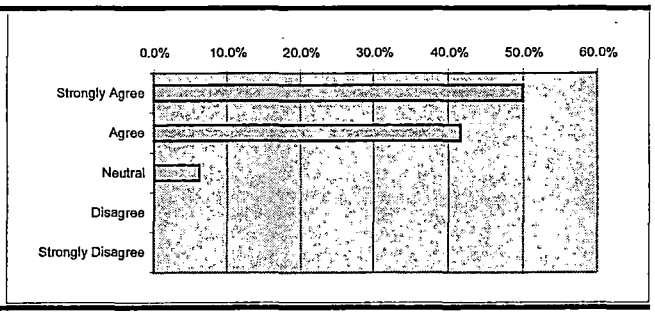
14. I am satisfied with my program of study.

Strongly Agree	35.4%
Agree	58.3%
Neutral	4.2%
Disagree	0.0%
Strongly Disagree	0.0%



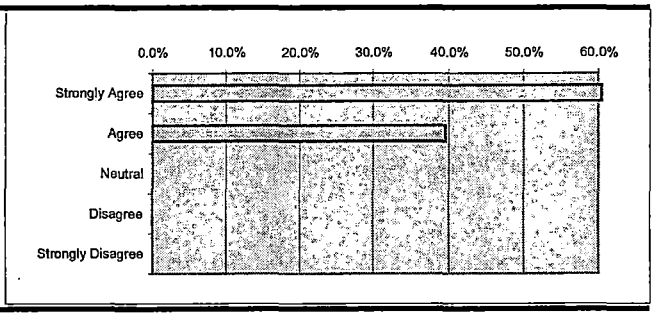
7. I am satisfied with the quality ofthe instructors in my program of study.

Strongly Agree	50.0%
Agree	41.7%
Neutral	6.3%
Disagree	0.0%
Strongly Disagree	0.0%



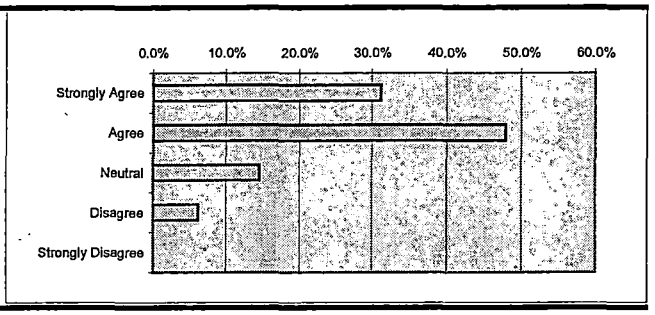
8. I feel that the instructors are knowledgeable about the course subject-matter.

Strongly Agree	60.4%
Agree	39.6%
Neutral	0.0%
Disagree	0.0%
Strongly Disagree	0.0%



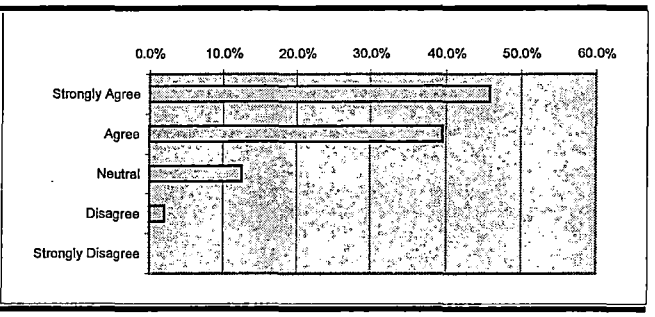
9. I am satisfied with the course offerings in my current program of study at Oakland Community College.

Strongly Agree	31.3%
Agree	47.9%
Neutral	14.6%
Disagree	6.3%
Strongly Disagree	0.0%



10. My instructors help me to understand how useful my program of study can be in the real-world.

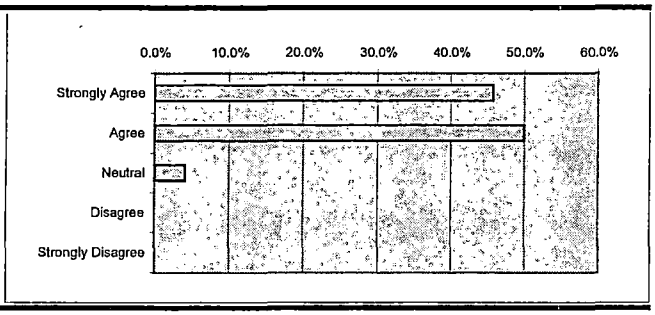
Strongly Agree	45.8%
Agree	39.6%
Neutral	12.5%
Disagree	2.1%
Strongly Disagree	0.0%



STUDENT PERCEPTIONS OF OCCUPATIONAL PROGRAMS
Robotics/Automated Systems Technology

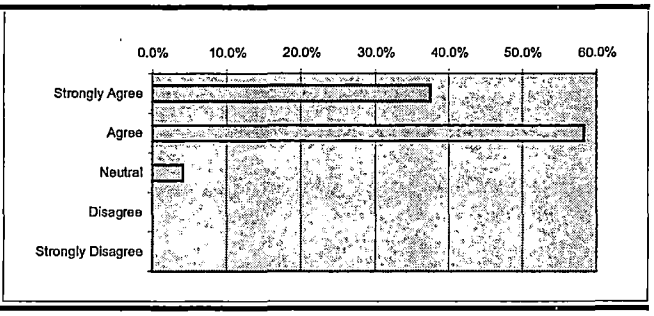
3.My program of study at Oakland Community College is meeting my expectations.

Strongly Agree	45.8%
Agree	50.0%
Neutral	4.2%
Disagree	0.0%
Strongly Disagree	0.0%



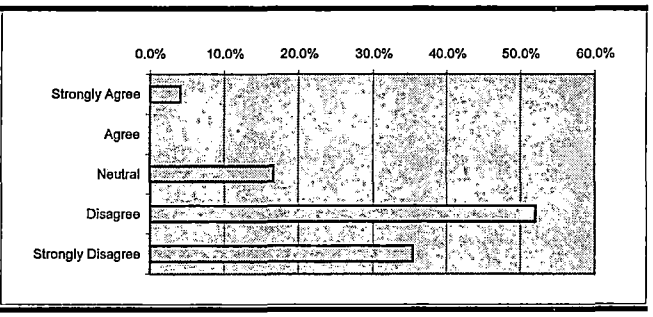
4. The courses offered in my program of study are preparing me for the workforce.

Strongly Agree	37.5%
Agree	58.3%
Neutral	4.2%
Disagree	0.0%
Strongly Disagree	0.0%



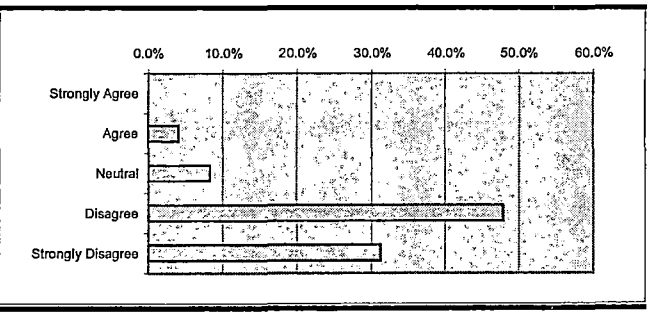
5. I would like to change my current program of study because of academic reasons.

Strongly Agree	4.2%
Agree	0.0%
Neutral	16.7%
Disagree	52.1%
Strongly Disagree	35.4%



6. I would like to attend another institution because of dissatisfaction with my current program of study at OCC.

Strongly Agree	0.0%
Agree	4.2%
Neutral	8.3%
Disagree	47.9%
Strongly Disagree	31.3%



- 89% Agree or Strongly Agree the department is committed to student success in the program.

- 95% Agree or Strongly Agree they are satisfied with their program of study.

Comments by students indicated the following.

- More open lab time in the evening.

  Currently open lab is scheduled Monday through Thursday form 3:00 to 6:00 PM. After 6:00 PM classes are held.

- Courses offered in summer.

  Enrollment does not allow for offering classes in the summer and then in either fall or winter semesters.

- Different types of robots and courses offered at other campuses.

  Advisor committee and other robotic representatives have indicated the industrial robots are similar and the important factor is the thoroughness of technological literacy. Economially impracticable to replicate the lab on other campuses.

1. Advisory Committee/Industry of Occupational Program Analysis.

The committee Agree or Strongly Agree the program is meeting expectations, preparing the students for the workforce, and are informed about the program.

The last advisory committee for the Robotics/Automated Systems Technology was in 2004, one member is from the previous advisory committee and all other eight members are new to the committee. Members Agreed or were Neutral in the input to the decision making with the program.

Members were in Strong Agreement with the direction of the program.

Two comments submitted by memebers:

"As we discussed at the meeting, I believe it is very important for potential robot techs to have a good electrical background and understand basic symbols and electrical troubleshooting."

"I believe that having a representative from the vision manufactures as guest speakers and guest instructors would help out the instructors as well as the students."

E. INPUT FROM EXTERNAL AND COMMUNITY - DATA ANALYSIS

1. Faculty Perception of Occupational Program Analysis.

   The program's Associates Degree, Certificate, and Certificate of Achievement in the Robotics/Automated Systems Technology program have been updated and approved by the Campus/College Curriculum Committees and Academic Senate for the 2008-9 catalog.

   Changes to the program's Associates Degree, Certificate, and adding of the Certificate of Achievement were balloted to the Applied Engineering & Technology department as part of the curriculum revision process. Ten ballots were sent, nine approved and one no response.

   The program's Associates Degree, Certificate, and Certificate of Achievement were reviewed by the Robotics/Automated Systems Technology advisory committee on April 16, 2008.

   The adjunct faculty member responded positively to the intent of the questions in the survey.

2. Student Perception of Occupational Program Analysis.

   The survey of Student Perception of Occupational Program results indicated the following. See pages 107 to 109 for charts on student responses.

   - Over 90% Agree or Strongly Agree the program is meeting their expectations and is preparing them for the workforce.
   - 80% of the student Disagree or Strongly Disagree they would change their program or attend another institution.
   - Over 90% Agree or Strongly Agree with the quality and knowledge of the programs instructors.
   - 78% of the students Agree or Strongly Agree with being satisfied with the current course offerings.
   - Over 80% Agree or Strongly Agree instructors help in understanding how the program of study is useful in the real-world.
   - 72% Agree or Strongly Agree instructors make the course subject-matter interesting.
   - 77% Agree or Strongly Agree they are informed about the program.

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- Exercises
    - R-J3iB, R-J3iBMate, and R-J Controller Identification
    - R-J3iB , R-J3iBMate, and R-J Controller Connection Diagram
    - R-J3iB and R-J3iBMate Indicator Identification
    - R-J3iB and R-J3iBMate Power and Mechanical Connections
    - R-J3iB and R-J3iBMate 24 Volt Connections
    - R-J3iB and R-J3iBMate E-Stop Unit
- Procedural Exercises
    - Zero Degree Mastering
    - Fixture Mastering
    - Program Shift[2]
    - R-J3iB or R-J3iBMate Tool Center Point, Three Point Method[2]
    - R-J3iB or R-J3iBMate Tool Center Point, Six Point Method[2]
    - R-J3iB or R-J3iBMate Status
    - R-J3iB or R-J3iBMate Image Backup and Restore
    - R-J3iB or R-J3iBMate File save As and Load
- Troubleshooting Exercises
    - R-J3iB Indicator Troubleshooting
    - R-J3iB 24 Volt Fuse Troubleshooting
    - R-J3iBMate Indicator Troubleshooting
    - R-J Fuse Troubleshooting
    - R-J System Troubleshooting
    - R-J3iB, R-J3iBMate, and R-J Troubleshooting

ROB 2500 Robotic Controller Maintenance

Unless noted, includes R-J3iBMate, R-J3iB, and R-J systems

- Safety During Electrical Repairs
- System Block Diagrams
- Controller Structures
    - Board Layout in Controller
    - Prints and Documentation
- Power and Robot Connections
- Board Functions
    - Backplanes
    - Main CPU Boards
        - Axis Control
    - Power Supply
    - Emergency Stop
    - Input/Output
- High Voltage Distribution
- Low Voltage Distribution
- Alarms
    - Types[7]
    - Menu Access
- Troubleshooting Documentation
    - Hardware
    - Alarm Codes
- Indicators
    - Locations
    - Function
    - Troubleshooting Documentation
- Fuses
    - Locations
    - Function
    - Troubleshooting Documentation
- Preventative Maintenance
- Emergency Stop Circuit
    - R-J3iBMate
    - R-J3iB

Systems and Teach Pendant

- Start Modes
- Test Cycle[7]
- Manipulating Files[7]
- Status Screens
- Error Recovery Procedures

- Frame Set-up[2]
    - Tool Frame
    - User Frame
- Program Shift[2]
- R-J3iBMate and R-J3iB Configuration Menu

ROB 2400 Robotic Automated Systems Applications

- Programming
    - Modify to Specification FMS-200 Application for Vision[4], HMI, and Networking[2]
    - Modify to Specification Bearing Assembly for Vision[4], HMI, and Networking[2]
    - Modify to Specification Spot Welding Cell for HMI, Networking [2] , and Safety
    - Program Application Material Handling
    - Program Application Pin Assembly[2]
    - Program Application Spot Welding Pedestal[2]
    - Program MIG Welding Cell[2]
- Simulation[1]
    - Programming Off-line and Verification
        - Material Handling Application
        - Pin Assembly Application
        - Spot Welding Pedestal Application
    - Advanced Functions
        - Abbreviated Implementation 2008-2009 Academic Year
        - Fully Implemented 2009-2010 Academic Year

Configuration and Diagnostics[2]

- HMI Programming[7]
  - Creating Applications
  - Open Existing Applications
    - Communications Setup
    - Project Settings
    - Modify Graphic Displays
      - Objects
        - Drawing
        - Pushbutton
        - Indicators
        - Numeric and String
        - Gauge and Graph
        - Navigation
      - Object Manipulation
      - Properties
      - Tags
    - Alarms[2]
      - Editor
      - Trigger
      - Display
    - Startup Setting
    - Runtime Files
  - HMI Panel[2]
    - Configurations
    - Application Transfer
    - Runtime
- Applications Programming
  - Modify to Specification FMS-200 Application for HMI and Networking[2]
  - Modify to Specification Bearing Assembly for Vision[4], HMI, and Networking[2]
  - Modify to Specification Spot Welding Cell for Networking [2]

ROB 2140 Advanced Programmable Controller Applications

- RSLogix 500/5000 and SLC/PAC Programming
    - Move and Logical Instructions
    - Arithmetic Instructions
    - Comparison Instructions
    - Program Control Instructions
    - Sequencer Instructions
    - Bit Shift, FIFO, and LIFO Instructions
    - File Manipulation Instructions
    - Analog Data and Scaling
- RSLogix 5000 and PAC Programming[7]
    - File Instructions
    - Input/Output Instructions
        - Immediate Output
        - Message
        - System Value
    - Producing and Consuming Data
    - Programming Structures
        - Tasks
        - Programs
        - Routines
    - Module Data Structures[7]
    - Add-on Instructions[2]
- Communications[2]
    - Networks Architectures for Automation Control
        - Network Levels
        - Application Requirements
    - DeviceNet
        - Media and Configurations
        - Creating and Modifying a DeviceNet Network Configuration
        - Commissioning Nodes
        - Mapping Inputs and Outputs to Scanner Module
        - Troubleshooting the Network
    - Ethernet/IP
        - Media and Configurations
        - Configuring and Modifying EtherNet/IP Addresses
        - Scanlist Configuration
    - Practical Exercises
        - Practical Exercises on Trainers
            - DeviceNet Configuration and Diagnostics
            - Eternet/IP Configuration and Diagnostics
        - Access FMS-200 for DeviceNet Access for Configuration and Diagnostics[2]
        - Access Spot Welding Cell for DeviceNet and Ethernet/IP for Configuration and Diagnostics[2]
        - Access Bearing Assembly for DeviceNet and Ethernet/IP for

- Practical Exercises on FMS-200
- RSLogix 5000 and PAC Programming[7]
  - Controller Organizer
  - Addressing Concepts
    - Tags
    - Aliases
  - Software Start-up and Configurations
  - Software Editor
    - Controller Organizer
    - Program Entry
- Human machine Interface (HMI)[2]
  - Concepts of HMIs
  - HMI Programming
    - Software Start-up and Open Existing Applications
    - Adding/Editing Graphical Objects
    - Data Connections of Graphical Objects
  - Program Abbreviated HMI Screens
  - Practical Exercises
    - Execute Spot Welding Cell for HMI
    - Execute FMS-200 Application for HMI
    - Execute Bearing Assembly for HMI
- Communications[2]
  - DeviceNet and Ethernet/IP Concepts for Automation Control
  - DeviceNet and Ethernet/IP Media and Configurations
  - Configuration and Diagnostic Software
    - Software Start-up and Functions
      - Configuration Tools
      - Diagnostics Tools
  - Observational Exercises
    - FMS-200 Access DeviceNet for Configuration and Diagnostics
    - Spot Welding Cell for Access DeviceNet and Ethernet/IP Access for Configuration and Diagnostics
    - Bearing Assembly Access DeviceNet and Ethernet/IP for Configuration and Diagnostics
  - Practical Abbreviated Exercises on Trainers
    - DeviceNet Configuration and Diagnostics
    - Eternet/IP Configuration and Diagnostics

ROB 2040 Programmable Controller Applications

- Safety, Electrical and Process
- PLC Hardware[7]
    - Processors
    - Power Supplies
    - Communications
    - Input/Output Modules
- PLC Installation[7]
    - Enclosure Mounting and Power Guidelines
    - Input/Output Wiring
    - Communications Cabling
- Theory of Controls
    - Field to Information Flow
    - Defining Design Dependancies
    - Addressing Concepts
- RSLogix 500 and SLC Programming
    - Software Start-up and Configurations
    - Processor Communications
    - Software Editor
        - Project Tree
        - Program Entry
        - Editor Functions
            - Symbols
            - Documentation
    - Relay Based Instructions
        - Normally Opened/Closed Concept
        - Interlocks
        - Logic Structures
            - AND - OR
        - Latch/Unlatch
        - One-shot
    - Timers and Counters
        - Status Bit
        - Data Structure
    - Program Control
        - Subroutines
    - Program Abbreviated Functions for FMS-200 Mechanisms
    - Lab Exercises
        - Use of Emulation
        - Use of Human machine Interface[2]
- Troubleshooting
    - Editor Diagnostic Functions
        - Cross Referencing
        - Search
        - Custom Data Monitors
        - Status File

- Process Variables
- Lighting
    - Function of Illumination
        - Contrast Enhancement
        - Suppression
        - Constant Levels
    - Material properties
        - Absorption
        - Transmission
        - Reflection
        - Fluorescence
    - Illumination Sources
        - LED
        - Quartz Halogen – Fiber Optics
        - Fluorescent
    - Lighting Techniques
        - Structured Illumination
        - Strobed Illumination
        - Front Lighting
            - Directional
            - Brightfield
            - Darkfield,
            - Omni-directional
        - Backlighting
            - Collimated,
            - Diffuse
        - Oblique Lighting
        - Co-Axial
- Optics
    - Lens Type and Mount
    - Working Distance
    - Depth of Field
    - Field of View
    - Resolution
- Simulation[1] - Fully Implemented 2009-2010 Academic Year
    - I/O Interaction
    - Animation for Simulation
    - Macro Gripper Actions for Simulation Animation
- Programming
    - Execute Spot Welding Cell for Networking and Safety [2]
    - Execute FMS-200 Application for Vision[4] and Networking[2]
    - Program Abbreviated Material Handling Application
    - Program Abbreviated Pin Assembly for Vision[4]
    - Program Abbreviated Bearing Assembly Vision[4]

ROB 1660 Robotic Communications and Machine Vision

- Sensors
    - Limit Switches
    - Photoelectric
    - Proximity
    - AC and DC Sink\Source Wiring
- Numbering Systems
- Input/Output Structures and Usage
    - Group I/O Configuration
    - Macro Configuration
    - User Operator Panel (UOP) Signals
    - Robot Service Request (RSR) Signals
    - Program Number Select (PNS) Signals
    - Controlling I/O - Simulate and Force
- Networks[5]
    - Industrial Hardware\Topologies
    - Communication Technology for Automation Equipment
        - Fieldbus Networks
            - DeviceNet
            - Profibus
        - Ethernet/IP
    - User Interfaces for Network Set-up\Diagnostics
    - Vision System Protocols[4]
    - File Transfer to FANUC Robots via Network
    - DeviceNet with FANUC Robots
        - Configuration
        - Programming Usage
- Programming
    - Logical Operators
    - Group Inputs/Output
    - TPP Skip Programming
    - TPP Condition Monitor Programming
    - Macros Operations[2]
    - User Operator Panel Signals[2]
    - Palletizing, Vacuum Sensor
    - Vision System Programming[4]
- Machine Vision[4,6]
    - Theory of Operations
        - Cameras and Image Processing
        - 2D, 3D, and Color
        - Software
    - Defining Vision Application
        - Guidance
        - Identification
        - Gauging
        - Inspection

    - Tool Frame Offset[2]
- Simulation[1] - Fully Implemented 2009-2010 Academic Year
    - Target Functions II
    - Automatic Path Generation
    - User Frame
    - Shift Functions

ROB 1640 Interpolated/Welding Robotic Applications

- Procedures
    - Determine Tool Center Point
        - Three Point Method
        - Six Point Method
    - Coordinates Offset Function[2]
    - Program Shift Utility[2]
- Resistance (Spot) Welding
    - Theory of Operations
    - Equipment Setup [2]
    - Weld Schedule
    - Servo-gun Operations [2]
    - Weld Samples
        - 18, 20, and 22 gauge
    - Remote Tool Center Point - Pedestal Welder[2]

MIG Welding

- Theory of Operations
- Equipment Setup[2]
- Weld Process Setup
- Weld Schedule
- Weave Schedule
- Weld Sample
    - Flat (butt)
    - Fillet
    - Circular
- Dual Robot
    - Flat (butt) with Angles
    - Circular (angled tube)

- Programming Labs
    - Linear Motion
    - Position Register Manipulation and User Frame
    - Circular Motion
    - Circular and Linear Motion
    - Circular\Linear with Continuous Motion
    - Complex Circular\Linear with Continuous Motion
    - Simulated Grinding with Blended Motions
    - Simulated Sealing Application
    - Simple User Frame Shift
    - Complex User Frame Shift
    - User Frame Shift over Distance
    - Tool Offset Around 360° Surface
        - Not Normal to Surface
        - Normal to Surface
        - Wrist Joint
    - Mirror Image[2]
    - User Frame Offset[2]

- Simulation [1] - Fully Implemented 2009-2010 Academic Year
  - Common Tools and Dialogs
  - Tool Center Point
  - Move To Functions
  - Target Functions I
  - Adding Fixture
  - Adding Part
  - Adding End Effector
  - Creating Simple Animation for Simulation
- Observational Exercises
  - Execute Spot Welding Cell [2]
    - Safety Interlocks and Recovery [2]
  - Execute MIG Welding Cell [2]
  - Execute FMS-200 Application [2]
  - Execute Pin Assembly[2]
  - Execute Bearing Assembly[2]

ROB 1620 Industrial Robotic Applications

- Application Examples and Case Studies
- Safety During Programming
- Programming
    - Looping Structures
        - Repeat - Until
        - Do While
        - For
        - Select - Case
    - Application Programs
        - Grinder
            - Wait with Timeout
            - Digital Output Pulse
            - Multiple Request Retry
            - Error Trapping
        - Tending
            - Gripper Orientation
            - Path Optimization
        - Parts Hopper
            - Error Trapping Based on Gripper Input
            - Position Increment Statement
            - Pause Statement
        - Three Parts
            - Part Selection Based on Input
        - Three Parts - New Pallet
            - Completed Parts Tracking
            - Total Parts Tracking
            - Indirect Digital Outputs
        - Three Parts - New Pallet - Errors
            - Error Trapping Based on Gripper Input
                - Open Error Pick-up
                - Close Error Pick-up
                - Open Error Drop-off
            - Error Recovery
        - Macro Call Program [2]
        - Program Call[2]
- Machine Vision[2]
    - Basic System Configuration
        - Camera
        - Lighting
        - Optics
    - Software Overview[4]
        - Cognex In-Sight
            - Simple Feature Applications Examples
        - FANUC visLOCi[4]
            - Simple Offset

ROB 1520 Robotic Maintenance

- Safety During Mechanical Repairs
- Mechanical Structures
    - Mechanical Drives
        - RV Reducers
        - Harmonic
    - Axis Removal and Replacement Procedures
    - Internal Robot Cable
        - Removal and Replacement Procedures
        - Cable Connector Assignments
    - Greasing Schedule and Procedures
    - Preventative Maintenance
- Input/Output Structures [3]
    - Digital I/O Configuration
        - Modular
        - Process
        - Complementary Outputs
        - Group
    - Controlling I/O - Simulate and Force
    - Robot I/O Assignments
    - User Operator Panel (UOP) Signals
    - System Configuration Setup applicable to I/O signals
- Procedures
    - Axis Limits
    - Over Travel Release [2]
    - Determine Tool Center Point
        - Three Point Method
    - Brake Settings
    - Reference Position
    - Resume Tolerance
    - Collision Guard
    - Mastering, Zero Position
    - Payload[2]
- Programming
    - Burn-in
    - Repeatability
- Observational Exercises
    - Execute Bearing Application for User Operator Signals
    - Execute Spot Welding Cell for User Operator Signals
    - Execute MIG Welding Cell for User Operator Signals

Robotics/Automated Systems Technology Course Content Outlines

Notes: [1] simulation new to program
[2] new to course
[3] content moved from ROB 2500
[4] vision equipment new to program
[5] labs to be developed as future equipment with network capabilities is purchased
[6] expanded content for machine vision
[7] revised content

ROB 1500 Introduction to Robotics Technology

- Terminology
- Safety During Operations
- Power ON Procedures
- Coordinate Systems and Jogging
- Creating Programs with Offline Software
    - Virtual Teach Pendant
    - Text Editor
    - Export/Import File
- Creating Programs on Teach Pendant
- Editing Programs on Teach Pendant
- Programming Instruction Set
    - Motion
    - Unconditional Branching
    - Wait Time/Digital and Robot Input
    - Digital and Robot Output
    - Registers
    - If Statement Conditional Branching
    - Program Call Statement
- Screen Displays
    - Registers
    - Digital and Robot Input/Output
    - Alarm
- Simulation [1]
    - Software Start-up
    - Selecting a Simulation
    - Camera Views - Pan, Tilt, and Rotate
    - Executing Simulation

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pallet.

Application Hardware: M16iB, DVT vision camera, two roller conveyors.

The robot is equipped with two sets of vacuum cups for the different box lengths. A vision camera reads the barcode and signals by point-to-point wiring the box type for retrieval by the robot. The robot picks up the box and places onto the pallet for the kit. If the box is on the pallet, the box is placed on a recycle conveyor.

MIG WELDING
Dual arm system with part orientation durning welding.

Application Hardware: FANUC ArcMate 100iB and F-200 robots.

Part are held by the F-200 and presented to the ArcMate 100 for welding at best orientation for the process. Different parts require linear and circular programming. The weld controller interface is accomplished on the robot teach pendant and user operations signals by point-to-point wiring at operator pushbutton/indicator station.

SPOT WELDING PEDESTAL
Application Hardware: M-710iB robot and pedestal weldgun.

Pneumatic resistance weldgun mounted to pedestal for remote tool centerpoint.

The course outlines, was presented to the Robotics/Automation Systems Technology Advisory Committee on April 16, 2007. Except for minor suggestions in network remote access and ambient lighting conditions for vision, the committee validated the topics outlined.

See pages 90 to 104.

SPOT WELDING CELL
Resistance welding on yet to be determined part.

Application Hardware: R2000iA robot with servo weldgun, CompactLogix programmable controller, PanelView HMI, SmartGuard safety controller, safety mats, light curtain, and barrier with interlocks.

Part will be welded by robot with simulated I/O for part entry and exit signals. Spot welding controller interface is accomplished on the robot teach pendant. User operations signals communication signals with the programmable controller are by point-to-point wiring. Process and robot information via the programmable controller is communicated to the HMI with an Ethernet/IP connection. Safety equipment is either point-to-point wiring or DeviceNet signals with the safety controller interfaced to the programmable controller by DeviceNet. Safety signals for the robot are point-to-point wires to the external safety terminations or user operations signals for various teach and run conditions.

FMS-200
Assembly of bearing housing.

Application Hardware: FMS-200 consist of six fluidic assembly stations each with a MicroLogix programmable controllers around a conveyor with a supervisory SLC 500 programmable controller. Stations use DeviceNet for communications. FANUC LRMate 200/3L , and DVT vision cameras. PanelView HMI with Devicenet Interface.

Stations are wired to induce faults for troubleshooting or HMI status/alarm displays. The robot retrieves the block from the conveyor and present views to camera for inspection. Parts are sorted by the robot.

PIN ASSEMBLY
Assembly of four pins of two different sizes in an asymmetrical pattern into a housing.

Application Hardware: LRMate 200iB with quick change tooling. FANUC vision camera and Cognex vision camera.

Housing will be placed on an unfixtured turntable within the cell. The FANUC vision system will determine offset and orientation of the part on the turntable for retrieval and placement into an assembly fixture. Robot changes tooling and place pins into the housing. Pin placement is verified by Cognex vision camera. FANUC vision offset communicated with Ethernet/IP and Cognex vision signals by point-to-point wiring.

MATERIAL HANDLING
Four boxes uniquely bar-coded boxes are randomly feed for packaging onto a kit

D. DISCIPLINE/PROGRAM NEEDS AND RESOURCES

Resources or services needed by Discipline/Program.

1. The current robot were purchased in 2003-4 academic year. Replace robots in the 2009-10 academic year. The advancement in robotic technology will obsolete the current systems.

2. Replace computer in the lab to efficiently support the instruction of simulation.

3. Increase the number of computers to support the applications implemented in the 2008-9 and 2009-10 academic years.

4. A comprehensive marketing plan for informing the general public of the opportunities in robotics and automation and the unique facilities at Oakland Community College.

5. Develop, with administrative support, an awareness program for secondary students the opportunities at Oakland Community College and articlation agreements with four-year universities.

Curriculum revisions or development in Discipline/Program beneficial to instruction.

To provide the students with integrated instruction the following applications are being developed for implementation in the 2008-9 and 2009-10 academic years.

BEARING ASSEMBLY
Assembly of a bearing, pin, and cover into a housing.

Application Hardware: two LRMate 200iB robots with quick change tooling, CompactLogix programmable controller, FlexI/O with DeviceNet and Ethernet/IP interfaces, DVT vision cameras, PanelView HMI, and a circular conveyor.

The first LRMate will pick-up a block, change grippers and then insert a bearing into the block. Prior to insertion, the bearing will be present to the vision camera for identification. The part will placed on the conveyor and shuttled to the second LRMate. The LRMate will remove the assembly from the conveyor, change grippers and insert a shaft and a cover, verified by the vision camera.

The programmable controller coordinates the application by communicating with the robots over DeviceNet and point-to-point wiring for user operations signals. Vision signals are point-to-point wiring for pass/fail status. Information from the robots and machine vision will pass through the programmable controller to the HMI via an Ethernet/IP interface for set-up, monitoring, and alarm screens.

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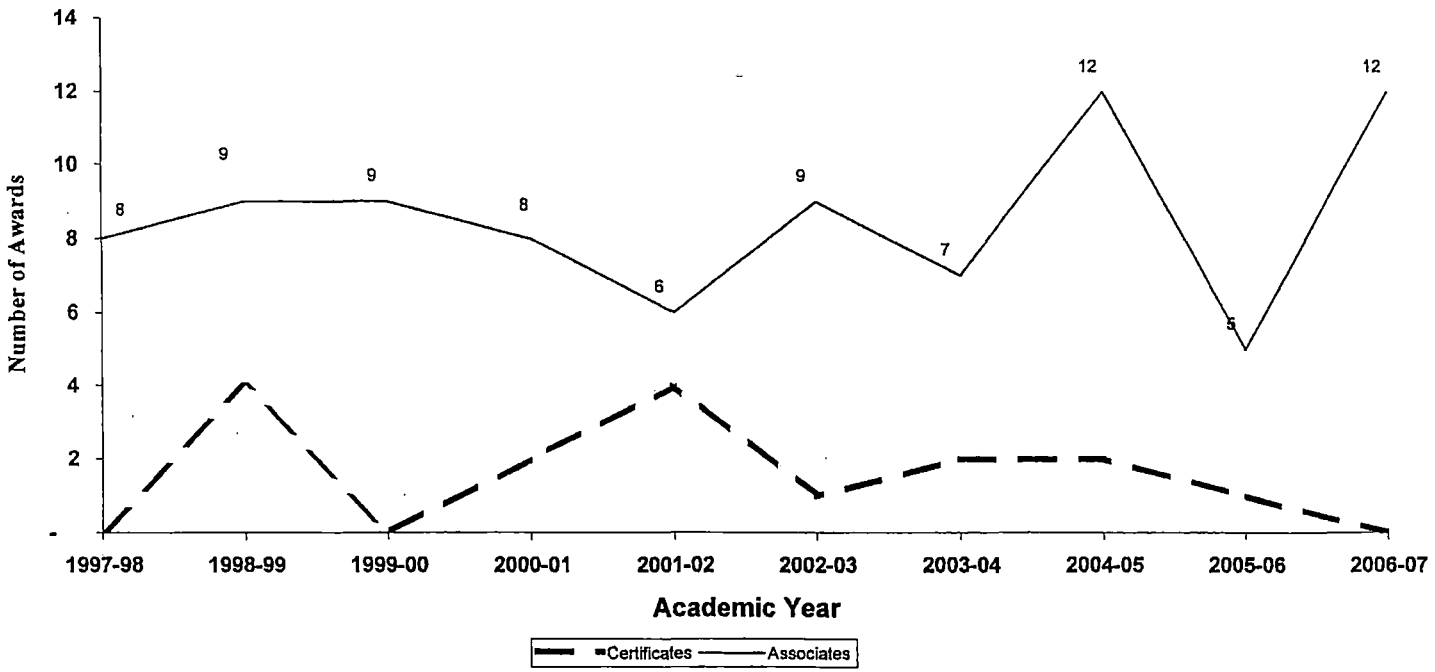
Oakland Community College
Associate Degrees and Certificates Awarded
Robotics Tech-Automated Systems
1997-98 through 2006-07



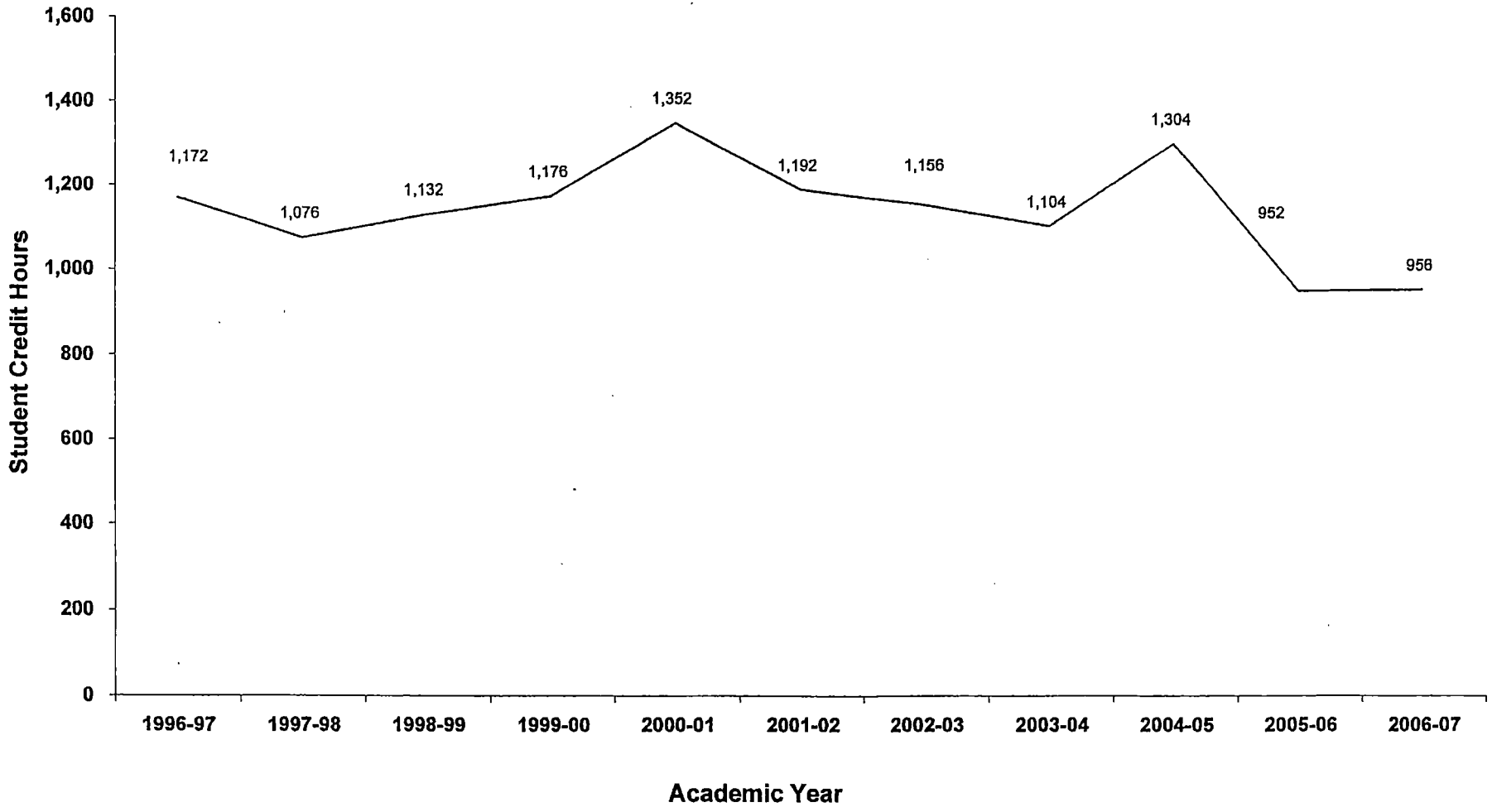
Academic Yr.	Certificates	Associates
1997-98	0	8
1998-99	4	9
1999-00	0	9
2000-01	2	8
2001-02	4	6
2002-03	1	9
2003-04	2	7
2004-05	2	12
2005-06	1	5
2006-07	0	12

Source: OCC, Office of Institutional Research

3/20/2008

Oakland Community College
Ten-Year Trend in Student Credit Hours
Robotics Tech
1996-97 through 2006-07

	1996-97 SCH	1997-98 SCH	1998-99 SCH	1999-00 SCH	2000-01 SCH	2001-02 SCH	2002-03 SCH	2003-04 SCH	2004-05 SCH	2005-06 SCH	2006-07 SCH	5-Year % Change	10-Year % Change
Robotics Tech	1,172	1,076	1,132	1,176	1,352	1,192	1,156	1,104	1,304	952	956	-19.8	-18.4
College Wide Totals	443,471	431,521	440,448	438,997	453,054	447,928	478,827	468,777	472,892	487,597	493,655	10.2	11.3



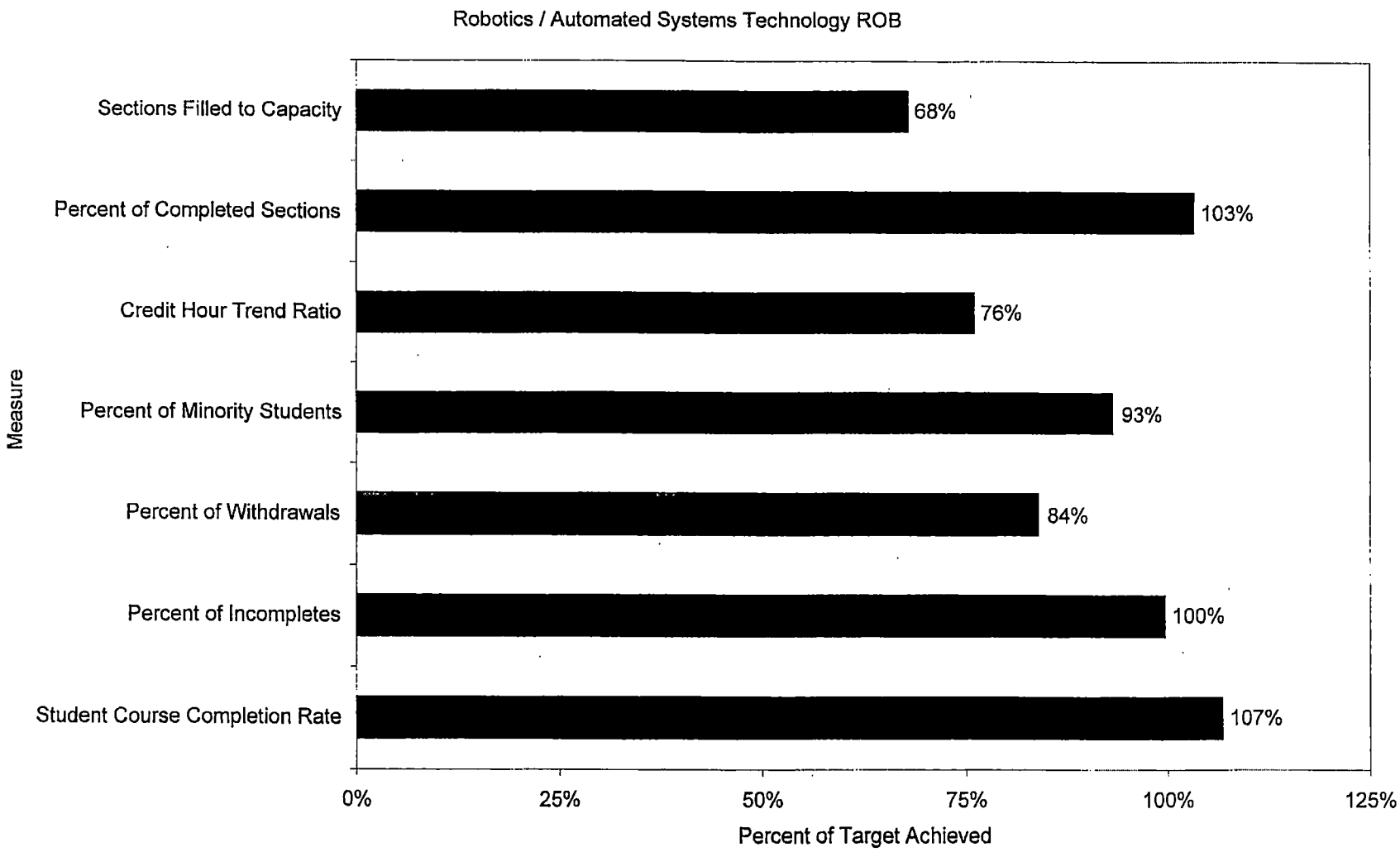
Oakland Community College
Program Dashboard Report
2006-07

Robotics / Automated Systems Technology ROB
Dashboard Score: 9.04

Measures	Current Score	Benchmarks: Trouble Score	Benchmarks: Target Score	Percent of Target Achieved	Weight	Weighted Score
Sections Filled to Capacity	61.1%	75.0%	90.0%	67.9%	18.0%	1.22
Percent of Completed Sections	92.9%	75.0%	90.0%	103.2%	14.2%	1.47
Credit Hour Trend Ratio	0.95	0.71	1.25	76.0%	15.3%	1.16
Percent of Minority Students	17.5%	16.9%	18.8%	93.1%	6.1%	0.57
Percent of Withdrawals	16.1%	15.0%	0.0%	83.9%	12.0%	1.01
Percent of Incompletes	0.4%	3.0%	0.0%	99.6%	7.9%	0.79
Student Course Completion Rate	80.0%	60.0%	75.0%	106.7%	26.5%	2.83

Source: Office of Assessment and Effectiveness
Updated On: 10/26/2007

Oakland Community College
Program Dashboard Report
2006-07



Source: Office of Assessment and Effectiveness
Updated On: 10/26/2007

Student Course Completion Rate

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2006-07	2005-06	2004-05	2003-04
Successful Grades	184	181	253	201
Total Student Grades	230	230	295	276
Student Course Completion Rate	80.0%	78.7%	85.8%	72.8%

Definition:

The percent of students who successfully complete a course with a grade of "C" or higher. Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: End of session files, after grades are posted.

Methodology:

Student success rates are based on end of session data after all grades have been posted. Data includes grades from the entire academic year (Summer II, Fall, Winter, and Summer I). The following grades/marks are excluded from the calculation: Audit (AU), Not Attended (N) and Not Reported (NR).

Percent of Incompletes

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2005-06	2005-06	2004-05	2003-04
Total Incompletes	1	2	0	0
Total Grades	230	230	295	276
Percent of Incompletes	0.4%	0.9%	0.0%	0.0%

Definition:

The percent of students who receive an incomplete in their course. Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: End of session files, after grades are posted.

Methodology:

Percent of incompletes is derived by dividing the total number of incompletes by the total number of grades and marks awarded throughout the academic year. The Continuous Progress (CP) grade is considered an Incomplete (I). Meanwhile, calculations exclude: Audit (AU), Not Attended (N), and Not Reported (NR).

Percent of Withdrawals

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2006-07	2005-06	2004-05	2003-04
Total Withdrawals	37	39	39	32
Total Grades	230	230	295	276
Percent of Withdrawals	16.1%	17.0%	13.2%	11.6%

Definition:

The percent of students who withdraw from their course after the term begins. Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: End of session files, after grades are posted.

80

Methodology:

Percent of withdrawals is derived by dividing the total number of student initiated withdrawals by the total number of grades and marks awarded throughout the academic year. The Withdrawal-Passing (WP), and Withdrawal-Failing (WF) are considered Withdrawals (W). Meanwhile, calculations exclude: Audit (AU), Not Attended (N), and Not Reported (NR).

Percent of Minority Students

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2006-07	2005-06	2004-05	2003-04
Minority Students	24	29	29	32
Total Students	137	142	153	152
Percent of Minority Students	17.5%	20.4%	19.0%	21.1%

Definition:

The percent of students who are minority. Minority status is self-reported by the student and includes: African American, Asian, Hispanic, Native American Indian and Other. Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: end of session for each term.

Methodology:

Percentages are based on known data and exclude missing information.

Credit Hour Trend Ratio

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2006-07	2005-06	2004-05	2003-04
Credit Hour Year 1	1,112	984	1,180	1,232
Credit Hour Year 2	1,180	1,112	984	1,180
Credit Hour Year 3	956	1,180	1,112	984
Credit Hour Year 4	960	956	1,180	1,112
Credit Hour Period 1	1,083	1,092	1,092	1,132
Credit Hour Period 2	1,032	1,083	1,092	1,092
Credit Hour Ratio	0.95	0.99	1.00	0.96

78

Definition:

Trend in student credit hours based on a three year rolling average. Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: One-tenth-day of each term.

Methodology:

In order to establish a meaningful enrollment statistic which applies to large as well as small disciplines/programs a "ratio" was calculated based on a three year rolling average of student credit hours.

The formula used to calculate this measure involves three simple steps:

a. Year 1 + Year 2 + Year 3 / 3 = Period 1
b. Year 2 + Year 3 + Year 4 / 3 = Period 2
c. Period 2 / Period 1 = Ratio

If the ratio is greater than "1" this means there has been an enrollment increase. On the other hand, if the ratio is less than "1" this translates into an enrollment decline. The larger the number the larger the enrollment increase. Likewise, the lower the number the greater the enrollment decline.

Headcount Trend Ratio

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2006-07	2005-06	2004-05	2003-04
Headcount Year 1	278	246	295	308
Headcount Year 2	295	278	246	295
Headcount Year 3	239	295	278	246
Headcount Year 4	240	239	295	278
Headcount Period 1	271	273	273	283
Headcount Period 2	258	271	273	273
Headcount Ratio	0.95	0.99	1.00	0.96

77

Definition:

Trend in student headcount based on a three year rolling average. Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: One-tenth-day of each term. (Note: this measure is not used in the calculation of the Program Dashboard score since it parallels trends depicted in Credit Hours.)

Methodology:

In order to establish a meaningful enrollment statistic which applies to large as well as small disciplines/programs a "ratio" was calculated based on a three year rolling average of student headcount.

The formula used to calculate this measure involves three simple steps:

a. Year 1 + Year 2 + Year 3 / 3 = Period 1
b. Year 2 + Year 3 + Year 4 / 3 = Period 2
c. Period 2 / Period 1 = Ratio

If the ratio is greater than "1" this means there has been an enrollment increase. On the other hand, if the ratio is less than "1" this translates into an enrollment decline. The larger the number the larger the enrollment increase. Likewise, the lower the number the greater the enrollment decline.

Percent of Completed Sections

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2006-07	2005-06	2004-05	2003-04
Active Sections	13	12	19	14
Cancelled Sections	1	3	2	0
Total Sections	14	15	21	14
Percent of Completed Sections	92.9%	80.0%	90.5%	100.0%

Definition:

Of all offered sections, the percent of sections that are completed (not cancelled). Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: End of session, after grades are posted.

Methodology:

Annually, the total number of offered credit sections that are completed. Formula = number of completed credit sections divided by the total number of offered credit sections. In other words, the percent of these sections that are not cancelled.

Sections Filled to Capacity

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2006-07	2005-06	2004-05	2003-04
Total Students	239	239	295	278
Total Capacity	391	364	352	391
Sections Filled To Capacity	61.1%	65.7%	83.8%	71.1%

Definition:

The percent of all available seats which are filled on the terms official census date. Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: One-tenth-day of each term.

Methodology:

Total number of sections (credit courses only) that are filled to their designated capacity e.g. allocated seats divided by the total number of available seats in all sections throughout the academic year (July 1 through June 30). In other words, how many sections are filled to their capacity on the sections 1/10 day out of all sections? Include sections that are more than filled / overflowing in calculation.

One-Tenth Day data shows the capacity filled numbers at approximately 3 weeks after the Fall and Winter terms begin; and 1 week after the Summer I and II terms begin. This data will not provide additional enrollment data if the sections begin after the one-tenth day.

While a section may only have a few students enrolled in it the college is able to designate some sections as 'full' so that they are not cancelled (per OCCFA Master Agreement). Therefore some disciplines may show low fill capacity rates, and the college never cancelled the sections or condense the students into fewer sections offering the same course.

Program Dashboard
Detail Report

Prefix ROB
Title Robotics / Automated Systems Technology

	Program				College Wide
	2006-07	**2005-06**	**2004-05**	**2003-04**	**2006-07**
Sections Filled to Capacity	61.1%	65.7%	83.8%	71.1%	84.4%
Percent of Completed Sections	92.9%	80.0%	90.5%	100.0%	90.7%
Headcount Trend Ratio	0.95	0.99	1.00	0.96	1.01
Credit Hour Trend Ratio	0.95	0.99	1.00	0.96	1.01
Percent of Minority Students	17.5%	20.4%	19.0%	21.1%	28.2%
Percent of Withdrawals	16.1%	17.0%	13.2%	11.6%	18.3%
Percent of Incompletes	0.4%	0.9%	0.0%	0.0%	1.5%
Student Course Completion Rate	80.0%	78.7%	85.8%	72.8%	67.7%
Dashboard Score	9.04	9.01	9.77	9.24	

established benchmarks. These include the percent of sections filled to capacity and the percent of withdrawals.

- Over the last four years, there has been an inverse relationship between the total capacity in ROB sections and the percent of these sections filling. For the most recent three year period, the total capacity has increased each year, and the percent of sections filling to capacity has decreased. In 2006-07, only 61% of ROB sections were filled, which is well below the college-wide average of 84%.

- Additionally, a rising trend in the percent of withdrawals has been seen and in 2006-07, 16% of the ROB students had withdrawn from their courses. Although this percent is below the college-wide 18% average, it surpassed the program dashboard trouble score of 15%.

- The annual number of credit hours in Robotics has experienced both upward and downward trends over the last ten years, and in recent years has declined. In fact, the last two years saw the most dramatic plunge in the numbers of ROB credit hours and were the lowest in the ten-year period. In 2006-07 the number of credit hours generated in ROB courses ranked 58th among all curriculum at the college.

- Over the past ten years there has been an average of 2 Certificates and approximately 9 Associate Degrees awarded per academic year in Robotics/Automated Systems. The peak number of Associate Degrees occurred recently with 12 being awarded in both 2004-05 and 2006-07, making it ranked 21st out of all OCC programs.

Faculty Summary

Of the withdraws from the 2006-7 academic year, the ROB 1500 Introduction to Robotics accounted for 49% of the student withdraws from the courses in the program. This attrition in the introductory course can be attributed to students not wanting to pursue a career in robotics or the technical (programming and operational procedures) requirements. The ROB 1620 Robotic Applications, the next programming course, accounted for 16% of the students withdraws from the courses in the program. These are two lower level classes are where the students determine to continue the program based on interest or aptitude for the instructional demands in robotics.

In the last two years, the downward trend in enrollment is tied to the economic situation in Michigan, in particular the automotive industry. The fact that automotive industry has been down-sizing in unskilled employees while increasing the use of automation, in particular robotics, has not been conveyed to the general public. Robotics has seen an increase in non-automotive industries which are in need of a skilled labor force. The lower enrollments are expected to continue until the economic conditions improve. Changes over the next two years being implemented in the Robotics/Automation Systems Technology program will position the college to offer the education required in the robotics/automation fields.

C. ENROLLMENT TRENDS AND STUDENT RETENTION

Enrollment 2006-07

Sections Filled to Capacity:	61%
Percent of Completed Sections:	92.9%
Headcount Trend Ratio:	95
Credit Hours Trend Ratio:	95

Minority Students 2006-07

Percent of Minority Students:	17.5%

Student and Course Success 2006-07

Percent of Withdrawals:	16.1%
Percent of Incompletes:	0.4%
Student Course Completion Rate	80%

Student Credit Hours 2006-07

Total SCH: 956

Associate Degrees and Certificates

Associate Degrees 2006-07:	12
Certificates 2006-07:	0

See pages 74 to 82 for Program Dashboard Reports
See pages 83 to 84 for Program dashboard Percent of Targets Achieved
See page 85 for Ten Year Trend in Student Credit Hours
See page 86 for Associate Degrees and Certificates Awarded

Summary provided by the office of Assessment & Effectiveness

- The Robotics/Automated Systems program has experienced a slight fluctuation in the Composite Dashboard Score over the last four years and at 9.04 in 2006-07, it ranked 64th of all 100 curriculum offered at the college.

- Two out of the seven program dashboard measures exceeded the college benchmarks, which include the percent of sections not canceled and the student course completion rate. Despite a downward trend in the percent of completed ROB sections over the past four years, a slight increase to 93% was seen in 2006-07 and this exceeds the college-wide average of 91%.

- Moreover, although the student course completion rate fluctuated over a four-year period, it still remained well above the college-wide average. In 2006-07, 80% of ROB students successfully completed the course with a grade of "C" or higher, which can be compared to a 68% student success rate college-wide.

- In contrast, two out of the seven program dashboard measures failed to meet their

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ROBOTICS 2140 SYLLABUS ADDENDUM

A. Student-initiated withdrawals will not be permitted beyond the twelfth week of instruction.

B. Available assistance:
   Robotics Lab: John Sefcovic
      Office Hours: 4:30 PM to 6:00 PM; Monday, Tuesday, Wednesday, and Thursday,
      Room: T202
      Phone: 248-232-4202
      E-mail: jpsefcov@oaklandcc.edu
   Technology Department Secretary:
      Office Hours 9:00 am -5:00 pm, Room A-365,
      Phone 248-232-4118
   IIC:
      Hours 9AM-4PM, Room D-210
      Phone 248-232-4439

C. Incomplete: This mark will be used sparingly and only when an emergency prevents a student from completing course work during the regular College session. This grade may be granted only when the student has completed at least 75% of the classwork with a passing grade of "C" or higher. It is the student's responsibility to complete a written agreement with the instructor detailing the requirements to be met for the completion of the "I" before it is assigned. The student is not to register for the course while carrying an incomplete "I". Unless there has been prior faculty-initiated action to change the "I", this mark will become a "WP" one year subsequent to its original issue.

D. Testing policy: Exams can be made up if arrangements have been made by the student prior to the examination date.

E. OPEN LAB
   Room T-3, **3:00 PM to 6:00 PM - MONDAY, TUESDAY, WEDNESDAY,** and **THURSDAY.**
   Room T-4, **3:00 PM to 6:00 PM - MONDAY.**
   When known, changes to the open lab will be posted. Open labs may be cancelled or hours of operation may be changed without notice.

F. Class Attendance / Tardiness: Students are expected to attend scheduled classes and to be on time. Failure to do this will be reflected in your final grade and in job recommendations.

G. SAFETY INSTRUCTIONS: Students will not attempt to release any mechanical jams. Notify the instructor.

H. Students may be dismissed or failed in this class for violating safety regulations, failure to complete lab assignments, or failing their exams.

I. Students requiring special assistance (including those affected by the Americans With Disabilities Act) should contact the PASS Office (248-232-4080) who will inform the instructor of any special conditions pertaining to your learning. The PASS Office is located in D-211.

J. Student Rights and Responsibilities are outlined in the Student Handbook that is available in the Campus Bookstore or online at http://www.oaklandcc.edu/Catalog/StudentRights/.

Note: the instructor may make reasonable revisions as circumstances require. Any reasonable revision will be announced in class.

ROBOTICS 2040 SYLLABUS ADDENDUM

Robotics Lab: John Sefcovic
Office Hours: Monday 1:00 PM to 1:30 PM; Monday, Tuesday, Wednesday, and Thursday 4:30 PM to 6:00 PM, Room: T202
Phone: 248-232-4202
E-mail: jpsefcov@oaklandcc.edu

A. Student-initiated withdrawals will not be permitted beyond the twelfth week of instruction.

B. Technology Department Secretary:
Office Hours 9:00 am -5:00 pm, Room A-365,
Phone 248-232-4118

IIC:
Hours 9AM-4PM, Room D-210
Phone 248-232-4439

C. Incomplete: This mark will be used sparingly and only when an emergency prevents a student from completing course work during the regular College session. This grade may be granted only when the student has completed at least 75% of the classwork with a passing grade of "C" or higher. It is the student's responsibility to complete a written agreement with the instructor detailing the requirements to be met for the completion of the "I" before it is assigned. The student is not to register for the course while carrying an incomplete "I". Unless there has been prior faculty-initiated action to change the "I", this mark will become a "WP" one year subsequent to its original issue.

D. Testing policy: Exams can be made up if arrangements have been made by the student prior to the examination date.

E. OPEN LAB
Room T-3, **3:00 PM to 6:00 PM - MONDAY, TUESDAY, WEDNESDAY**, and **THURSDAY.**
Room T-4, **3:00 PM to 6:00 PM - MONDAY.**
When known, changes to open lab will be posted. Open lab may be cancelled or hours of operation may be changed without notice.

F. Assignments: All lab assignments are due no later than the week after they are assigned.

G. Class Attendance / Tardiness: Students are expected to attend scheduled classes and to be on time. Failure to do this will be reflected in your final grade and in job recommendations.

H. SAFETY INSTRUCTIONS: Students are not permitted behind the safety barriers unless they have the teach pendant in their possession, or the emergency stop is set. Rob 150 students are not to go behind the safety barriers.

I. Students may be dismissed or failed in this class for violating safety regulations, failure to complete lab assignments, or failing their exams.

J. Students requiring special assistance (including those affected by the Americans With Disabilities Act) should contact the PASS Office (248-232-4080) who will inform the instructor of any special conditions pertaining to your learning. The PASS Office is located in D-211.

K. Student Rights and Responsibilities are outlined in the Student Handbook that is available in the Campus Bookstore or online at http://www.oaklandcc.edu/Catalog/StudentRights/.

Note: the instructor may make reasonable revisions as circumstances require. Any reasonable revision will be announced in class.

ROBOTICS SYLLABUS ADDENDUM
SUMMER SEMESTER

A. Student-initiated withdrawals will not be permitted beyond the twelfth week of instruction.

B. Available assistance:
   Robotics Lab: John Sefcovic
      Office Hours: 4:30 PM to 6:00 PM; Monday, Room: T202
      Phone: 248-232-4202
      E-mail: jpsefcov@oaklandcc.edu
   Technology Department Secretary:
      Office Hours 9:00 am -5:00 pm, Room A-365,
      Phone 248-232-4118
   IIC:
      Hours 9AM-4PM, Room D-210
      Phone 248-232-4439

C. Incomplete: This mark will be used sparingly and only when an emergency prevents a student from completing course work during the regular College session. This grade may be granted only when the student has completed at least 75% of the classwork with a passing grade of "C" or higher. It is the student's responsibility to complete a written agreement with the instructor detailing the requirements to be met for the completion of the "I" before it is assigned. The student is not to register for the course while carrying an incomplete "I". Unless there has been prior faculty-initiated action to change the "I", this mark will become a "WP" one year subsequent to its original issue.

D. Testing policy: Exams can be made up if arrangements have been made by the student prior to the examination date.

E. **OPEN LAB** from **3PM to 6:00 PM - MONDAY.**
When known, changes to the open lab will be posted. Open labs may be cancelled or hours of operation may be changed without notice.

F. Class Attendance / Tardiness: Students are expected to attend scheduled classes and to be on time. Failure to do this will be reflected in your final grade and in job recommendations.

G. SAFETY INSTRUCTIONS: Students are not permitted behind the safety barriers unless they have the teach pendant in their possession, or the emergency stop is set. ROB 1500 students are not to go behind the safety barriers.

H. Students may be dismissed or failed in this class for violating safety regulations, failure to complete lab assignments, or failing their exams.

I. Students requiring special assistance (including those affected by the Americans With Disabilities Act) should contact the PASS Office (248-232-4080) who will inform the instructor of any special conditions pertaining to your learning. The PASS Office is located in D-211.

J. Student Rights and Responsibilities are outlined in the Student Handbook that is available in the Campus Bookstore or online at http://www.oaklandcc.edu/Catalog/StudentRights/.

Note: the instructor may make reasonable revisions as circumstances require. Any reasonable revision will be announced in class.

ROBOTICS SYLLABUS ADDENDUM
WINTER SEMESTER

A. Student-initiated withdrawals will not be permitted beyond the twelfth week of instruction.

B. Available assistance:
   Robotics Lab: John Sefcovic
      Office Hours: 4:30 PM to 6:00 PM; Monday, Tuesday, Wednesday, and Thursday,
      Room: T202
      Phone: 248-232-4202
      E-mail: jpsefcov@oaklandcc.edu
   Technology Department Secretary:
      Office Hours 9:00 am -5:00 pm, Room A-365,
      Phone 248-232-4118
   IIC:
      Hours 9AM-4PM, Room D-210
      Phone 248-232-4439

C. Incomplete: This mark will be used sparingly and only when an emergency prevents a student from completing course work during the regular College session. This grade may be granted only when the student has completed at least 75% of the classwork with a passing grade of "C" or higher. It is the student's responsibility to complete a written agreement with the instructor detailing the requirements to be met for the completion of the "I" before it is assigned. The student is not to register for the course while carrying an incomplete "I". Unless there has been prior faculty-initiated action to change the "I", this mark will become a "WP" one year subsequent to its original issue.

D. Testing policy: Exams can be made up if arrangements have been made by the student prior to the examination date.

E. **OPEN LAB** from **3PM to 6:00 PM - MONDAY, TUESDAY, WEDNESDAY**, and **THURSDAY.** When known, changes to the open lab will be posted. Open labs may be cancelled or hours of operation may be changed without notice.

   Note on THURSDAY Open Lab: The robots are set-up for the ROB 2500 Automated Controller Maintenance course, robots may not be operational.

F. Class Attendance / Tardiness: Students are expected to attend scheduled classes and to be on time. Failure to do this will be reflected in your final grade and in job recommendations.

G. SAFETY INSTRUCTIONS: Students are not permitted behind the safety barriers unless they have the teach pendant in their possession, or the emergency stop is set. ROB 1500 students are not to go behind the safety barriers.

H. Students may be dismissed or failed in this class for violating safety regulations, failure to complete lab assignments, or failing their exams.

I. Students requiring special assistance (including those affected by the Americans With Disabilities Act) should contact the PASS Office (248-232-4080) who will inform the instructor of any special conditions pertaining to your learning. The PASS Office is located in D-211.

J. Student Rights and Responsibilities are outlined in the Student Handbook that is available in the Campus Bookstore or online at http://www.oaklandcc.edu/Catalog/StudentRights/.

Note: the instructor may make reasonable revisions as circumstances require. Any reasonable revision will be announced in class.

ROBOTICS SYLLABUS ADDENDUM
FALL SEMESTER

A. Student-initiated withdrawals will not be permitted beyond the twelfth week of instruction.

B. Available assistance:
   Robotics Lab: John Sefcovic
      Office Hours: 4:30 PM to 6:00 PM; Monday, Tuesday, Wednesday, and Thursday,
      Room: T202
      Phone: 248-232-4202
      E-mail: jpsefcov@oaklandcc.edu
   Technology Department Secretary:
      Office Hours 9:00 am -5:00 pm, Room A-365,
      Phone 248-232-4118
   IIC:
      Hours 9AM-4PM, Room D-210
      Phone 248-232-4439

C. Incomplete: This mark will be used sparingly and only when an emergency prevents a student from completing course work during the regular College session. This grade may be granted only when the student has completed at least 75% of the classwork with a passing grade of "C" or higher. It is the student's responsibility to complete a written agreement with the instructor detailing the requirements to be met for the completion of the "I" before it is assigned. The student is not to register for the course while carrying an incomplete "I". Unless there has been prior faculty-initiated action to change the "I", this mark will become a "WP" one year subsequent to its original issue.

D. Testing policy: Exams can be made up if arrangements have been made by the student prior to the examination date.

E. **OPEN LAB** from **3PM to 6:00 PM - MONDAY, TUESDAY, WEDNESDAY**, and **THURSDAY**. When known, changes to the open lab will be posted. Open labs may be cancelled or hours of operation may be changed without notice.

F. Class Attendance / Tardiness: Students are expected to attend scheduled classes and to be on time. Failure to do this will be reflected in your final grade and in job recommendations.

G. SAFETY INSTRUCTIONS: Students are not permitted behind the safety barriers unless they have the teach pendant in their possession, or the emergency stop is set. ROB 1500 students are not to go behind the safety barriers.

H. Students may be dismissed or failed in this class for violating safety regulations, failure to complete lab assignments, or failing their exams.

I. Students requiring special assistance (including those affected by the Americans With Disabilities Act) should contact the PASS Office (248-232-4080) who will inform the instructor of any special conditions pertaining to your learning. The PASS Office is located in D-211.

J. Student Rights and Responsibilities are outlined in the Student Handbook that is available in the Campus Bookstore or online at http://www.oaklandcc.edu/Catalog/StudentRights/.

Note: the instructor may make reasonable revisions as circumstances require. Any reasonable revision will be announced in class.

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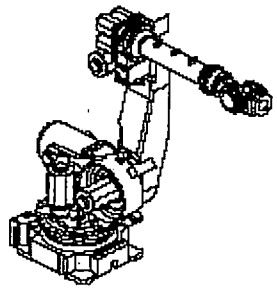
ROB 2500
LAB SIGN-OFF SHEET



ROBOTICS/AUTOMATED SYSTEMS TECHNOLOGY

Name:_____

ASSIGNMENT	POINTS	SUBMITTED
R-J3iB, R-J3iBMate, AND R-J Controller Identification**	2	
R-J3iB , R-J3iBMate, AND R-J Controller Connection Diagram**	2	
Zero Degree Mastering*	1	
R-J3iB Power and Mechanical Connections	4	
24 Volt Connections	5	
Fixture Mastering*	5	
R-J3iB Indicator Identification	3	
R-J3iB 24 Volt Fuse Troubleshooting	10	
R-J Fuse Troubleshooting	10	
R-J3iB Indicator Troubleshooting	10	
R-J3iBMate Indicator Troubleshooting	10	
R-J3iB and R-J3iBMate E-Stop Unit	2	
R-J3iB Status Information*	2	
R-J System Troubleshooting	10	
R-J3iB or R-J3iBMate File Save As and Load*	2	
R-J3iB Backup and Restore as Image*	2	
R-J3iB,R-J3iBMate, and R-J Troubleshooting	20	

ALL LABS ARE DUE THE FOURTEENTH (14) WEEK

Labs marked with a single asterisk are procedures and must be properly completed for credit. Labs with double asterisk must be completed correctly for full credit.

EXPECTED COMPETENCIES FOR ROB 250

This is a list of the expected student competencies for the Robotics 2500 course. The student will have completed these expectations by the end of this course.

AT THE END OF THE ROB 2500 COURSE THE STUDENT WILL BE ABLE TO:

1. explain proper safety procedures involved in troubleshooting automation controllers.
2. explain the troubleshooting procedures.
3. explain diagram controller configuration.
4. identify controller components.
5. explain the function of the boards.
6. explain the AC distribution for the controller.
7. list the fuses, their values, and why they are in the circuit.
8. demonstrate proper and safe use of the multi-meter and record values.
9. explain the DC distribution
10. explain the troubleshooting procedures for the power supply.
11. use multi-meter and record voltages.
12. list the connectors on the circuit boards and their functions.
13. list the LEDs and their importance to troubleshooting.
14. write and execute a program that will test the I/O configuration of the controller.
15. explain the operation of the servo system.
16. visually examine and describe servo system components.
17. describe proper troubleshooting techniques for the servo system.
18. explain software problems that could be involved in controller failure.
19. demonstrate the use of error codes and diagnostics in troubleshooting controller malfunctions.

LAB ASSIGNMENTS:

Lab will be assigned pertaining to the session lecture material. Listed is the percentage of lab total for each assignment. Labs marked with a single asterisk are procedures and must be properly completed for credit. Labs with double asterisk must be completed correctly for full credit.

R-J3iB Controller Identification** 1
R-J3iB Controller Connection Diagram** 1
R-J3iBMate Controller Connection Diagram** 1
R-J Controller Configuration** 1
Zero Degree Mastering* 1
R-J3iB Power and Mechanical Connections. 5
24 Volt Connections 5
Fixture Mastering* 5
R-J3iB Indicator Identification. 3
R-J3iB 24 Volt Fuse Troubleshooting. 10
R-J Fuse Troubleshooting. 10
R-J3iB Indicator Troubleshooting 10
R-J3iBMate Indicator Troubleshooting 10
R-J3iB E-Stop Unit 3
R-J3iBMate E-Stop Unit 3
R-J3iB Status Information* 2
R-J System Troubleshooting. 10
R-J3iB or R-J3iBMate File Save As and Load* 2
R-J3iB Backup and Restore as Image* 2
R-J3iB, R-J3iBMate, and R-J Troubleshooting. 15

MIDTERM and FINAL:

NO MAKE-UP WILL BE GIVEN FOR THE MIDTERM OR FINAL UNLESS YOU HAVE CONTACTED THE INSTRUCTOR FOR ALTERNATIVE ARRAIGNMENTS.

The mid-term and final exams are based on the lecture content and lab assignments.

SCHEDULE:

WEEK 7: REVIEW FOR MIDTERM
WEEK 8: MID-TERM
WEEK 14: REVIEW FOR FINAL EXAM
WEEK 15: FINAL

troubleshooting controller problems
Course procedures
contact hours, office hours
assignments, exam schedules, lab proficiency, student responsibilities
Lab
schedule
procedures

CONTROLLER CONFIGURATIONS
R-J3iB Components and Board Layout
R-J3iBMate Components and Board Layout
R-J Components and Board Layout
Component and Board Functions

CONTROLLER PRINTS
R-J3iB
High Voltage Circuits and Mechanical Connections
Low Voltage Circuits and Mechanical Connections
E-Stop Circuits and Mechanical Connections
R-J3iBMate
High Voltage Circuits and Mechanical Connections
Low Voltage Circuits and Mechanical Connections
E-Stop Circuits and Mechanical Connections
R-J
High Voltage Circuits and Mechanical Connections
Low Voltage Circuits and Mechanical Connections
E-Stop Circuits and Mechanical Connections

CONTROLLER PROCEDURES
Status
Zero and Fixture Mastering
File Transfer
Back-up and Restore

TROUBLESHOOTING PROCEDURES
R-J3iB
Power-up Sequence
Fuse based problems
Connection problems
R-J3iBMate
Power-up Sequence
Fuse based problems
Connection problems
R-J
Power-up Sequence
Fuse based problems
Connection problems

CONTROLLER MAINTENANCE
Periodic checks

OAKLAND COMMUNITY COLLEGE®

ROB 2500
AUTOMATED CONTROLLER MAINTENANCE

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOGY, AUBURN HILLS, MI

INSTRUCTOR: John Sefcovic
248-232-4202
jpsefcovic@oaklandcc.edu

This course will introduce the student to the techniques needed to troubleshoot robot controllers. Students will study the many components that are involved in robotic maintenance that are being used in todays industry. The course will include maintenance programming, electrical theory, analysis and troubleshooting, and an detailed study of robot controllers. Development of these skills should enable the student to effectively maintain robotic systems that are used in industry.
Prerequisite: Rob 166

TEXT: NO REQUIRED TEXT BOOK. Student will use manufacture's documentation

BASIS OF FINAL GRADE:

A	95 - 100	C-	66 - 69
A-	92 - 94	D+	60 - 65
B+	89 - 91	D	51 - 59
B	83 - 88	F	- 50
B-	80 - 82		
C+	77 - 79		
C	70 - 76		

WARNING: If you do not withdraw or make arrangements with the instructor to withdraw you from the course, *YOUR FINAL GRADE WILL BE DETERMINED FROM THE GRADES EARNED.*

GRADE BREAKDOWN:

40% Test Averages

60% Lab Proficiencies

COURSE CONTENT:

INTRODUCTION TO COURSE
Review of course objectives
analysis and troubleshooting techniques

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Pallet 3 x 3 Parts with Abort. 10
Pallet 3 x 3 Parts with Restart. 25
Process Documentation

RJ3iB Material Handling. 25
Process Documentation

Simulation. 5

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. . . . . .

2400-1 Syllabus .wpd Edited: January 9, 2008

COURSE CONTENT:

1. Introduction to the course.

2. Discussion of projects.
   a. Group size and responsibilities
   b. Documentation
   c. Scheduling

3. Palletizing Applications

4. Assembly Applications

5. Material Handling Applications

LABS:

Pallet B Lab 6 Parts
Pallet B 8 x 6 Parts
Pallet E Lab 8 Parts

Pallet 3 x 3 Parts Two Layers

Pallet 3 x 3 Parts
Pallet 3 x 3 Parts with Abort
Pallet 3 x 3 Parts with Restart

RJ3iB Material Handling

Spot Welding

LABS: ROB 2400 WINTER 2008

LAB	POINTS
Pallet B Lab 6 Parts	5
Pallet B 8 x 6 Parts	
Pallet E Lab 8 Parts	
All of the above labs must be done for credit.	
Pallet 3 x 3 Parts Two Layers	20
Process Documentation	
Pallet 3 x 3 Parts.	10

OAKLAND COMMUNITY COLLEGE®

ROB 2400 AUTOMATED SYSTEMS APPLICATIONS

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOGY, AUBURN HILLS, MI

INSTRUCTOR: John Sefcovic
248-232-4202
jpsefcovic@oaklandcc.edu

This is a course of study in Computer Integrated Manufacturing Applications for Robotics. This course will provide students with basic knowledge into the various disciplines that integrate together to build successful CIM applications. Topics of discussion will include Cell Development, Justification, Flexible Manufacturing Systems (FMS), Manufacturing Automation Protocol (MAP), Computer Aided Manufacturing (CAM), Computer Aided Engineering (CAE), Management Information Systems (MIS), Materials Requirement/Resource Programming (MRP), Automatic Guided Vehicle Systems (AGVS), Just In Time (JIT), and various disciplines, techniques, and methods which will be used to successfully implement CIM into the factories of the future. The major focus of this class shall be the "REAL WORLD" and CIM Robotic applications.

TEXT: Optional

BASIS OF FINAL GRADE:

A	95 - 100	C-	66 - 69
A-	92 - 94	D+	60 - 65
B+	89 - 91	D	51 - 59
B	83 - 88	F	- 50
B-	80 - 82		
C+	77 - 79		
C	70 - 76		

WARNING: If you do not withdraw or make arrangements with the instructor to withdraw you from the course, *YOUR FINAL GRADE WILL BE DETERMINED FROM THE GRADES EARNED.*

GRADE BREAKDOWN:

100% Lab Proficiencies

RSLogix 5000 LABS:

	POINTS	POINTS	INITIALS	DATE
THE FOLLOWING LABS ARE DUE BY THE START OF THE FORTH (4) SESSION:				
MOVE INSTRUCTION	3			
THE FOLLOWING LABS ARE DUE BY THE START OF THE EIGHTH (8) SESSION:				
TIMED PROCESS OUTPUT	3			
TEMPERATURE CONVERSION with INDICATORS	3			
THE FOLLOWING LABS ARE DUE BY THE FOURTEENTH (14) SESSION:				
ANALOG INPUT	3			

HMI LABS:

	POINTS	POINTS	INITIALS	DATE
THE FOLLOWING LABS ARE DUE BY THE START OF THE FIFTH (5) SESSION:				
MOTOR CONTROL	3			
THE FOLLOWING LABS ARE DUE BY THE START OF THE TENTH (10) SESSION:				
TIMED PROCESS OUTPUT	3			
TEMPERATURE CONVERSION with INDICATORS	3			
THE FOLLOWING LABS ARE DUE BY THE FOURTEENTH (14) SESSION:				
ANALOG INPUT	3			

FMS-200 PRACTICAL LABS:

FMS LABS BY THE FOURTEENTH (14) SESSION:			
FMS-200 STATION NO. _____	15	*Grade kept separately, this is for your own record*	
FMS-200 STATION NO. _____	15	*Grade kept separately, this is for your own record*	

NAME:

OAKLAND COMMUNITY COLLEGE

ROB 2140
LAB CHECK SHEET

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOGY

CHECK SHEET MUST BE TURNED IN WITH THE FINAL FOR CREDIT.
NO DUPLICATE COPY IS KEPT BY THE INSTRUCTOR.

RSLogix 500 LABS:

	POINTS	POINTS	INITIALS	DATE
THE FOLLOWING LABS ARE DUE BY THE START OF THE FORTH (4) SESSION:				
PRACTICE PROBLEMS: TIMERS and COUNTERS	2			
HEATING ELEMENTS	2			
MOVE INSTRUCTION	2			
THE FOLLOWING LABS ARE DUE BY THE START OF THE EIGHTH (8) SESSION:				
TIMED PROCESS OUTPUT	5			
TEMPERATURE CONVERSION	5			
TEMPERATURE CONVERSION with INDICATORS	5			
THE FOLLOWING LABS ARE DUE BY THE START OF THE TWELFTH (12) SESSION:				
BORE CYCLE	10			
ROBOT WITH INDEX TABLE	5			
THE FOLLOWING LABS ARE DUE BY THE FOURTEENTH (14) SESSION:				
ANALOG INPUT	10			
TORQUE	10			

SESSION 14

OPEN LAB

SESSION 15

FINAL EXAM

SESSION 8

TEXT: pg 133, File Fill
LECTURE: Data Transfer Operations
File Arithmetic Operations
Advanced Addressing

SESSION 9

TEXT: pgs. 145 - 155, Sequencer
LECTURE: Sequencer ans Shift Instructions
Mechanical Sequencers
Sequencer Instructions
Bit Shift
Word Shift Registers

SESSION 10

TEXT: pgs. 135 - 137, Block Transfer Instructions
LECTURE: Block Transfer and Analog Input
LABS: ANALOG INPUT
TORQUE

SESSION 11

LECTURE: Analog Output

SESSION 12

TEXT: pgs. 185- 223, Chapter 10, DeviceNet
pgs. 291 - 297, Appendix, Control Logic

SESSION 13

OPEN LAB

SESSION 4

TEXT: pgs. 155 - 122, Math Instructions
LECTURE: Programming Compute Instructions
Math Instructions
Addition Instructions
Subtraction Instructions
Multiplication Instructions
Division Instructions
Other Word Level Math Instructions
Numerical Data I/O Interfaces
HMI (Human Machine Interface)
Numeric Control Graphics

LABS: TIMED PROCESS OUTPUT
TEMPERATURE CONVERSION

SESSION 5

TEXT: pgs 122 - 127, Relational Operators and Logical Operators
LECTURE: Programming Compare Instructions
Data Compare Instructions
Data Manipulation Programs

LAB: TEMPERATURE CONVERSION with INDICATORS

SESSION 6

LECTURE: Program Control Instructions
Master Control and Zone Control Instructions
Jump Instructions
Temporary End (TND) Instruction
Immediate Input and Immediate Output Instructions

SESSION 7

LABS: BORE CYCLE
ROBOT WITH INDEX TABLE

COURSE CONTENT:

SESSION 1

LECTURE: RSLogix Software
- Database - Symbols and Descriptions
- Custom Data Monitor
- Cross-referencing
- Find

LABS: PRACTICE PROBLEMS: TIMERS and COUNTERS

SESSION 2

TEXT: pgs. 131 - 133, Copy, Move, and Move Mask Instructions
pgs. 66 - 68, Program Flow

LECTURE: Programming Data Manipulation Instructions
- Move
- Move with Mask

Programming Subroutines
- Subroutine functions
- Defining subroutines
- Subroutine Instructions

HMI (Human Machine Interface)
- New/Save/Open project
- Graphical elements
- Accessing Tags

LAB: MOVE INSTRUCTION
HEATING ELEMENTS

SESSION 3

LECTURE: Program Control Instructions
- Jump - Label
- Immediate Input and Immediate Output Instructions
- For-Next Loop
- Forcing External I/O Addresses

HMI (Human Machine Interface)
- State Controls Graphics
- Assigning Tags

LAB: FMS-200 ASSIGNED

given will be determined by completeness of specified functions. The number of points earned will be applied to thirty percent (30%) of your Course Total Grade.

MicroLogix 1500 PRACTICAL LABS:
The lab will be applied to thirty percent (40%) of your Course Total Grade.

FINAL:
The final is a performance exam with problems similar to the PLC-5 labs. Programs for the performance Final are to be completed within the allotted time limit. The average of points earned will be applied to forty percent (30%) of your Course Total Grade. Grade per program will be as follows:

- Complete and correct program will receive 100 points.
- A program with logic errors will receive between 95 or less points depending on the number of logic errors.

LABS:

The labs are to be done in the T-4 lab. Labs will be assigned on material that has been discussed in the lecture.

The FMS-200 practical labs use the equipment in the T-3 Robotics Lab.

IT IS YOUR RESPONSIBILITY TO ASK QUESTION ON WHAT YOU DO NOT UNDERSTAND.

OAKLAND COMMUNITY COLLEGE

ROB 2140
ADVANCED PROGRAMMABLE CONTROLLER APPLICATIONS

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOGY, AUBURN HILLS, MI

INSTRUCTOR: John Sefcovic, 248-232-4202
jpsefcov@oaklndcc.edu

The course will be structured to provide the student with an understanding of the relationship between the "real time" control systems and industrial devices and machines. The advanced instruction set of programable controllers will be studied in relevancy to concepts and structures of automated control systems. Various applications will be defined in which the student will develop the written programs for each hardware and software specification of the process problems. The use of the Robotics Lab equipment will give the student practical programming and troubleshooting skills that are used in the maintenance of automated systems.

BASIS OF FINAL GRADE:

A	95 - 100	C-	66 - 69
A-	92 - 94	D+	60 - 65
B+	89 - 91	D	51 - 59
B	83 - 88	F	- 50
B-	80 - 82		
C+	77 - 79		
C	70 - 76		

WARNING: If you do not withdraw or make arrangements with the instructor to withdraw you from the Course, *YOUR FINAL GRADE WILL BE DETERMINED FROM THE GRADES EARNED.*

GRADE BREAKDOWN:

COURSE TOTAL:

RSLogix-500, 5000 and HMI Labs	40 %
FMS 200 Practical Labs	30 %
Final Exam	30 %

PLC-500 LABS:
Each lab will have a point value for a total of one-hundred (100) percentage points. See Lab Check Sheet for points assigned to each lab. Number of points

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	POINTS	INITIALS	DATE
SESSION 10:			
VAT WITH TIMED MOTOR *(1 % of course grade)*			
TIMED WASHER STATION, RETENTIVE *(1 % of course grade)*			
SESSION 11:			
BLDG./LOT LIGHTS			
TIMER ANTI-TIE DOWN*(1 % of course grade)*			
SESSION 12:			
CONVEYOR TIMER			
PARTS DIVERTER FOR INSPECTION *(1 % of course grade)*			
SPOOL COUNTER *(1% of course grade)*			
SESSION 13:			
CONVEYOR TIMER WITH INDICATORS *(1% of course grade)*			

	POINTS	INITIALS	DATE
SESSION 1:			
INTRODUCTION TO RELAY INSTRUCTIONS			
SESSION 2:			
CYLINDER INTERLOCKS			
SESSION 3:			
EDITOR PROFICIENCY			
WASHER STATION *(1 % of course grade)*			
SESSION 4:			
START-STOP CIRCUITS, SS1 *(1 % of course grade)*			
START-STOP CIRCUITS, SS2			
START-STOP CIRCUITS, SS3 *(1 % of course grade)*			
START-STOP CIRCUITS, SS4 *(1 % of course grade)*			
START-STOP CIRCUITS, SS5			
START-STOP CIRCUITS, SS6 *(1 % of course grade)*			
SESSION 5:			
CONVEYOR *(1 % of course grade)*			
SESSION 6:			
HEATING ELEMENTS *(1 % of course grade)*			
HARDWIRED TO RELAY LOGIC *(1 % of course grade)*			
SESSION 7: ***DUE AT SESSION 9.***			
MIXING VAT			
TANK *(1 % of course grade)*			
SESSION 9:			
HARDWIRED TIMERS			
TIMER ON STATUS BITS *(1 % of course grade)*			
TIMER OFF STATUS BITS *(1 % of course grade)*			
TIMER CIRCUITS *(1 % of course grade)*			
START-UP TIMER *(1 % of course grade)*			
TIMED WASHER STATION *(1 % of course grade)*			

Name:

OAKLAND COMMUNITY COLLEGE®

ROB 2040
LAB CHECK SHEET

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOY, AUBURN HILLS, MI

THIS CHECK SHEET MUST BE IN FOLDER WHEN TURNING IN ASSIGNMENTS AND AT THE END OF THE SEMESTERS. DO NOT LOSE, NO DUPLICATE RECORD IS KEPT!

MicroLogix 1500 Practical Labs *(2 % of course grade each)*

	POINTS	INITIALS	DATE
STATION No. _____ TROUBLESHOOTING			
STATION No. _____ TROUBLESHOOTING			
STATION No. _____ TROUBLESHOOTING			
STATION No. _____ TROUBLESHOOTING			
APPLICATION PROGRAMMING 1			
APPLICATION PROGRAMMING 2			
APPLICATION PROGRAMMING 3			

RSLogix 5000 Editor/Programming

	POINTS	INITIALS	DATE
RSLogix 5000 EDITOR			
RSLogix 5000 WASHER STATION *(1 % of course grade)*			
RSLogix 5000 VAT *(1 % of course grade)*			
RSLogix 5000 START-UP TIMER *(1 % of course grade)*			

CLASSROOM LABS APPLICATION PROGRAMMING 1

Labs are due by the start of the next session, except where noted

Labs where boxes are shade, are done in class during the lecture.

Lab problems for both midterm and final are performance exams where programs will be assigned to be completed within the allotted time limit.

The Mid-term will begin at the specified start time.

EXPECTED COMPETENCIES FOR ROB 204

This is a list of the expected student competencies for the Robotics 204 course. The student will have completed these expectations by the end of this course.

AT THE END OF THE ROB 204 COURSE THE STUDENT WILL BE ABLE TO:

1. Define the term Programable Controller.
2. List advantages of a PLC over relay systems.
3. Identify the four main components of a PLC and describe their functions.
4. Outline the basic sequence of operation for a PLC.
5. Identify the general classifications of PLC's.
6. List and describe the functions of the hardware components used in a PLC system.
7. Describe the basic circuitry and applications for discrete and analog I/O modules.
8. Interpret typical I/O and CPU specifications.
9. Explain I/O addressing concepts.
10. Describe the general classes and types of PLC memory devices.
11. List and describe the different types of PLC peripheral support devices.
12. Define the decimal, binary, octal, and hexadecimal numbering systems.
13. Define the memory terms as they apply to binary locations.
14. Describe and construct a truth table for the Boolean equations.
15. Convert relay schematic into ladder logic programs.
16. Define and identify the functions of a PLC memory map.
17. Describe input and output image files.
18. Describe data files in the PLC memory structure.
19. Describe the PLC program scan sequence.
20. Define and identify the function of relay instructions in a ladder program.
21. Identify the common modes of operations of a PLC.
22. Identify the functions of electro mechanical control relays, contractors, and motor starters.
23. Identify common switching devices found in PLC installations.
24. Explain the operation of output controls commonly found in PLC installations.
25. Define and identify the function of timer instructions in a ladder program.
26. Define and identify the function of counter instructions in a ladder program.
27. Enter and document PLC ladder programs from a narrative description.
28. Access data information that relates to PLC ladder instructions.
29. Explain and demonstrate common troubleshooting techniques for programmable controllers.

Group Lockout or Tagout
Sample Lockout Procedure
Sample Lockout/Tagout Checklist

Chapter 5

Counters
Rockwell Automation Counters

Programming Counter Instructions

LABS: BUILDING AND PARKING LOT LIGHTS
TIMER ANTI-TIE DOWN
RSLogix 5000 START-UP TIMER

SESSION 12:

LECTURE:

Move Instruction
Introduction to Subroutines

LABS: CONVEYOR TIMER
PART DIVERTER FOR INSPECTION
SPOOL COUNTER

SESSION 13: Final review

LABS: CONVEYOR TIMER WITH INDICATORS

SESSION 14: *FINAL EXAM - Group B*

SESSION 15: *FINAL EXAM - Group A*

LABS ASSIGNMENTS:

Labs will be assigned on material that has been discussed in the lecture.
See LAB CHECK SHEET for point value and when labs are due. There will be no exceptions. The PLC-5 LABS will be discussed in lecture on the session due.

MIDTERM and FINAL:

THE MIDTERM AND FINAL EXAMS WILL BE BASED ON THE LABS.

NO MAKE UP WILL BE GIVEN FOR THE MIDTERM OR FINAL UNLESS YOU HAVE CONTACTED THE INSTRUCTOR FOR ALTERNATIVE ARRAIGNMENTS.

LABS: MIXING VAT
TANK

SESSION 8: ***MID-TERM EXAM***
Group A - 6:00 P.M. to 7:30 P.M.
Group B - 7:45 P.M. to 9:15 P.M.

SESSION 9:

LECTURE: Memory Architecture, Part 2
Programming Timer Instructions
Chapter 5
Timers
Cascading Timers
RSLogix 5000 Tags
Controller
Alias

LABS: TIMER CIRCUITS
HARDWIRED TIMERS
START-UP TIMER
TIMER ON STATUS BITS
TIMER OFF STATUS BITS
TIMED WASHER STATION
RSLogix 5000 WASHER STATION

SESSION 10:

LECTURE: PLC-5 Programming Timer Instructions
Retentive Timer

LABS: VAT WITH TIMED MOTOR
TIMED WASHER STATION RETENTIVE TIMER
RSLogix 5000 VAT

SESSION 11:

LECTURE: *Chapter 11*
Safety
Causes of Accidents
Accident Prevention
Safe Use of Lab Equipment and Hand Tools
Overview of Lockout/Tagout
Training
Requirements for Lockout/Tagout Devices
Application Control
Testing of Machines, Equipment, or Components

SESSION 4:

LECTURE: *Chapter 9*

The Need for Sensors
Sensor Types
Digital Sensors
Electronic Field Sensors
Sensor Wiring
Sourcing and Sinking Sensors
Analog Sensors
Installation Considerations
Typical Applications

PLC-5 and SLC-5 Programming Relay Instructions

LAB: START-STOP CIRCUIT/DOWNLOAD

SESSION 5:

LECTURE:

SLC-5 Configuration
Internal Relay Instructions

LABS: CONVEYOR

SESSION 6:

LECTURE: *Chapter 12*

Installation and Trouble Shooting
PLC Installation
Industrial Controller Maintenance
PLC Trouble Shooting

Force Functions
Converting Ladder Diagrams into PLC Ladder Programs

LABS: HEATING ELEMENTS
HARDWIRED LOGIC TO RELAY LOGIC

SESSION 7:

RSLogix 5000 Controller Organization
- Tasks
- Programs
- Routines

RSLogix 5000 Configure I/O Modules
Mid-Term Review

COURSE CONTENT:

SESSION 1:

LECTURE: *Chapter 1*

PLC Components
PLC Applications

Introduction to the PLC, Part 1

LAB: INTRODUCTION TO LADDER LOGIC

SESSION 2:

LECTURE: *Chapter 2*

Decimal System
Binary System
Binary Coded Decimal
Octal System
Hexadecimal System

Chapter 3

Ladder logic
Ladder Diagrams
Multiple Contacts
Branching
PLC Scanning and Scan Time

Introduction to the PLC, Part 2

LABS: CYLINDER INTERLOCKS/DOWNLOAD

SESSION 3:

LECTURE: *Chapter 4*

Understanding Rockwell File Organization and Addressing
User-Defined Files
Rockwell Automation Contacts
Special Contacts
Rockwell Automation Coils
Program Flow

Memory Architecture, Part 1
PLC-5 and SLC-5 Programming Relay Instructions
Documentation Functions

LABS: EDITOR PROFICIENCY
WASHER STATION

OAKLAND COMMUNITY COLLEGE

ROB 2040
PROGRAMMABLE CONTROLLER APPLICATIONS

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOY, AUBURN HILLS, MI

INSTRUCTOR: John Sefcovic, 248-232-4202
jpsefcov@oaklandcc.edu

The programmable controllers class will give the student the fundamentals of Programmable Logic Controller operations including symbology and structure. After these fundamentals are understood, the student will write, enter and execute application programs using the programmable controllers.

TEXT: OPTIONAL Programming PLCs Using Rockwell Automation Controllers, ISBN 0-13-094002X Jon Stenerson

BASIS OF FINAL GRADE:

A	95 - 100
A-	92 - 94
B+	89 - 91
B	83 - 88
B-	80 - 82
C+	77 - 79
C	70 - 76
C-	66 - 69
D+	60 - 65
D	51 - 59
F	- 50

WARNING: If you do not withdraw or make arrangements with the instructor to withdraw you from the Course, *YOUR FINAL GRADE WILL BE DETERMINED FROM THE GRADES EARNED.*

GRADE BREAKDOWN:

MicroLogix Labs	12%
RSLogix 5000	3%
Classroom Labs	20%
Mid-Term Exam	25%
Final Exam	40%

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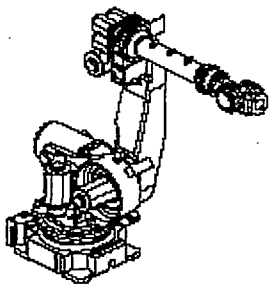
ASSIGNMENT	POINTS		INITIALS	DATE
DVT Vision LAB 1	4			
DVT Vision LAB 2	4			
DVT Vision LAB 3	5			
DVT Vision LAB 4	5			
DVT Vision LAB 5	5			

OAKLAND COMMUNITY COLLEGE

ROB 1660

LAB SIGN-OFF SHEET



ROBOTICS/AUTOMATED SYSTEMS TECHNOLOY, AUBURN HILLS, MI

Name:_____

ASSIGNMENT	POINTS		INITIALS	DATE
Controlling I/O - Simulate and Force	2			
I/O Configuration R-J3iB - Process	2			
I/O Configuration R-J3iB Mate - Modular	2			
Configure Complementary Outputs	2			
I/O Configuration R-J3iB - Group Inputs/Outputs	2			
Sequential Outputs	4			
Group Inputs/Output Programming	4			
TPP Skip Programming	5			
TPP Condition Monitor Programming	5			
Robot Service Request (RSR) Signals	4			
User Operator Panel (UOP) Signals	5			
Proximity - TPP	7			
Proximity - KAREL	7			
Photoelectric- TPP	7			
Photoelectric - KAREL	7			
Material Handling - Boxes	6			
Material handling - Plates	6			

OVER

print-out produced for full credit.

MIDTERM and FINAL:
NO MAKE UP WILL BE GIVEN FOR THE MIDTERM OR FINAL UNLESS YOU HAVE CONTACTED THE INSTRUCTOR FOR ALTERNATIVE ARRAIGNMENTS.

The mid-term and final is based on the lecture content and lab assignments.

SCHEDULE:
Midterm: Week 8
Final: Week 15

EXPECTED COMPETENCIES FOR ROB 1660
This is a list of the expected student competencies for the SENSOR TECHNOLOGY course. The student will have completed these expectations by the end of this course.

At the end of the ROB 1660 course the student will be able to:

1. list three methods in which sensors are used to prevent entry into an active robots work cell.
2. classify sensors according to the type of interface that is used.
3. explain the binary numbering system.
4. define the term sensor.
5. explain the I/O system on the FANUC R-J controller and how it is configured.
6. list three basic reasons sensors are used in automation.
7. list the sensors used in most manufacturing systems.
8. list two types of proximity sensors.
9. list four types of photo-electric sensors.
10. explain the difference between fixed and expandable I/O robot controllers.
11. demonstrate machine vision sensing principles.

COURSE CONTENT:

Introduction to course
- Review of course objectives
  - basic robotic review
  - interfacing considerations
  - numbering systems
  - interface programming
  - general sensor operations
- Course procedures
  - contact hours, lab facility and practice, office hours
  - assignments and exam schedules
  - student responsibilities
    - correct spelling and grammar is expected
    - lab and classroom participation and attendance

General Operation of Systems
- Fanuc R-J3iB System Technology

Review of basic robotics
- Work cell development considerations
- Program design considerations
- Safety

Interfacing Considerations and Programming
- Interfacing lines for safety
- Application interfacing considerations
- Dedicated I/O

Numbering Systems Review

Types of Sensors
- Contacting
- Proximity Sensors
- Photoelectric

Applications For Sensors
- Transducers in the robotic workcell
- Sensing devices used by the robotic mechanical unit

Machine Vision
- Theory of Sensing
- Programming Sensors

TASK SIGN-OFF

The sign-off sheet for each lab task has two components, the writing of the program and the running of the program task. The review of the writing component **does not mean** the program is correct. The review is for program structure and obvious errors. Final check of the program is done when the program is executed (run on the robot). Problem found during the running of the program will need to be corrected and a new

OAKLAND COMMUNITY COLLEGE®

ROB 1660
SENSOR TECHNOLOGY

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOY, AUBURN HILLS, MI

INSTRUCTOR: John Sefcovic
248-232-4202
jpsefcovic@oaklandcc.edu

This course will give the student a working knowledge of the various types of sensors and transducers that could possibly be incorporated into a robotic workcell. The student will investigate how the robot controller is programmed to interact with the feedback devices and the types of signals the sensors and transducers will supply to the controller. The course provides classroom lecture and demonstration of technical information and student laboratory experiences.

TEXT: No text. Students will work from manufactures documentation and handouts.

BASIS OF FINAL GRADE:

A	95 - 100	C-	66 - 69
A-	92 - 94	D+	60 - 65
B+	89 - 91	D	51 - 59
B	83 - 88	F	- 50
B-	80 - 82		
C+	77 - 79		
C	70 - 76		

WARNING: If you do not withdraw or make arrangements with the instructor to withdraw you from the course, *YOUR COURSE GRADE WILL BE DETERMINED FROM THE GRADES EARNED.*

ATTENDANCE:

Attendance is mandatory for lecture. Non-attendance for any two lecture sessions will result in 5% deduction from the course grade. Three non-attended lectures will result in 15% deducted from the course grade. Four or more non-attended lectures will result in a failure in the course. A grade of F will be assigned, or you may withdraw from the course.

GRADE BREAKDOWN:

40% Test Averages
60% Lab Proficiencies

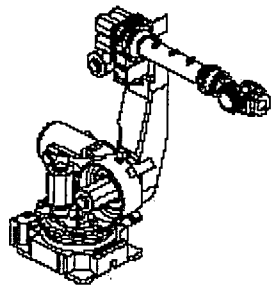
Spot Welding, 18, 20, and 22 gauge	10			

Circular with 45° Orientation	3			

MIG Welding, Flat 1/8" Stock	5			
MIG Welding, Flat 3/16" Stock	5			
MIG Welding, Angle 3/16" Stock	8			
MIG Welding, Circular	10			

OAKLAND COMMUNITY COLLEGE

ROB 1640
LAB SIGN-OFF SHEET



ROBOTICS/AUTOMATED SYSTEMS TECHNOLOY, AUBURN HILLS, MI

Name:_____

ASSIGNMENT	POINTS	INITIALS	DATE
World and Tool Jog Identification - Completed by Week 2	Required		
Tool Offset - 3 Point Method - Completed by Week 3	Required		
Tool Offset - 6 Point Method - Completed by Week 7	Required		

Failure to complete above required labs will result in course grade being lowered by one grade.

Lab No. 1 *Execute*	5			
Lab No. 2 *Execute*	5			
Lab No. 3 *Execute*	5			
Lab No. 4 *Execute*	5			
Lab No. 5 *Execute*	5			
Lab No. 6 *Execute*	8			
Lab No. 7 *Execute*	5			
Lab No. 8 *Execute*	8			
Lab No. 9 *Execute*	8			
Lab No. 10 *Execute*	5			

OVER

5. list various shielding gases and their proper use.

6. demonstrate the use of proper joint design.

7. explain the various weld positions with reference to correct weld parameters (plate thickness, wire diameter, etc).

8. describe how a RESISTANCE weld is developed using correct terminology.

9. set MIG welding parameters on the robot controller for GAS METAL ARC WELDING (GMAW).

10. set the parameters on the controllers for resistance welding.

11. demonstrate proper techniques for robotic GMAW.

12. demonstrate proper techniques for robotic resistance welding.

13. demonstrate proper teaching procedures for safely controlling (jog speed of robot) the FANUC robots.

14. explain the coordinate systems that can be used in robotic applications.

15. set, program, and jog robot with USER frame.

16. set, program, and jog robot with TOOL frame.

17. create and demonstrate a robot program using linear interpolation.

18. create and demonstrate Position Registers manipulation.

19. create a program and demonstrate correct use of the circular motion commands.

20. demonstrate in programs specified and continuous motion terminations.

21. create and demonstrate a robot program using multiple frames.

Process
Configuration

Robotic Resistance Welding
Process
Configuration

R-J TPP
Interpolated programming
linear
circular
Motion Parameters

TASK SIGN-OFF:
The sign-off sheet for each lab task has two components, the writing of the program and the running of the program task. The review of the writing component **does not mean** the program is correct. The review is for program structure and obvious errors. Final check of the program is done when the program is executed (run on the robot). Problem found during the running of the program will need to be corrected and a new print-out produced for full credit.

MIDTERM and FINAL:
NO MAKE UP WILL BE GIVEN FOR THE MIDTERM OR FINAL UNLESS YOU HAVE CONTACTED THE INSTRUCTOR FOR ALTERNATIVE ARRAIGNMENTS.

The mid-term and final is based on the lecture content and lab assignments.

SCHEDULE:
Midterm: Week 8
Final: Week 15

EXPECTED COMPETENCIES FOR ROB 1640:
This is a list of the expected student competencies for the ROBOTICS 1640 course. The student will have completed these expectations by the end of this course.

At the end of the ROB 1640 course the student will be able to:

1. state proper safety procedures when working around robots.

2. state correct safety precautions used for a welding robot.

3. explain the process called GAS METAL ARC WELDING (GMAW).

4. classification of welding electrodes.

LAB ASSIGNMENTS:

Lab No. 1 - Session 2
Lab No. 2 - Session 3
Lab No. 3 - Session 4
Lab No. 4 - Session 5
Lab No. 5 - Session 6
Lab No. 6 - Session 7
Lab No. 7 - Session 9
Lab No. 8 - Session 10
Lab No. 9 - Session 11
Lab No. 10 - Session 12

MIG Welding Labs - Assigned Session 4
Resistance Welding Labs - Assigned Session 5

COURSE CONTENT:

Introduction to course
- Course procedures
  - credit hours: 4
  - contact hours, lab facility and practice, office hours
  - assignments, exam schedules, lab sign-off sheet
  - student responsibilities

Safety
- Robot safety
- Welding safety

Types of robotic welding
- GMAW, GTAW. Plasma, Submerged Arc, Resistance, Laser

Types of weld joints, positions, and process
- Joints
  - Butt, lap, tee
- Weld positions
  - Flat, horizontal, vertical up/down, overhead
- Welding Process
  - Base metals
  - Filler metals
  - Fit up

R-J Controllers
- Specifications for weld interface
- Language statements for welding
- Weld schedules and weaving

GMAW Robotic Welding

OAKLAND COMMUNITY COLLEGE

ROB 1640 INTERPOLATED/WELD ROBOTIC APPLICATIONS

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOY, AUBURN HILLS, MI

INSTRUCTOR: John Sefcovic
248-232-4202
jpsefcovic@oaklandcc.edu

The student will program and operate robotic welding systems using resistance and arc welding technologies. The course will include laboratory hands-on experience in basic welding fundamentals. Robotic weld schedules will be used to enable robot welding applications using Gas Metal Arc Welding. Resistance welding programs will also be studied by the student. Linear and circular programming will be an important part of this course.

NO TEXT IS USED: Students will use manufacturer's documentation for resource information.

BASIS OF FINAL GRADE:

A	95 - 100	C-	66 - 69
A-	92 - 94	D+	60 - 65
B+	89 - 91	D	51 - 59
B	83 - 88	F	- 50
B-	80 - 82		
C+	77 - 79		
C	70 - 76		

WARNING: If you do not withdraw or make arrangements with the instructor to withdraw you from the course, *YOUR COURSE GRADE WILL BE DETERMINED FROM THE GRADES EARNED.*

ATTENDANCE:

Attendance is mandatory for lecture. Non-attendance for any two lecture sessions will result in 5% deduction from the course grade. Three non-attended lectures will result in 15% deducted from the course grade. Four or more non-attended lectures will result in a failure in the course. A grade of F will be assigned, or you may withdraw from the course.

GRADE BREAKDOWN:

40% Test Averages
60% Lab Proficiencies

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ASSIGNMENT			
Robotic Application: Narrative Paper 1 Due: Week 8	5	*Grade kept separately, this is for your own record*	
Robotic Application: Narrative Paper 2 Due: Week 13	5	*Grade kept separately, this is for your own record*	

1620 SIGN-OFF SHEET.wpd Edited: January 7, 2008

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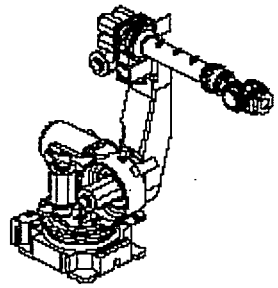
ROB 1620

LAB SIGN-OFF SHEET



ROBOTICS/AUTOMATED SYSTEMS TECHNOLOGY

Name:_____

LAB IS DUE THE FOURTH (4) WEEK

ASSIGNMENT		EXECUTED - INITIALS	DATE
LOOP, REPEAT - UNTIL	10		
LOOP, DO WHILE			
LOOP, FOR			
LOOP, SELECT - CASE			

ALL LABS AND PROCESS DOCUMENTATION ARE DUE THE EIGHTH (8) WEEK

ASSIGNMENT		EXECUTED - INITIALS	DATE
GRINDER	15		
Process Documentation			
TENDING	10		

LAB AND PROCESS DOCUMENTATION ARE DUE THE TENTH (10) WEEK

PARTS HOPPER	15		
Process Documentation			

ALL LABS ARE DUE THE THIRTEENTH (13) WEEK. PROCESS DOCUMENTATION IS DUE THE FOURTEENTH (14) WEEK

ASSIGNMENT		EXECUTED - INITIALS	DATE
THREE PARTS	5		
THREE PARTS / PALLET	5		
THREE PARTS / PALLET / ERRORS	30		
Process Documentation			

9. define the term END OF ARM TOOLING

10. list four common applications in which robots can be used

11. explain the formula for computing the payback period for a robot

12. explain how the speed of an FANUC robot is controlled in the teach mode and also in the repeat mode

13. list the operational aides available on the FANUC controller

14. explain three different jog modes that can be used by robots

15. describe the safety consideration when working in close proximity with a robot while teaching a program

16. explain the structure of a TPP and KAREL program

17. describe the motion, speed, and termination parameters for TPP and KAREL programs

18. explain the use of registers in a TPP program

19. explain the use of variables in a KAREL program

20. describe input/output signal and programming instruction for TPP and KAREL

21. list the types of branches that can be used in a robot program

22. write an assigned application program, safely enter it into the controller and execute it successfully

TASK SIGN-OFF

The sign-off sheet for each lab task has two components, the writing of the program and the running of the program task. The review of the writing component **does not mean** the program is correct. The review is for program structure and obvious errors. Final check of the program is done when the program is executed (run on the robot). Problem found during the running of the program will need to be corrected and a new print-out produced for full credit.

MIDTERM and FINAL:

NO MAKE UP WILL BE GIVEN FOR THE MIDTERM OR FINAL UNLESS YOU HAVE CONTACTED THE INSTRUCTOR FOR ALTERNATIVE ARRAIGNMENTS.

The mid-term and final exams are based on the lecture content and lab assignments.

SCHEDULE:

Midterm: Week 8
Final: Week 15

EXPECTED COMPETENCIES FOR ROB 1620:

This is a list of the expected student competencies for the INDUSTRIAL ROBOTICS APPLICATIONS course. The student will have completed these expectations by the end of the course.

AT THE END OF THE ROB 162 COURSE THE STUDENT WILL BE ABLE TO:

1. list five components that should be considered in the process of program design
2. identify what a robot program is
3. explain the two types of programs used by a robot controller
4. define the term OFF-LINE PROGRAMMING
5. describe the process of PALLETIZING
6. use proper flowchart symbols when defining a robot task
7. explain the term INTERFACING between the robot controller and its peripheral components
8. list four basic programming functions and describe their purpose

Interfacing lines for safety purposes
Application interfacing considerations
Programming inputs and outputs

Entering robot programs into controller
Controller programming aids
Off-line programming

READING ASSIGNMENTS

Discussion of reading assignments will be on the following session.

Week 1:	Chapters 2 and 3 Case Studies 1 and 2
Week 2:	Chapter 4 Case Studies 3 and 4
Week 3:	Case Studies 5 and 6
Week 4:	Case Studies 7 and 8
Week 5:	Chapter 5 Case Studies 9 and 10
Week 6:	Chapter 9 Case Studies 11, 12, and 13
Week 7:	Case Studies 14, 15, 16, and 17
Week 9:	Chapter 6 Case Studies 18, 19, 20, and 21
Week 10:	Chapter 7 and 8 Case Studies 22, 23, 24, 25, and 26
Week 11:	Chapter 10 Case Studies 27, 28, 29, and 30
Week 12:	Chapter 11 Case Studies 31, 32, 33, and 34

use proper flowchart symbols
alternatives to flowcharting
identify interface lines for a robot application
enter robot program into controller and edit program

Course procedures
credit hours: 4
contact hours, lab facility and practice, office hours
assignments and exam schedules
research papers
correct spelling and grammar is expected
student responsibilities

Review of basic robotics
Definition of a robot
Geometric design classifications
Servo/non-servo controlled robots
Point-to-point and continuous path robots

Work cell development considerations
What is application to be robotized
Cost justification of robot application
Human effect of robot's use
Design of work cell

Safety
Safety in planning robot work cell
Safety considerations when teaching a program
Production operation safety procedures
Safety involved with inspection and maintenance

Components considered in process of program design
Task analysis
Defining procedures
Sketch of task
Creating a program flowchart
Documentation

Converting task description and flowchart to robot languages
FANUC TPP language
FANUC Karel language
Teaching program
Editing program

Interfacing considerations in programming

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ROB 1620
INDUSTRIAL ROBOTIC APPLICATIONS

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOGY, AUBURN HILLS, MI

INSTRUCTOR: John Sefcovic, 248-232-4202
jpsefcov@oaklandcc.edu

This course offers the opportunity to study, program and work with robots as stand alone units and with robots integrated into work cells. The student will investigate work cell development for various applications. An in depth study of applications programming will be covered during the semester. The study will include different manufacture's programming languages. Applications will include palletizing, spot welding, arc welding and pick and place programs.

BASIS OF FINAL GRADE:

A	95 - 100	C-	66 - 69
A-	92 - 94	D+	60 - 65
B+	89 - 91	D	51 - 59
B	83 - 88	F	- 50
B-	80 - 82		
C+	77 - 79		
C	70 - 76		

WARNING: If you do not withdraw or make arrangements with the instructor to withdraw you from the course, *YOUR FINAL GRADE WILL BE DETERMINED FROM THE GRADES EARNED.*

GRADE BREAKDOWN:

Test Averages	- 40 %
Labs	- 60 %

LABS:

See LAB SIGN-OFF SHEET for assignments

COURSE CONTENT:

Introduction to course
Review of course objectives
identify components considered in process of designing a robot program
create a robot program flowchart use

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ASSIGNMENT		POINTS	INITIALS	DATE
Procedures RJ3iB				
Determine Tool Center Point	Robot:	3		
Brake Settings	Robot:	2		
Reference Position	Robot:	2		
Resume Tolerance	Robot:	2		
Collision Guard	Robot:	2		
Mechanical				
R-C Axis Rho Belt		3		
R-C Axis Theta Backlash		3		
R-C Axis Alpha Replacement		3		
Disassembly Demonstration		5		

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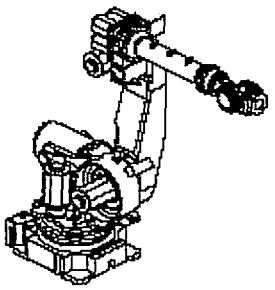
ROB 1520
LAB SIGN-OFF SHEET



ROBOTICS/AUTOMATED SYSTEMS TECHNOLOY, AUBURN HILLS, MI

Name:_____

ASSIGNMENT	POINTS	INITIALS	DATE
Burn-in and Repeatability - RJ3iB			
Burn-in Program Multiple Axis - TPP	3		
Burn-in Program Single Axis - TPP	3		
Repeatability Program, Single Axis, Pointer - TPP	3		
Repeatability Program, Single Axis, Dial Indicator - TPP	3		
Repeatability Program, Multiple Axis, Pointer - TPP	3		
Repeatability Program, Multiple Axis - TPP	3		
Axis Limits - RJ3iB			
Set Software Axis Limits — Robot:	2		
Set Software Limit/Overtravel Switch - Axis 1 R2000iA	5		
Mastering - RJ			
Mastering To Match Marks - RJ — Robot:	5		
Documentation RJ3iB			
J1 Reducer	10		
J5 Reducer	10		
J6 Reducer	10		
Cabling Routing	5		
Preventative Maintenance	5		
Greasing Schedule and Procedures	5		

EXPECTED COMPETENCIES:

This is a list of the expected student competencies for the Robotics 1520 course. The student will have completed these expectations by the end of this course.

At the end of the ROB 1520 course the student will be able to:

1. describe personal safety procedures when working with the robot mechanical unit.
2. explain the purpose of a burn-in program (exercise program) that will be used after a robot has been mechanically repaired.
3. explain the term repeatability and why it is important to the robot.
4. define what a software limit is in reference to a work envelope.
5. set the maximum software limit on the base rotational axis on the Fanuc robot.
6. write a step by step procedure to limit the base rotational axis on the Fanuc robot.
7. write and enter a repeatability program for the Fanuc robots.
8. explain the mastering procedure for an R-J controlled robot.
9. properly set the overtravel switches on the Fanuc robot.
10. list the major components of a harmonic drive
11. list three types of drive mechanisms used on Fanuc robots.
12. list the preventive maintenance procedures for Fanuc robots using manufacture's documentation
13. discuss general lubrication procedures for robot mechanical units.

Open Lab

SESSION FOURTEEN

Review for FINAL EXAM

Lab completion - Turn in Lab Check-Off sheets

SESSION FIFTEEN

FINAL EXAM

COURSE EVALUATION by student

TASK SIGN-OFF:

The sign-off sheet for each lab task has two components, the writing of the program and the running of the program task. The review of the writing component **does not mean** the program is correct. The review is for program structure and obvious errors. Final check of the program is done when the program is executed (run on the robot). Problem found during the running of the program will need to be corrected and a new print-out produced for full credit.

MIDTERM and FINAL:

NO MAKE UP WILL BE GIVEN FOR THE MIDTERM OR FINAL UNLESS YOU HAVE CONTACTED THE INSTRUCTOR FOR ALTERNATIVE ARRAIGNMENTS.

The mid-term and final exams are based on the lecture content and lab assignments.

SCHEDULE:

Midterm: Session 8

Final: Session 15

SESSION FOUR
Hard Stop adjustments and Overtravel Switch
J5 Gear Replacement
    Backlash adjustment
Single Axis Repeatability

SESSION FIVE
General Mechanism - Gears
Robot accuracy and repeatability
Single Axis Repeatability

SESSION SIX
Ball and Lead Screws
Reference Position
Multi-Axis Repeatability

SESSION SEVEN
Resume Tolerance
Review for MID-TERM
Review TPP programming

SESSION EIGHT
MID-TERM

SESSION NINE
Review of Mid-term
Harmonic Drives
Mastering
Zero Degree Mastering
J6 Motor and reducer Replacement

SESSION TEN
Preventive maintenance schedules

SESSION ELEVEN
Lubrication procedures
    Student verify lubrication procedures in robot manuals
Collision Guard

SESSION TWELVE
Wiring Configurations

SESSION THIRTEEN

COURSE CONTENT:

SESSION ONE

Introduction to course
- Student information sheet
  - name
  - contact phone number/e-mail
  - occupation or student year
  - reason for taking course
  - educational background
- Review of course objectives
  - identify components of mechanical drives using proper terminology
  - enter a repeatability program into robot
  - mechanical calibration positions
  - list the types of mechanical drives used on robots
  - identify and adjust mechanical mechanisms on robots
  - enter test or burn-in program to exercise each axis of robot
  - identify proper preventive maintenance procedures
  - observe safety procedures when working on robot
  - identify performance criteria for robot drive mechanisms
- Course procedures
  - assignments and exam schedules
  - student responsibilities

Electronic Documentation
- Mechanical manual
- Parts manual
  - manual layout
  - small parts table
  - configuration and references

SESSION TWO

Safety when working with robots
- Working in or near robot work cell
- Personal safety
- Inspecting robots

RV reducer

J1 Axis RV Gear Replacement

Basic programming review

Burn In Programming Multiple Axis

SESSION THREE

General Mechanism - Belts and Chain Drives

Axis Limits

Burn In Programming Single Axis

OAKLAND COMMUNITY COLLEGE

ROB 1520
ROBOT MANIPULATOR DRIVES AND LINKAGES

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOY, AUBURN HILLS, MI

INSTRUCTOR: John Sefcovic
248-232-4202
jpsefcovic@oaklandcc.edu

This course is designed to give the student a detailed knowledge of the robot mechanical unit. The types of gears and gearing systems that are used in robots will be studied. Many other aspects of the robot mechanical unit will be observed, such as mechanical adjustments, preventive maintenance and maintenance programming. Components of the mechanical unit such as bearings, cams, chains, belts and various drive mechanisms will also be investigated during the semester. The safety involved with working on any robot system will be strongly emphasized.

TEXT: No text. Students will work from manufactures documentation and handouts.

BASIS OF FINAL GRADE:

A	95 - 100	C-	66 - 69
A-	92 - 94	D+	60 - 65
B+	89 - 91	D	51 - 59
B	83 - 88	F	- 50
B-	80 - 82		
C+	77 - 79		
C	70 - 76		

WARNING: If you do not withdraw or make arrangements with the instructor to withdraw you from the course, *YOUR COARSE GRADE WILL BE DETERMINED FROM THE GRADES EARNED.*

GRADE BREAKDOWN:

50% Test Averages
50% Lab Proficiencies

The labs assignment below **MUST BE COMPLETED BY WEEK 14** to receive credit.

ASSIGNMENT	POINTS		INITIALS	DATE
Week 8				
Task No. 6 - TPP	3			
RJ-TPP Download and Teach Task No. 5	4			
RJ-TPP Program POINTERS	5			
Operation exercise No. 3	2			
Week 9				
Task No. 7- TPP	3			
RJ-TPP Download and Teach Task No. 6	4			
TPP Controller Program Edit Exercise 1	2			
Week 10				
Task No. 8- TPP	3			
RJ-TPP Download and Teach Task No. 7	4			
TPP Controller Program Edit Exercise 2	2			
Operation exercise No. 4	2			
Week 11				
Task No. 9- TPP	3			
RJ-TPP Download and Teach Task No. 8	3			
TPP Controller Program Edit Exercise 3	2			
Week 12				
Task No. 10- TPP	3			
RJ-TPP Download and Teach Task No. 9	4			
TPP Controller Program Edit Exercise 4	2			
Week 13				
RJ-TPP Download and Teach Task No. 10	4			

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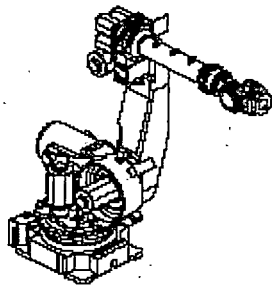
ROB 1500
LAB SIGN-OFF SHEET



ROBOTICS/AUTOMATED SYSTEMS TECHNOLOGY, AUBURN HILLS, MI

Name:_____

DO NOT LOSE THIS SHEET, NO DUPLICATE RECORD KEPT.
RETURN WHEN SUBMITTING FINAL EXAM.

The labs assignment below **MUST BE COMPLETED BY WEEK 7** to receive credit.

ASSIGNMENT	POINTS	INITIALS	DATE
Week 2			
Task No. 1 - TPP	3		
RJ Axis Identification - Joint - ***Required***	2		
Week 3			
Task No. 2 - TPP	3		
RJ-TPP Download and Teach Task No. 1	4		
Week 4			
Task No. 3 - TPP	3		
RJ-TPP Download and Teach Task No. 2	4		
Operation exercise No. 1	2		
Week 5			
Task No. 4 - TPP	3		
RJ-TPP Download and Teach Task No. 3	4		
RJ-TPP Program "JOE"	5		
Operation exercise No. 2	2		

Lab assignments for WEEK 6 **MUST BE COMPLETED BY WEEK 8** to receive credit.

Week 6				
Task No. 5 - TPP	3			
RJ-TPP Download and Teach Task No. 4	4			
RJ Axis Identification - World - - ***Required***	3			

8. Define the terms repeatability and accuracy.

9. Explain the difference between a servo and non-servo robot.

10. Described standard end-of-arm tooling for robots.

11. Explain two coordinate systems in which robots can be manually jogged.

12. Describe the basic programming function that may be used in robot programs.

13. Explain sensors interfaced to a robot.

14. Convert a given binary number to its decimal equivalent.

15. Convert a given decimal number to a binary number.

16. Explain the proper safety precautions that will be used when working around robots.

17. List three methods that can be used to prevent people from entering an active robot work cell.

18. Discuss the various consideration that will be used in a robot work cell.

19. Describe what is included in a robot program.

20. Write and enter a given application program into the FANUC TPP robots.

SESSION 14
Open Lab - **ALL LABS DUE BY END OF SESSION**

SESSION 15
FINAL EXAM

TASK SIGN-OFF:
The sign-off sheet for each lab task has two components, the writing of the program and the running of the program task. The review of the writing component **does not mean** the program is correct. The review is for program structure and obvious errors. Final check of the program is done when the program is executed (run on the robot). Problems found during the running of the program will need to be corrected and a new print-out produced for full credit.

MIDTERM and FINAL:
NO MAKE UP WILL BE GIVEN FOR THE MIDTERM OR FINAL UNLESS YOU HAVE CONTACTED THE INSTRUCTOR FOR ALTERNATIVE ARRAIGNMENTS.

The mid-term and final exams are based on the lecture content and lab assignments.

SCHEDULE:
Midterm: Week 7
Final: Week 15

EXPECTED COMPETENCIES FOR ROB 150:
This is a list of the expected student competencies for the Robotics 150 course. The student will have completed these expectations by the end of this course.

At the end of the ROB 1500 course the student will be able to:

1. Define what a robot is according to the Robot Industries Association.
2. List the three basic components of any robot system, and describe their functions.
3. Classify robots according to their geometric design.
4. List the 3 minor (wrist) axes of a robot.
5. Describe the difference between an end effector and end of arm tooling.
6. Classify robots by their drive control systems.
7. Classify robots by their teaching methods.

SESSION 8

Mid-Term exam results
Discuss chapter 6
- End-of-Arm Tooling
  - Terms
  - Power Sources
- Standard Grippers
  - Angular
  - Parallel
  - Internal-external Gripping
  - Vacuum
  - Magnetic
  - Flexible
- Special Purpose

Reading Assignment: Chapter 7

SESSION 9

Discuss chapter 7
- Controller Functions
- Elements of a Robot Program
- Program Commands
- Arm Motion
- Task Point Diagram
- Online-offline Programming

SESSION 10

Robot Safety
- Robots Require Respect = 3Rs
- People dealing with robots

Numbering Systems
- Binary

SESSION 11

Numbering Systems
- Binary Review
- Hexadecimal

SESSION 12

- Lecture on Lab Assignment

SESSION 13

- Review for FINAL EXAM
  - all chapters 1-7
  - all lecture materials
  - all procedures on robots

TPP Program Transfer
Controller Teach and Automatic Operations

SESSION 4
Discuss chapter 3
- Robot Classification
  - Control Systems
  - Open-loop
  - Operations
  - Advantages/Disadvantages
  - Applications
  - Closed-loop
  - Operations
  - Advantages/Disadvantages
  - Applications

Reading Assignment: Chapter 4

SESSION 5
Discuss chapter 4
- Robot Classification
  - Rectangular Geometry
  - Cylindrical Geometry
  - Spherical Geometry
  - Jointed-spherical Geometry
  - Power Sources
- Path Control
  - Continuous-path
  - Point-to-point
  - Controlled
  - Non-controlled

Reading Assignment: Chapter 5

SESSION 6
Discuss chapter 5
- Sensor Overview
- Contact Sensors
- Noncontact Sensors
  - Photoelectric
  - Proximity
- Simple Process Sensors
- Complex Process Sensors

Review for MID-TERM EXAM
- review chapters 1-5
- review lecture material for sessions 1-5
- review operating procedures for robot and TPP programming

SESSION 7
MID-TERM EXAM
Reading Assignment: Chapter 6

GRADE BREAKDOWN:

25% Mid-term Grade
25% Final Grade
50% Lab Proficiencies

LABS:

See LAB SIGN-OFF SHEET for assignments and for session due.

COURSE CONTENT:

SESSION 1

Introduction to course
- Student information sheet
  - name
  - occupation or student year
  - reason for taking course
  - educational background
- Course procedures
  - credit hours: 4
  - contact hours, lab facility and practice, office hours
  - assignments, exam schedules, lab proficiency sheet
  - student responsibilities
- Review of course objectives

Lab Orientation
Reading Assignment: Chapter 1

SESSION 2

Discuss chapter 1
- History of Robotics
- Definition of a robot
- Mass Production
- Batch Manufacturing
- Flexible Manufacturing Systems

Reading Assignment: Chapter 2
TPP Programming Software
Controller Power-on and Robot Jogging

SESSION 3

Discuss chapter 2
- Robot introduction
- Basic components of robot systems
- Manipulator geometry
- Wrists
- End effectors
- Classifying robots by drive control systems
- Classifying robots by teaching methods
- Specifying robot by repeatability, precision, accuracy

Reading Assignment: Chapter 3

OAKLAND COMMUNITY COLLEGE

ROB 1500 INTRODUCTION TO ROBOTICS

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOGY, AUBURN HILLS, MI

INSTRUCTOR: John Sefcovic
248-232-4202
jpsefcovic@oaklandcc.edu

This course is an overview of robotics systems technology. The student will be introduced to basic robot terminology; different types of robots; robot safety; basic robot programming; preparing a robot program; interfacing or robot communications; robot work cell development; robot applications; and an overview of the sociological impact of robots entering the workplace. Programmable controllers and their applications will be introduced to the student.

TEXT: ROBOTICS An Introduction
by Schoolcraft Publishing

BASIS OF FINAL GRADE:

A	95 - 100	C-	66 - 69
A-	92 - 94	D+	60 - 65
B+	89 - 91	D	51 - 59
B	83 - 88	F	- 50
B-	80 - 82		
C+	77 - 79		
C	70 - 76		

WARNING: If you do not withdraw or make arrangements with the instructor to withdraw you from the course, *YOUR COURSE GRADE WILL BE DETERMINED FROM THE GRADES EARNED.*

ATTENDANCE:

Attendance is mandatory for lecture. Non-attendance for any two lecture sessions will result in 5% deduction from the course grade. Three non-attended lectures will result in 15% deducted from the course grade. Four or more non-attended lectures will result in a failure in the course. A grade of F will be assigned, or you may withdraw from the course.

Summary of syllabus items.

Mandatory Items (per FMA and Federal Law)	
ADA Notification	Syllabus Addendum
Course Goals	Syllabus , stated as objectives
Grading Standards and Practices	Syllabus
Tentative Schedule of Assignments and Tests	Syllabus and Lab Sign-off Sheet
Recommended Items (per Academic Senate)	
Course Name and Number	Syllabus
Instructor, Office Location, Method of Contact	Syllabus
Office Hours	Syllabus Addendum
Available Assistance	Syllabus Addendum
Course Catalog Description with Prerequisites	Syllabus
General Education Attributes (where pertinent)	Not Applicable
Required Books and Supplies	Syllabus
List of Supportive Materials (where available)	Not Applicable
Evaluation/Testing System & Policies	Syllabus
Attendance Policy	Syllabus Addendum
Safety Instructions	Syllabus Addendum
Disclaimer Allowing for Reasonable Revisions	Syllabus Addendum
Optional Items	
Semester Meeting Times & Room	Not Included
Teaching/Learning Strategies	Not Included
Applicable Forms Pertinent to Course	Not Applicable
Reference to Student Policies in OCC Catalog	Syllabus Addendum
Policy on Use of Computing Resources	Not Included
Description of Required Computing Skills	Not Included
Policy on Plagiarism	Not Included
Student Bill of Responsibilities	Syllabus Addendum

B. SYLLABUS REVIEW

All syllabi are provided by the full time instructor, contact information for the adjunct faculty included in the course's syllabus. Students in addition to the syllabus are provided with an addendum and assignment sign-off sheet. Depending on the course, different due dates are assigned for the assignments.

Content for the course syllabi will be updated over the next two years based on three factors.

1. New applications built and installed,
2. Curriculums developed for new hardware applications and software.
3. Students progressing through the program with the updated curriculum in prerequisite classes to support objectives in the course.

Following modifications will be adopted for the 2008-9 academic year.

1. An attendance policy that will deduct points from final grade based on the number of classroom sessions missed. See proposed text below.

ATTENDANCE:
Attendance is mandatory for lecture. Non-attendance for any three lecture sessions will result in 5% deduction from the course grade. Four non-attended lectures will result in 15% deducted from the course grade. Five or more non-attended lectures will result in a failure in the course. A grade of F will be assigned, or you may withdraw from the course.

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2. The assignment sign-off will be in the format of the points awarded for assignment completion. The grading is based on three assessments, mid-term and final exams, and lab assignments. Each assessment is scored at 100%, then weighed with a percentage to determine the course grade. Currently, lab assignments are based on a scale of 0 to 100. This will be changed to a scale of 0 to 1000 to allow for partial points to be assigned.

3. Added to the 2008-9 college catalog program description is a notice of computer skill required. The language, with examples of requisite computer skills, will be included in the syllabi.

4. Use of portable "thumb or flash" drives. These devices will be allowed, but files must to backed-up on lab's file server. Loss of the drive or data on will not be an excuse, last version of assignment when in lab must be saved to the file server.

See pages 9 to 71 for syllabi, addendums, and sign-off sheets.

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ROB 2500.....4 Credits
Automated Controller Maintenance
Prerequisite: ROB 1500 or consent of instructor.

~~This course will introduce the student to the techniques needed to troubleshoot~~ robot controllers. Students will study the techniques and components involved in robotic maintenance including: ~~maintenance programming; electrical theory~~; analysis and troubleshooting; ~~and a detailed study of robot controllers. Development of these skills will enable the student to effectively maintain robotic systems currently used in industry.~~
Course/lab fees.

ROB 2500.....4 Credits
Robotic Controller Maintenance
Prerequisite: ROB 1500 or consent of instructor.

This course will cover the maintenance aspect of robot controllers. Students will study the techniques and components involved in maintenance including: controller settings; electrical/electronic architecture; analysis and troubleshooting techniques of robot controllers. Students will utilize observations, documentation, and prints to diagnose and correct problems on the robotic controllers.
Course/lab fees.

ROB 2140.....4 Credits
Advanced Programmable Controllers Applications
Prerequisite: ROB 2040.

The course will be structured to provide the student with an understanding of the relationship between "real time" control systems and industrial devices and machines. The advanced instruction set of programmable controllers will be studied ~~in relevancy~~ to concepts and structures of automated control systems. Various applications will be defined in which the student will develop the written programs for each hardware and software specification of the process problems. The use of the Robotics Lab equipment will give the student practical programming and troubleshooting skills that are used in the maintenance of automated systems.
Course/lab fees.

ROB 2400.....4 Credits
Automated Systems Applications
Prerequisites: ROB 1660

~~This is a course of study that will give the student an understanding of the various aspects of automated systems utilizing real world applications. Topics such as automated materials handling systems, robotic systems, communication systems and computer information systems will be discussed.~~ The student will gain practical information on how these systems are interfaced together mechanically, electrically and software-wise. Robotic simulation and machine vision sensors will be utilized by the students in robotic work cell applications.
Course/lab fees.

ROB 2140..... 4 Credits
Advanced Programmable Controllers Applications
Prerequisite: ROB 2040.

The course will be structured to provide the student with an understanding of the relationship between "real time" control systems and industrial devices and machines. The advanced instruction set of programmable controllers will be studied relevant to concepts and structures of automated control systems. Various applications will be defined in which the student will develop the written programs for each hardware and software specification of the process problems, including field devices, data networks, and Human Machine Interfaces (HMI). The use of the Robotics Lab equipment will give the student practical programming and troubleshooting skills used in the maintenance of automated systems.
Course/lab fees.

ROB 2400.....4 Credits
Robotic Automated Systems Applications
Prerequisites: ROB 1640 and ROB 1660

This course provides the system aspects for applying robots in automation. Topics include the process requirements, programming, and communication for implementing robotic applications. The student will gain practical information on how these systems are interfaced together mechanically, electrically and software-wise. Robotic simulation and machine vision sensors will be utilized by the students in robotic work cell applications.
Course/lab fees.

ROB 1660.....4 Credits
Sensor Technology
Prerequisites: ROB 1620

This course will give the student a working knowledge of the various types of industrial sensors ~~that could possibly be~~ incorporated into a complex work cell. The student will ~~investigate how controllers are programmed to interact with the feedback devices and the types of signals the sensors will supply to the controller. Students will use robotic simulation for the interaction of sensor signals in applications. Programming and setup aspects of machine vision sensors will be studied.~~ Course/lab fees.

ROB 1660.....4 Credits
Robotic Communications and Machine Vision
Prerequisites: ROB 1620

This course will give the student a working knowledge of the various types of industrial sensors incorporated into a complex work cell. The student will utilize point-to-point wiring interfaces, field device networks, and data networks to investigate how controllers are programmed to interact with the types of signals the sensors will supply to the controller. Concepts of machine vision lighting/lensing and programming will be studied and applied to robotic applications. Students will study the use of simulation in programming signal exchanges in robotics applications.
Course/lab fees.

ROB 2040.....4 Credits
Programmable Controller Applications

This class will ~~present~~ the fundamentals of Programmable Logic Controller (PLC) operations, including symbology and ~~structure. After these fundamentals are understood, the student will write, enter, and execute application programs using the programmable controllers.~~
Course/lab fees.

ROB 2040.....4 Credits
Programmable Controller Applications

This class will introduce the fundamentals of Programmable Logic Controller (PLC) operations, including symbology and programming techniques. PLC hardware and data structures will be presented. Methods of using the programming interface to troubleshoot applications will be emphasized. The student will write, enter, and execute application programs using the programmable controllers and Human Machine Interface (HMI). The use of the Robotics Lab equipment will give the student practical programming and troubleshooting skills used in the maintenance of automated systems
Course/lab fees.

ROB 1620.....4 Credits
Industrial Robotic Applications
Prerequisite: ROB 1500

This course offers the opportunity to study, program and work with robots and stand alone ~~units~~ and with robots integrated into work cells. ~~The student will investigate work cell development for various applications. An in-depth study of applications~~ programming will be covered during the semester. ~~The study will include different manufacturers' programming languages. Applications will include palletizing, spot welding, arc welding and pick-and-place programs. Students will use robotics as a method of programming applications.~~ Course/lab fees.

ROB 1620.....4 Credits
Industrial Robotic Applications
Prerequisite: ROB 1500

This course offers the opportunity to study, program, and work with stand-alone robots and with robots integrated into work cells. Applications studied will include palletizing and packaging, material joining, material removal and material handling. An in-depth study of applications programming will be covered during the semester. Programming will include different methods of error handling and operator interfacing used in robotic applications. Students will be introduced to robotic simulation.
Course/lab fees.

ROB 1640.....4 Credits
Interpolated/Welding Robotic Applications
Prerequisites: ROB 1620

~~The student will program and operate robotic welding systems using resistance and arc welding technologies. The course will include laboratory hands-on experience in basic welding fundamentals. Robotic weld schedules will be used to enable robot welding applications using Gas Metal Arc Welding. Resistance welding programs will also be studied by the student.~~ Students will use robotic simulation for complex motions ~~and welding applications.~~ Course/lab fees.

ROB 1640.....4 Credits
Interpolated/Welding Robotic Applications
Prerequisites: ROB 1620

Students will study the complex motions in robotic applications. Controller frame set-up and programming techniques for interpolated linear and circular motions will be investigated in the lecture. The concepts will be applied in the Robotics Lab to investigate techniques for various types of material removal and joining applications. The course will include lectures on basic welding fundamentals. The student will program and set weld schedules to enable robotic welding applications using Gas Metal Arc Welding (GMAW) and resistance welding. Students will use robotic simulation for complex motions.
Course/lab fees.

ROBOTICS/AUTOMATED SYSTEMS TECHNOLOGY
CURRENT/REVISED COURSE DESCRIPTIONS

CURRENT

ROB 1500.....4 Credits
Introduction to Robotics Technology

This course is an overview of robotic and automated system technology. The student will be introduced to basic manufacturing techniques; robot terminology; different types of automation; safety; basic robotic programming; interfacing robotic communications; automated work cells; robotic applications; ~~and students will be introduced to machine vision sensors and robotic simulation.~~
Course/lab fees.

ROB 1520.....4 Credits
Robot Manipulator Drives and Linkages
Prerequisites: ROB 1500.

This course is designed to give students a detailed knowledge ~~of automated mechanical units. The types of gears and gearing systems that are used in automation will be studied.~~ Many aspects of robotic mechanical units will be observed, such as mechanical adjustments, preventative maintenance ~~and maintenance programming. Components of the mechanical unit such as bearings, cam, chains, belts and various drive mechanisms will also be investigated during the semester. The safety involved in working with automated systems will be strongly emphasized.~~
Course/lab fees.

REVISED

ROB 1500.....4 Credits
Introduction to Robotics Technology

This course is an overview of robotic and automated systems technology. The student will be introduced to basic manufacturing techniques, robot terminology, different types of automation, safety, basic robotic programming, interfacing robotic communications, automated work cells, and robotic applications. Robot operations and programming fundamentals will be applied by the students.
Course/lab fees.

ROB 1520.....4 Credits
Robotic Maintenance
Prerequisites: ROB 1500.

This course is designed to give students a detailed knowledge of robotic mechanical units. The types of gears and gear reduction systems that are used in robots will be studied. Many aspects of robotic mechanical units will be observed, including mechanical adjustments and preventative maintenance. Controller setting and procedures which influence the motion of the robotic manipulator will be investigated. The safety procedures involved in working with robotic mechanical units will be emphasized.
Course/lab fees.

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A. CATALOG COURSE DESCRIPTIONS - SUMMARY

The catalog descriptions for the courses in the Robotics/Automated Systems Technology program have been updated and approved by the Campus/College Curriculum Committees and Academic Senate for the 2008-9 catalog.

Changes to the course descriptions were balloted to the Applied Engineering & Technology department as part of the curriculum revision process. Ten ballots were sent, nine approved and one no response.

The catalog descriptions were reviewed by the Robotics/Automated Systems Technology advisory committee on April 16, 2008.

The following course descriptions have been revised.

ROB 1500 Introduction to Robotics Technology
ROB 1520 Robot Manipulator Drives and Linkages
ROB 1620 Industrial Robotic Applications
ROB 1640 Interpolated/Welding Robotic Applications
ROB 1660 Sensor Technology
ROB 2040 Programmable Controller Applications
ROB 2140 Advanced Programmable Controller Applications
ROB 2400 Automated Systems Applications
ROB 2500 Automated Controller Maintenance

See pages 2 to 6.

Part II- Program Review and Program Review of Occupational Evaluation (PROE)

CURRICULUM REVIEW
Robotics/Automated Systems Technology

Table of Contents

Part I-Core Review

OAKLAND
COMMUNITY
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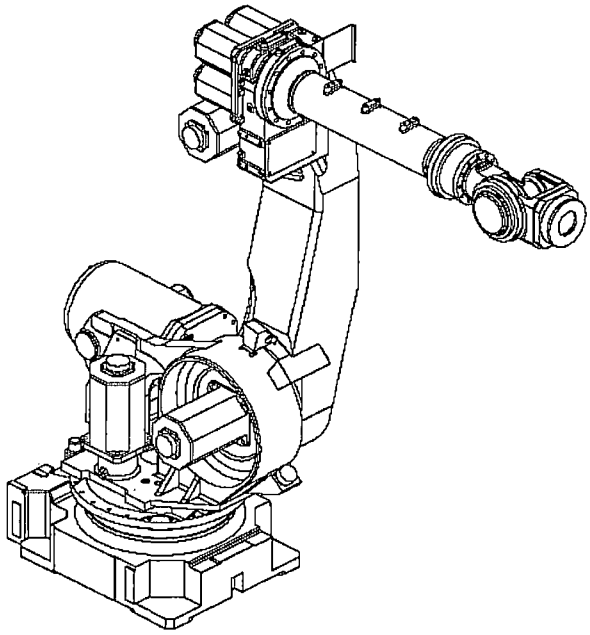
CURRICULUM REVIEW SELF-STUDY FOR DISCIPLINE/PROGRAM



ROBOTICS/AUTOMATED SYSTEMS TECHNOLOGY

MAY 16, 2008

Major Highlights

Program Dashboard

Program Dashboard – Percent of Targets Achieved

Credit Hour Trends

Degree Trends

Occupational Projections

Occupational Skills Analysis

Program Assessment Plan

Program Assessment Findings

CRC Recommendations

CRC Follow-Up

Robotics/Automated Systems
Major Highlights
April 2008

Overview

The information contained in this binder represents supporting reports and data associated with the CRC's review of the Robotics/Automated Systems program. These reports are intended to provide a historical perspective, as well as an idea of current strengths and future challenges facing the program which may impact short and long term curriculum Development.

As a point of reference each section begins with a brief synopsis of the data and information presented in the section followed by summative as well as detailed analysis.

Major Highlights

- The Robotics/Automated Systems program has experienced a slight fluctuation in the composite dashboard score over the last four years and at 9.04 in 2006-07, it ranked 64th of all 100 curriculum offered at the college.

- Two out of the seven program dashboard measures exceeded the college benchmarks, which include the percent of sections not canceled and the student course completion rate. Despite a downward trend in the percent of completed ROB sections over the past four years, a slight increase to 93% was seen in 2006-07 and this exceeds the college-wide average of 91%.

- Moreover, although the student course completion rate fluctuated over a four-year period, it still remained well above the college-wide average. In 2006-07, 80% of ROB students successfully completed the course with a grade of "C" or higher, which can be compared to a 68% student success rate college-wide.

- In contrast, two out of the seven program dashboard measures failed to meet their established benchmarks. These include the percent of sections filled to capacity and the percent of withdrawals.

- Over the last four years, there has been an inverse relationship between the total capacity in ROB sections and the percent of these sections filling. For the most recent three year period, the total capacity has increased each year, and the percent of sections filling to capacity has decreased. In 2006-07, only 61% of ROB sections were filled, which is well below the college-wide average of 84%.

- Additionally, a rising trend in the percent of withdrawals has been seen and in 2006-07, 16% of the ROB students had withdrawn from their courses. Although this percent is below the college-wide 18% average, it surpassed the program dashboard trouble score of 15%.

- The annual number of credit hours in Robotics has experienced both upward and downward trends over the last ten years, and in recent years has declined. In fact, the last two years saw the most dramatic plunge in the numbers of ROB credit hours and were the lowest in the ten-year period. In 2006-07 the number of credit hours generated in ROB courses ranked 58th among all curriculum at the college.

Source: OCC, Office of Assessment & Effectiveness

- Over the past ten years there has been an average of 2 Certificates and approximately 9 Associate Degrees awarded per academic year in Robotics/Automated Systems. The peak number of Associate Degrees occurred recently with 12 being awarded in both 2004-05 and 2006-07, making it ranked 21st out of all OCC programs.

- Four occupations were identified relating to Robotics/Automated Systems Technology for the four-county region of southeast Michigan. According to EMSI, Electro-Mechanical Technicians and also Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders have very little projected growth for the next five years. In addition, Electromechanical Equipment Assemblers and also Computer-Controlled Machine Tool Operators (metal and plastic) are projected to see a slight decline in the number of jobs available in this same time period. As a whole, there are a large number of current Robotics positions in the region (7,117), but the occupations seem quite stagnant and a loss of 52 jobs is expected to occur over all Robotics occupations, which includes both new and replacement positions.

- In terms of program assessment, the previous Robotics/Automated Systems Technology assessment plan had three unique Learning Outcomes and a total of 6 Benchmarks. In March 2008, the plan was modified and now has four unique Learning Outcomes and a total of 6 Benchmarks, which is in accordance with the guidelines established by the Student Outcomes Assessment Committee.

- Between April 2007 and March 2008, all 6 benchmarks were assessed, although one of the benchmarks was determined to be unmeasurable so the result was unknown. This was part of the plan modifications and this particular benchmark was changed. Overall, 83% of the 6 Benchmarks were met.

- Various action strategies were identified as a result of recent assessment activities. These include making modifications to several plan benchmarks and assessment methods which were completed and submitted to the Office of Assessment. Also, proposed changes to the way in which information will be delivered to the students and to the curriculum were proposed. For the way in which information will be delivered to students, it was suggested that students would be provided with a grading rubric on the requirements and the format required for the program and process documentation. Curriculum changes include creating exercises, which are part of the study guide materials, to provide the students with additional resources on the connection on the boards/components and the relationship between the boards/components in the operations of the system. In addition, a change to the curriculum would occur for ROB 1620 where students will submit documents on separate applications, one in the first third of the semester and the next submission in the second third of the semester.

Source: OCC, Office of Assessment & Effectiveness

Oakland Community College
Program Dashboard

The purpose of the program dashboard is to provide a data driven tool designed for the objective review of all curriculum offerings. Based on a common set of measures which apply to all programs/disciplines the dashboard facilitates the systematic identification of well performing as well as ailing curriculum so early intervention efforts can be undertaken.

In a rapidly changing economic and competitive environment it is necessary if not imperative to continually review curriculum offerings annually. Dashboard reports are a useful tool for monitoring program performance. In addition, they allow for an integrated approach for collecting, presenting, and monitoring data to meet long and short-term programmatic decision-making needs.

The Program Dashboard is based on seven measures which include:

- Sections Filled to Capacity
- Percent of Completed Sections
- Credit Hour Trend Ratio
- Percent of Minority Students
- Percent of Withdrawals
- Percent of Incompletes
- Student Course Completion Rate

The following report provides summative information for the most recent academic year as well as detailed trend data on each measure over the past several years.

Program Dashboard
Detail Report

Prefix ROB
Title Robotics / Automated Systems Technology

	Program				College Wide
	2006-07	**2005-06**	**2004-05**	**2003-04**	**2006-07**
Sections Filled to Capacity	61.1%	65.7%	83.8%	71.1%	84.4%
Percent of Completed Sections	92.9%	80.0%	90.5%	100.0%	90.7%
Headcount Trend Ratio	0.95	0.99	1.00	0.96	1.01
Credit Hour Trend Ratio	0.95	0.99	1.00	0.96	1.01
Percent of Minority Students	17.5%	20.4%	19.0%	21.1%	28.2%
Percent of Withdrawals	16.1%	17.0%	13.2%	11.6%	18.3%
Percent of Incompletes	0.4%	0.9%	0.0%	0.0%	1.5%
Student Course Completion Rate	80.0%	78.7%	85.8%	72.8%	67.7%
Dashboard Score	9.04	9.01	9.77	9.24	

Sections Filled to Capacity

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2006-07	2005-06	2004-05	2003-04
Total Students	239	239	295	278
Total Capacity	391	364	352	391
Sections Filled To Capacity	61.1%	65.7%	83.8%	71.1%

Definition:

The percent of all available seats which are filled on the terms official census date. Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: One-tenth-day of each term.

Methodology:

Total number of sections (credit courses only) that are filled to their designated capacity e.g. allocated seats divided by the total number of available seats in all sections throughout the academic year (July 1 through June 30). In other words, how many sections are filled to their capacity on the sections 1/10 day out of all sections? Include sections that are more than filled / overflowing in calculation.

One-Tenth Day data shows the capacity filled numbers at approximately 3 weeks after the Fall and Winter terms begin; and 1 week after the Summer I and II terms begin. This data will not provide additional enrollment data if the sections begin after the one-tenth day.

While a section may only have a few students enrolled in it the college is able to designate some sections as 'full' so that they are not cancelled (per OCCFA Master Agreement). Therefore some disciplines may show low fill capacity rates, and the college never cancelled the sections or condense the students into fewer sections offering the same course.

Percent of Completed Sections

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2006-07	2005-06	2004-05	2003-04
Active Sections	13	12	19	14
Cancelled Sections	1	3	2	0
Total Sections	14	15	21	14
Percent of Completed Sections	92.9%	80.0%	90.5%	100.0%

Definition:

Of all offered sections, the percent of sections that are completed (not cancelled). Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: End of session, after grades are posted.

Methodology:

Annually, the total number of offered credit sections that are completed. Formula = number of completed credit sections divided by the total number of offered credit sections. In other words, the percent of these sections that are not cancelled.

Headcount Trend Ratio

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2006-07	2005-06	2004-05	2003-04
Headcount Year 1	278	246	295	308
Headcount Year 2	295	278	246	295
Headcount Year 3	239	295	278	246
Headcount Year 4	240	239	295	278
Headcount Period 1	271	273	273	283
Headcount Period 2	258	271	273	273
Headcount Ratio	0.95	0.99	1.00	0.96

Definition:

Trend in student headcount based on a three year rolling average. Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: One-tenth-day of each term. (Note: this measure is not used in the calculation of the Program Dashboard score since it parallels trends depicted in Credit Hours.)

Methodology:

In order to establish a meaningful enrollment statistic which applies to large as well as small disciplines/programs a "ratio" was calculated based on a three year rolling average of student headcount.

The formula used to calculate this measure involves three simple steps:

a. Year 1 + Year 2 + Year 3 / 3 = Period 1
b. Year 2 + Year 3 + Year 4 / 3 = Period 2
c. Period 2 / Period 1 = Ratio

If the ratio is greater than "1" this means there has been an enrollment increase. On the other hand, if the ratio is less than "1" this translates into an enrollment decline. The larger the number the larger the enrollment increase. Likewise, the lower the number the greater the enrollment decline.

Credit Hour Trend Ratio

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2006-07	2005-06	2004-05	2003-04
Credit Hour Year 1	1,112	984	1,180	1,232
Credit Hour Year 2	1,180	1,112	984	1,180
Credit Hour Year 3	956	1,180	1,112	984
Credit Hour Year 4	960	956	1,180	1,112
Credit Hour Period 1	1,083	1,092	1,092	1,132
Credit Hour Period 2	1,032	1,083	1,092	1,092
Credit Hour Ratio	0.95	0.99	1.00	0.96

Definition:

Trend in student credit hours based on a three year rolling average. Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: One-tenth-day of each term.

Methodology:

In order to establish a meaningful enrollment statistic which applies to large as well as small disciplines/programs a "ratio" was calculated based on a three year rolling average of student credit hours.

The formula used to calculate this measure involves three simple steps:

a. Year 1 + Year 2 + Year 3 / 3 = Period 1
b. Year 2 + Year 3 + Year 4 / 3 = Period 2
c. Period 2 / Period 1 = Ratio

If the ratio is greater than "1" this means there has been an enrollment increase. On the other hand, if the ratio is less than "1" this translates into an enrollment decline. The larger the number the larger the enrollment increase. Likewise, the lower the number the greater the enrollment decline.

Percent of Minority Students

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2006-07	2005-06	2004-05	2003-04
Minority Students	24	29	29	32
Total Students	137	142	153	152
Percent of Minority Students	17.5%	20.4%	19.0%	21.1%

Definition:

The percent of students who are minority. Minority status is self-reported by the student and includes: African American, Asian, Hispanic, Native American Indian and Other. Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: end of session for each term.

Methodology:

Percentages are based on known data and exclude missing information.

Percent of Withdrawals

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2006-07	2005-06	2004-05	2003-04
Total Withdrawals	37	39	39	32
Total Grades	230	230	295	276
Percent of Withdrawals	16.1%	17.0%	13.2%	11.6%

Definition:

The percent of students who withdraw from their course after the term begins. Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: End of session files, after grades are posted.

Methodology:

Percent of withdrawals is derived by dividing the total number of student initiated withdrawals by the total number of grades and marks awarded throughout the academic year. The Withdrawal-Passing (WP), and Withdrawal-Failing (WF) are considered Withdrawals (W). Meanwhile, calculations exclude: Audit (AU), Not Attended (N), and Not Reported (NR).

Percent of Incompletes

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2005-06	2005-06	2004-05	2003-04
Total Incompletes	1	2	0	0
Total Grades	230	230	295	276
Percent of Incompletes	0.4%	0.9%	0.0%	0.0%

Definition:

The percent of students who receive an incomplete in their course. Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: End of session files, after grades are posted.

Methodology:

Percent of incompletes is derived by dividing the total number of incompletes by the total number of grades and marks awarded throughout the academic year. The Continuous Progress (CP) grade is considered an Incomplete (I). Meanwhile, calculations exclude: Audit (AU), Not Attended (N), and Not Reported (NR).

Student Course Completion Rate

Prefix ROB

Prefix Title Robotics / Automated Systems Technology

	2006-07	2005-06	2004-05	2003-04
Successful Grades	184	181	253	201
Total Student Grades	230	230	295	276
Student Course Completion Rate	80.0%	78.7%	85.8%	72.8%

Definition:

The percent of students who successfully complete a course with a grade of "C" or higher. Time Frame: Academic Year (Summer II, Fall, Winter, Summer I). Data Source: End of session files, after grades are posted.

Methodology:

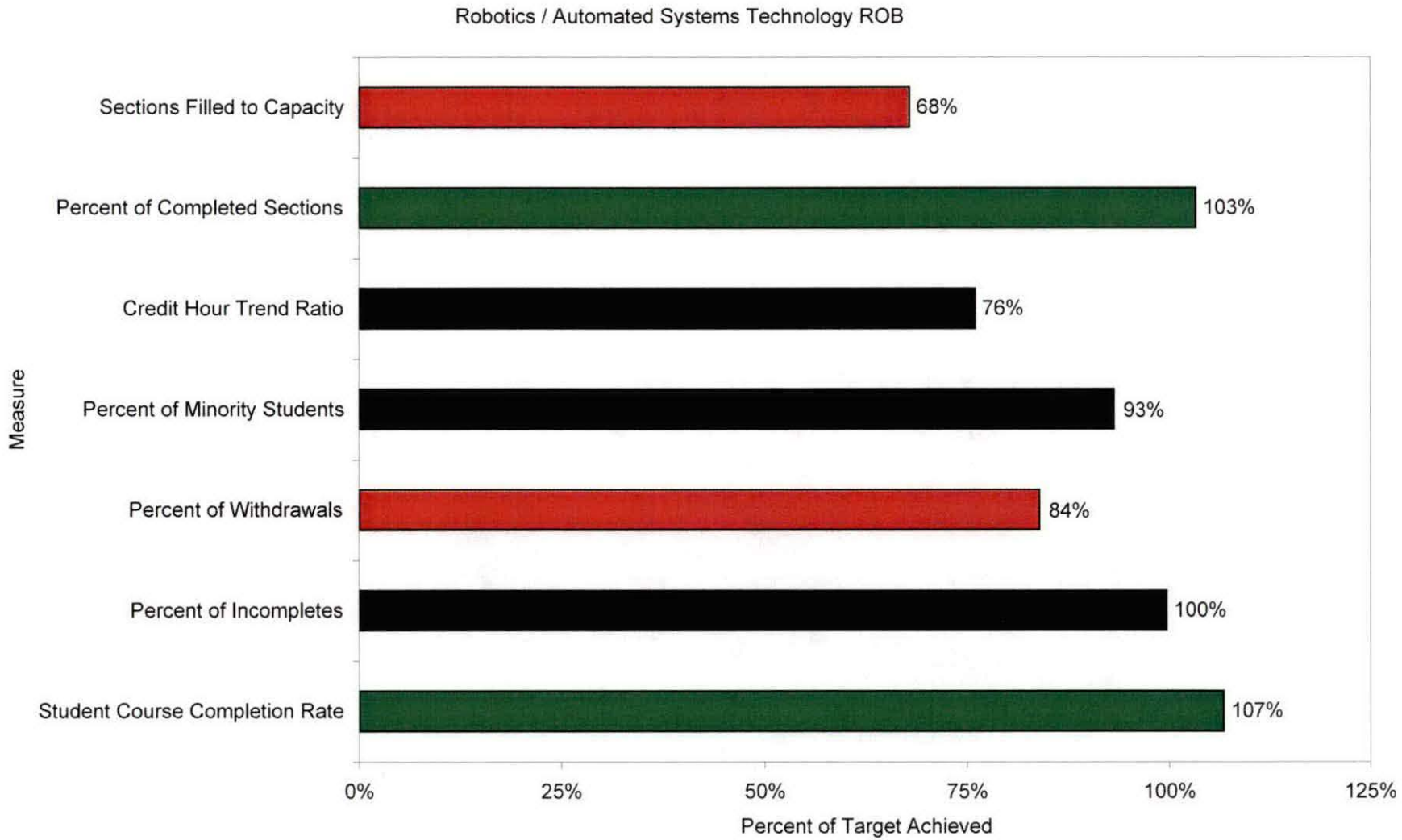
Student success rates are based on end of session data after all grades have been posted. Data includes grades from the entire academic year (Summer II, Fall, Winter, and Summer I). The following grades/marks are excluded from the calculation: Audit (AU), Not Attended (N) and Not Reported (NR).

Oakland Community College
Program Dashboard
Percent of Targets Achieved

The following graph and table depict the extent to which each of the seven Program Dashboard measures met established college-wide benchmarks. Benchmarks (targets and trouble scores) are based on historical data and reflect a range within which each measure is expected to perform.

Measures which exceed the established benchmark are depicted in green, while those that fall short of the benchmark are shown in red. This information is useful in identifying areas of excellence, as well as areas of concern. As a consequence, this report can help to identify specific areas which may require additional attention by program staff.

Oakland Community College
Program Dashboard Report
2006-07



Source: Office of Assessment and Effectiveness
Updated On: 10/26/2007

Oakland Community College
Program Dashboard Report
2006-07

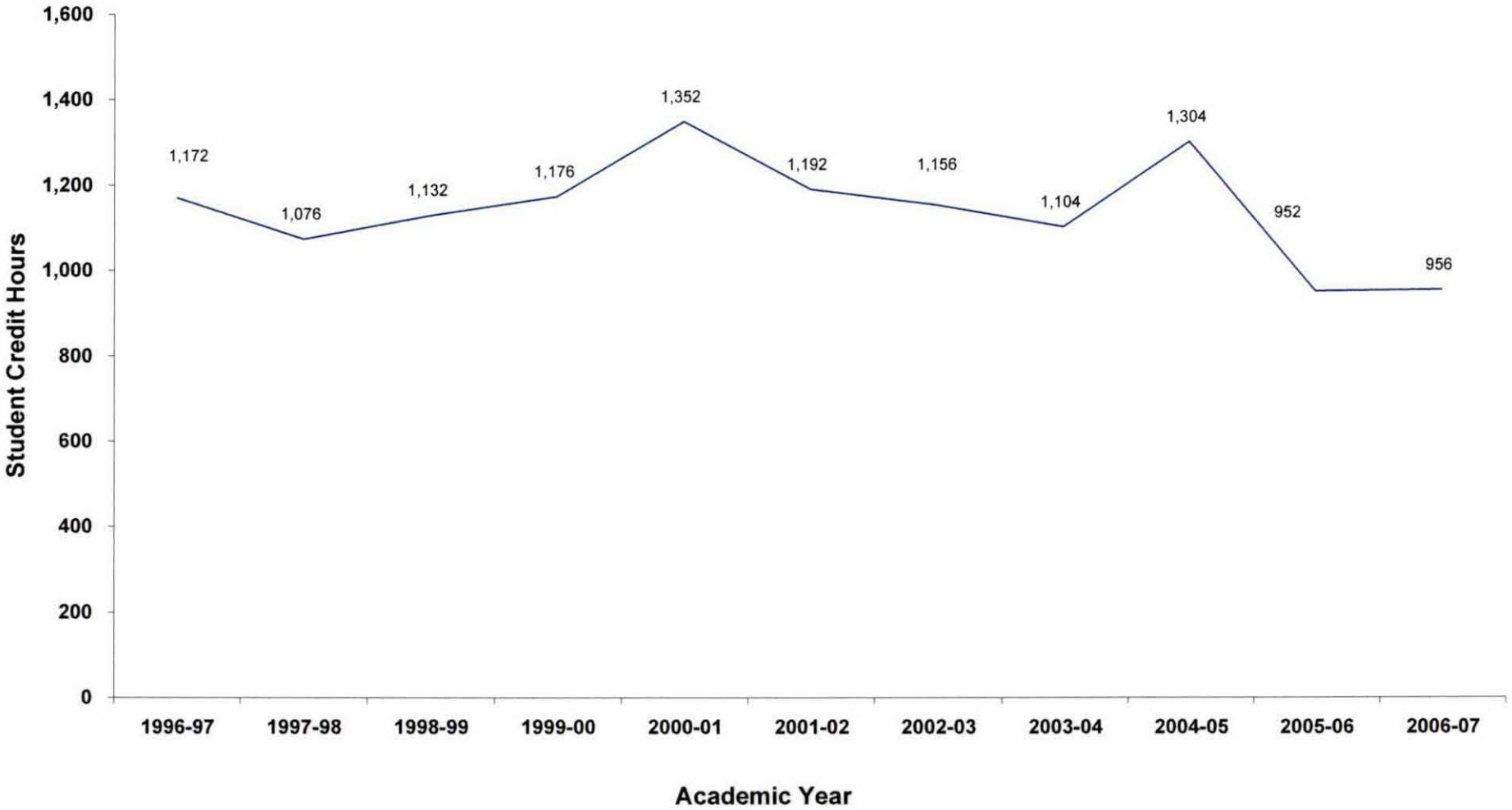
Robotics / Automated Systems Technology ROB
Dashboard Score: 9.04

Measures	Current Score	Benchmarks: Trouble Score	Benchmarks: Target Score	Percent of Target Achieved	Weight	Weighted Score
Sections Filled to Capacity	61.1%	75.0%	90.0%	67.9%	18.0%	1.22
Percent of Completed Sections	92.9%	75.0%	90.0%	103.2%	14.2%	1.47
Credit Hour Trend Ratio	0.95	0.71	1.25	76.0%	15.3%	1.16
Percent of Minority Students	17.5%	16.9%	18.8%	93.1%	6.1%	0.57
Percent of Withdrawals	16.1%	15.0%	0.0%	83.9%	12.0%	1.01
Percent of Incompletes	0.4%	3.0%	0.0%	99.6%	7.9%	0.79
Student Course Completion Rate	80.0%	60.0%	75.0%	106.7%	26.5%	2.83

Source: Office of Assessment and Effectiveness
Updated On: 10/26/2007

Oakland Community College
Ten-Year Trend in Student Credit Hours
Robotics Tech
1996-97 through 2006-07

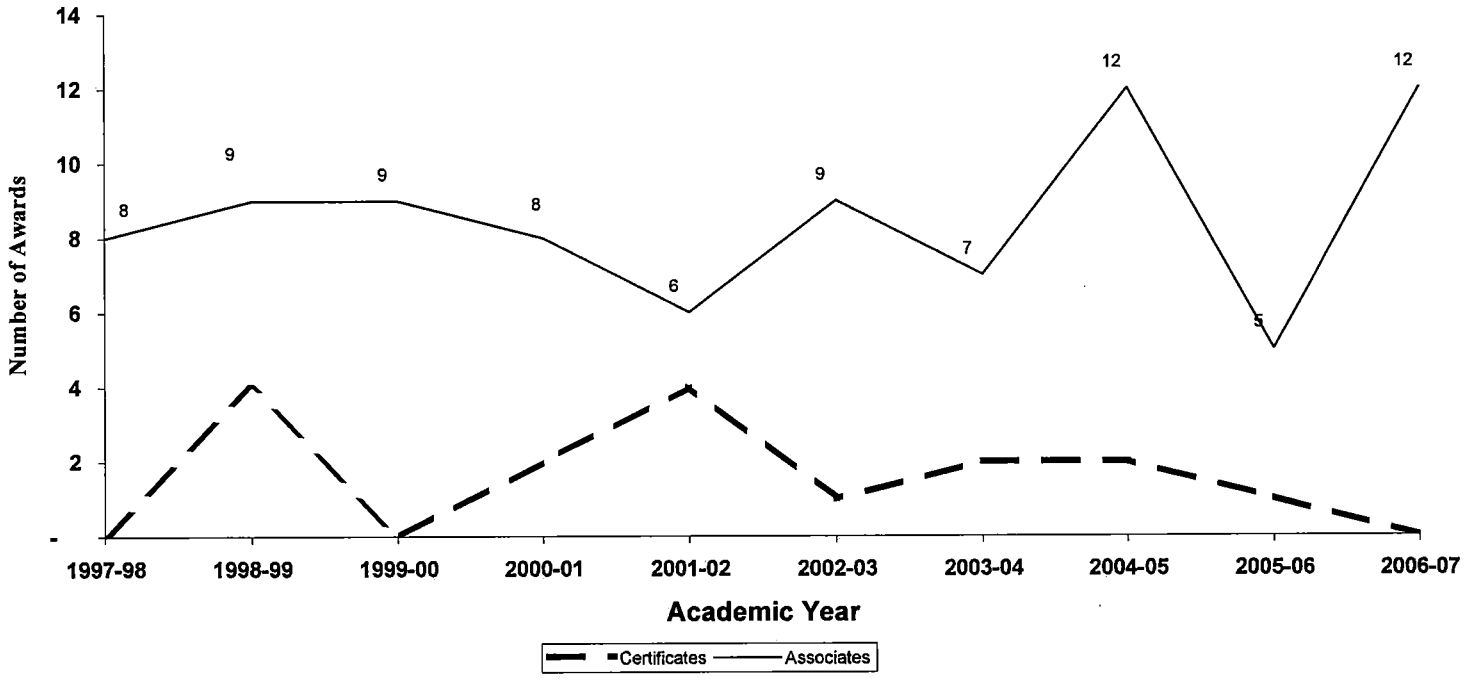
	1996-97 SCH	1997-98 SCH	1998-99 SCH	1999-00 SCH	2000-01 SCH	2001-02 SCH	2002-03 SCH	2003-04 SCH	2004-05 SCH	2005-06 SCH	2006-07 SCH	5-Year % Change	10-Year % Change
Robotics Tech	1,172	1,076	1,132	1,176	1,352	1,192	1,156	1,104	1,304	952	956	-19.8	-18.4
College Wide Totals	443,471	431,521	440,448	438,997	453,054	447,928	478,827	468,777	472,892	487,597	493,655	10.2	11.3



Source: OCC, Office of Institutional Research

3/20/2008

Oakland Community College
Associate Degrees and Certificates Awarded
Robotics Tech-Automated Systems
1997-98 through 2006-07



Academic Yr.	Certificates	Associates
1997-98	0	8
1998-99	4	9
1999-00	0	9
2000-01	2	8
2001-02	4	6
2002-03	1	9
2003-04	2	7
2004-05	2	12
2005-06	1	5
2006-07	0	12

Source: OCC, Office of Institutional Research

3/20/2008

Occupational Projections
(2007 – 2012)

The following projections are for those occupations most closely associated with this program based on national and regional sources. However, the extent to which specific OCC programs lead to employment within a given Standard Occupational Code (SOC) is dependent upon the way in which the U.S. Department of Labor groups specific occupations.

Occupational projections are presented at the "Detailed Standard Occupational Code" level as defined by the U.S. Department of Labor.

Although based on sound well tested economic modeling procedures, projections are subject to change based on emerging economic, political and social forces.

These projections reflect the four county region of Oakland, Macomb, Livingston and Wayne counties.

Projections are based on data from 24 major data sources, including the U.S. Department of Commerce, Bureau of Labor Statistics (BLS), Internal Revenue Service (IRS), and Census data. To forecast occupational demand at the county level, BLS data are regionalized and adjusted for emerging technological changes, the age of workers by occupation, and other factors affecting occupational demand.

Occupational forecast data was obtained from CCbenefits Inc. Community College Strategic Planner (CCSP).

Robotics/Automated Systems Technology Occupations and Projections
SOC Detail Definitions

SOC Code 17-3024
Name Electro-mechanical technicians

Definition
Operate, test, and maintain unmanned, automated, servo-mechanical, or electromechanical equipment. May operate unmanned submarines, aircraft, or other equipment at worksites, such as oil rigs, deep ocean exploration, or hazardous waste removal. May assist engineers in testing and designing robotics equipment.

Examples

SOC Code 51-2023
Name Electromechanical equipment assemblers

Definition
Assemble or modify electromechanical equipment or devices, such as servomechanisms, gyros, dynamometers, magnetic drums, tape drives, brakes, control linkage, actuators, and appliances.

Examples
Appliance Assembler, Vending Machine Assembler

SOC Code 51-4011
Name Computer-controlled machine tool operators, metal and plastic

Definition
Operate computer-controlled machines or robots to perform one or more machine functions on metal or plastic work pieces.

Examples
Numerical Control Machine Operator, Robot Operator

SOC Code 51-4122
Name Welding, soldering, and brazing machine setters, operators, and tenders

Definition
Set up, operate, or tend welding, soldering, or brazing machines or robots that weld, braze, solder, or heat treat metal products, components, or assemblies. Include workers who operate laser cutters or laser-beam machines.

Examples
Electron Beam Welder Setter, Laser-Beam Machine Operator, Ultrasonic Welding Machine Operator

SOC Code	Name	Education	Base	Five Year	Job Change	Ind Mix Effect	Nat Gro Effect	Expct Chng	Compet Effect	Earnings Average	Earnings Median
17-3024	Electro-mechanical technicians	Associate's degree	241	253	12	-8	17	8	4	$22.27	$23.64
51-2023	Electromechanical equipment assemblers	Short-term on-the-job training	957	896	-61	-151	66	-85	24	$15.36	$14.42
51-4011	Computer-controlled machine tool operators, metal and plastic	Moderate-term on-the-job training	3,719	3,689	-29	-358	255	-103	74	$16.57	$15.55
51-4122	Welding, soldering, and brazing machine setters, operators, and tenders	Moderate-term on-the-job training	2,200	2,225	26	-129	151	22	4	$20.12	$19.34
Totals:			7,117	7,063	-52						

Job Change- Column represents the addition of new jobs due to growth over the projection period. Indicates how many jobs will be added in the region over the selected time frame.

Industry Mix Effect- Column indicates how many of those jobs are due to movement within the industry at the national level. If the industry is growing across the nation, this is what is expected in the local area.

National Growth Effect- Column shows how the national economy affects the industry or occupation. This operates on the "rising tide carries all ships" assumption. If the economy is doing well, it is expected that this field in the region would benefit from that effect.

Expected Change- Column combines the Industry Mix Effect column and the National Growth Effect column to indicate how much the field is expected to grow in the region, without the input of variables within the economy. This is what is expected to happen if the local economy merely followed national trends.

By netting the Expected Change result out of the Job Change result, the Competitive Effect column shows the jobs that have been added in a field in the region due to growth specific to the region. These are the jobs created locally which aren't merely following national trends. A high Competitive Effect number indicates that the region has found some way to foster growth beyond other regions or even perhaps in spite of decline at the national level.

Thursday, April 10, 2008

Source: OCC, Office of Assessment && Effectiveness (CCSP)

Occupational Skills Analysis

The following report provides detailed information on the knowledge, skills and abilities required for a given occupation. Consideration of these different competencies and levels of attainment while designing and reviewing curriculum will ensure that students enrolled in our programs are adequately prepared for employment.

In particular this report provides:

Importance of the competency to the occupation (in general terms)

- Not important
- Somewhat important
- Important
- Very important
- Extremely important

Importance of the competency to the occupation (in specific terms).

- 0 to 20 = not important
- 21 to 40 = somewhat important
- 41 to 60 = important
- 61 to 80 = very important
- 81 to 100 = extremely important

Level of Attainment in the competency required by the occupation:

- Basic = 0 to 24
- Intermediate = 25 to 49
- Advanced = 50 to 74
- Expert = 75 to 100

Current Occupation

17-3024.00 - Electro-Mechanical Technicians

Operate, test, and maintain unmanned, automated, servo-mechanical, or electromechanical equipment. May operate unmanned submarines, aircraft, or other equipment at worksites, such as oil rigs, deep ocean exploration, or hazardous waste removal. May assist engineers in testing and designing robotics equipment.

Occupational Knowledge

Knowledge	Importance	Imp (0-100)	Level	Lvl (0-100)
Mechanical	Important	74	Advanced	70
Mathematics	Very Important	76	Advanced	70
Computers and Electronics	Very Important	78	Advanced	70
Engineering and Technology	Important	70	Advanced	65
English Language	Important	63	Advanced	55
Design	Somewhat Important	41	Intermediate	47
Production and Processing	Important	66	Intermediate	47
Customer and Personal Service	Important	57	Intermediate	42
Chemistry	Somewhat Important	43	Intermediate	42
Physics	Somewhat Important	37	Intermediate	40
Public Safety and Security	Somewhat Important	38	Intermediate	38
Clerical	Somewhat Important	43	Intermediate	34
Administration and Management	Somewhat Important	29	Intermediate	27
Communications and Media	Not Important	21	Intermediate	26
Education and Training	Not Important	24	Basic	24
Psychology	Not Important	21	Basic	24
Building and Construction	Not Important	17	Basic	22
Personnel and Human Resources	Not Important	20	Basic	18
Telecommunications	Not Important	18	Basic	18
Geography	Not Important	12	Basic	13
Law and Government	Not Important	12	Basic	12
Sales and Marketing	Not Important	9	Basic	11
Economics and Accounting	Not Important	12	Basic	10
Medicine and Dentistry	Not Important	9	Basic	8
Transportation	Not Important	5	Basic	7
Sociology and Anthropology	Not Important	3	Basic	5
Philosophy and Theology	Not Important	3	Basic	4
Therapy and Counseling	Not Important	2	Basic	2
Fine Arts	Not Important	1	Basic	2
Biology	Not Important	1	Basic	2
Foreign Language	Not Important	1	Basic	1
History and Archeology	Not Important	0	Basic	0
Food Production	Not Important	0	Basic	0

Source: O*NET Database 11

Occupational Skills

Skill	Importance	Imp (0-100)	Level	Lvl (0-100)
Equipment Maintenance	Very Important	82	Advanced	74
Quality Control Analysis	Important	74	Advanced	73
Operation Monitoring	Important	74	Advanced	72
Mathematics	Important	68	Advanced	68
Troubleshooting	Very Important	75	Advanced	67
Equipment Selection	Important	68	Advanced	66
Installation	Important	69	Advanced	65
Operation and Control	Important	68	Advanced	64
Reading Comprehension	Important	74	Advanced	63
Instructing	Important	70	Advanced	63
Complex Problem Solving	Important	66	Advanced	58
Learning Strategies	Important	63	Advanced	57
Writing	Important	61	Advanced	57
Critical Thinking	Important	59	Advanced	55
Active Learning	Important	56	Advanced	55
Active Listening	Important	62	Advanced	53
Time Management	Important	61	Advanced	52
Operations Analysis	Important	56	Advanced	52
Repairing	Important	66	Advanced	52
Science	Somewhat Important	48	Advanced	51
Coordination	Important	61	Advanced	50
Monitoring	Important	55	Intermediate	49
Service Orientation	Somewhat Important	41	Intermediate	48
Speaking	Important	50	Intermediate	46
Judgment and Decision Making	Important	50	Intermediate	46
Management of Material Resources	Important	56	Intermediate	44
Technology Design	Important	50	Intermediate	42
Social Perceptiveness	Somewhat Important	43	Intermediate	41
Systems Evaluation	Somewhat Important	42	Intermediate	38
Systems Analysis	Somewhat Important	40	Intermediate	35
Persuasion	Somewhat Important	30	Intermediate	34
Negotiation	Somewhat Important	30	Intermediate	33
Programming	Somewhat Important	27	Basic	23
Management of Personnel Resources	Somewhat Important	26	Basic	22
Management of Financial Resources	Not Important	14	Basic	9

Source: O*NET Database 11

Occupational Abilities

Ability	Importance	Imp (0-100)	Level	Lvl (0-100)
Near Vision	Important	72	Advanced	59
Oral Comprehension	Important	60	Advanced	57
Control Precision	Important	66	Advanced	55
Visualization	Important	56	Advanced	55
Written Comprehension	Important	56	Advanced	55
Oral Expression	Important	60	Advanced	55
Information Ordering	Important	63	Advanced	55
Finger Dexterity	Important	69	Advanced	55
Selective Attention	Important	63	Advanced	54
Deductive Reasoning	Important	66	Advanced	54
Reaction Time	Important	56	Advanced	52
Far Vision	Important	66	Advanced	52
Auditory Attention	Important	56	Advanced	52
Problem Sensitivity	Important	63	Advanced	50
Inductive Reasoning	Important	69	Advanced	50
Arm-Hand Steadiness	Important	72	Advanced	50
Manual Dexterity	Important	69	Advanced	50
Perceptual Speed	Important	66	Advanced	50
Flexibility of Closure	Important	60	Intermediate	48
Visual Color Discrimination	Important	63	Intermediate	48
Number Facility	Important	50	Intermediate	46
Written Expression	Important	56	Intermediate	46
Category Flexibility	Important	53	Intermediate	46
Depth Perception	Somewhat Important	47	Intermediate	45
Speech Recognition	Important	60	Intermediate	43
Time Sharing	Somewhat Important	47	Intermediate	43
Hearing Sensitivity	Important	63	Intermediate	43
Multilimb Coordination	Important	56	Intermediate	41
Speech Clarity	Important	63	Intermediate	41
Memorization	Somewhat Important	47	Intermediate	41
Speed of Closure	Important	50	Intermediate	39
Mathematical Reasoning	Somewhat Important	47	Intermediate	39
Static Strength	Somewhat Important	44	Intermediate	38
Response Orientation	Somewhat Important	44	Intermediate	38
Fluency of Ideas	Somewhat Important	35	Intermediate	38
Rate Control	Somewhat Important	47	Intermediate	34
Trunk Strength	Somewhat Important	47	Intermediate	34
Originality	Somewhat Important	35	Intermediate	32
Wrist-Finger Speed	Somewhat Important	35	Intermediate	30
Glare Sensitivity	Somewhat Important	31	Intermediate	29
Gross Body Coordination	Somewhat Important	28	Intermediate	27
Speed of Limb Movement	Somewhat Important	31	Intermediate	27
Spatial Orientation	Not Important	19	Basic	23
Stamina	Somewhat Important	28	Basic	21
Dynamic Strength	Not Important	9	Basic	9
Peripheral Vision	Not Important	6	Basic	5
Extent Flexibility	Not Important	6	Basic	5
Sound Localization	Not Important	6	Basic	5
Gross Body Equilibrium	Not Important	3	Basic	4
Night Vision	Not Important	3	Basic	4
Explosive Strength	Not Important	3	Basic	2
Dynamic Flexibility	Not Important	0	Basic	0

Source: O*NET Database 11

Current Occupation

51-2023.00 - Electromechanical Equipment Assemblers

Assemble or modify electromechanical equipment or devices, such as servomechanisms, gyros, dynamometers, magnetic drums, tape drives, brakes, control linkage, actuators, and appliances.

Occupational Knowledge

Knowledge	Importance	Imp (0-100)	Level	Lvl (0-100)
Mechanical	Extremely Important	100	Advanced	71
Computers and Electronics	Very Important	95	Advanced	71
Production and Processing	Very Important	75	Intermediate	49
Design	Somewhat Important	45	Intermediate	40
Engineering and Technology	Important	55	Intermediate	31
Mathematics	Somewhat Important	35	Intermediate	29
Physics	Somewhat Important	40	Intermediate	29
English Language	Not Important	20	Intermediate	26
Building and Construction	Not Important	20	Basic	23
Public Safety and Security	Not Important	10	Basic	17
Law and Government	Not Important	5	Basic	11
Telecommunications	Not Important	10	Basic	11
Communications and Media	Not Important	10	Basic	9
Transportation	Not Important	5	Basic	9
Customer and Personal Service	Not Important	20	Basic	6
Psychology	Not Important	0	Basic	6
Personnel and Human Resources	Not Important	5	Basic	6
Sociology and Anthropology	Not Important	0	Basic	6
Clerical	Not Important	5	Basic	6
Philosophy and Theology	Not Important	0	Basic	6
Chemistry	Not Important	5	Basic	6
Geography	Not Important	0	Basic	3
History and Archeology	Not Important	0	Basic	3
Medicine and Dentistry	Not Important	0	Basic	3
Education and Training	Not Important	0	Basic	0
Sales and Marketing	Not Important	0	Basic	0
Biology	Not Important	0	Basic	0
Foreign Language	Not Important	0	Basic	0
Fine Arts	Not Important	0	Basic	0
Administration and Management	Not Important	0	Basic	0
Food Production	Not Important	0	Basic	0
Therapy and Counseling	Not Important	0	Basic	0
Economics and Accounting	Not Important	0	Basic	0

Source: O*NET Database 11

Occupational Skills

Skill	Importance	Imp (0-100)	Level	Lvl (0-100)
Installation	Important	65	Intermediate	49
Quality Control Analysis	Important	70	Intermediate	46
Mathematics	Important	60	Intermediate	46
Operation Monitoring	Important	55	Intermediate	40
Operation and Control	Somewhat Important	45	Intermediate	40
Equipment Selection	Important	65	Intermediate	40
Reading Comprehension	Important	50	Intermediate	40
Equipment Maintenance	Somewhat Important	45	Intermediate	37
Technology Design	Somewhat Important	35	Intermediate	34
Troubleshooting	Somewhat Important	30	Intermediate	34
Science	Somewhat Important	30	Intermediate	31
Repairing	Not Important	20	Intermediate	31
Judgment and Decision Making	Somewhat Important	25	Intermediate	29
Monitoring	Somewhat Important	35	Intermediate	29
Critical Thinking	Somewhat Important	30	Intermediate	29
Active Learning	Not Important	20	Intermediate	29
Learning Strategies	Not Important	15	Intermediate	26
Systems Analysis	Somewhat Important	25	Intermediate	26
Complex Problem Solving	Somewhat Important	26	Intermediate	25
Operations Analysis	Somewhat Important	25	Basic	23
Coordination	Somewhat Important	25	Basic	23
Writing	Not Important	15	Basic	20
Speaking	Not Important	20	Basic	20
Systems Evaluation	Not Important	18	Basic	20
Active Listening	Somewhat Important	30	Basic	20
Time Management	Not Important	10	Basic	14
Management of Material Resources	Not Important	20	Basic	14
Instructing	Not Important	5	Basic	14
Persuasion	Not Important	5	Basic	9
Negotiation	Not Important	5	Basic	9
Management of Personnel Resources	Not Important	5	Basic	6
Management of Financial Resources	Not Important	5	Basic	6
Service Orientation	Not Important	0	Basic	3
Social Perceptiveness	Not Important	0	Basic	3
Programming	Not Important	0	Basic	0

Source: O*NET Database 11

Occupational Abilities

Ability	Importance	Imp (0-100)	Level	Lvl (0-100)
Manual Dexterity	Very Important	85	Advanced	54
Visualization	Very Important	75	Advanced	51
Arm-Hand Steadiness	Important	70	Advanced	51
Control Precision	Somewhat Important	45	Intermediate	46
Problem Sensitivity	Important	55	Intermediate	46
Near Vision	Important	65	Intermediate	46
Visual Color Discrimination	Important	50	Intermediate	46
Finger Dexterity	Important	70	Intermediate	46
Multilimb Coordination	Important	50	Intermediate	43
Written Comprehension	Important	55	Intermediate	43
Wrist-Finger Speed	Somewhat Important	45	Intermediate	43
Extent Flexibility	Important	60	Intermediate	43
Static Strength	Somewhat Important	40	Intermediate	40
Number Facility	Important	60	Intermediate	40
Deductive Reasoning	Important	55	Intermediate	40
Trunk Strength	Important	55	Intermediate	40
Information Ordering	Important	50	Intermediate	40
Reaction Time	Somewhat Important	40	Intermediate	37
Explosive Strength	Important	50	Intermediate	34
Memorization	Somewhat Important	35	Intermediate	34
Dynamic Strength	Somewhat Important	45	Intermediate	34
Speed of Limb Movement	Somewhat Important	40	Intermediate	34
Depth Perception	Somewhat Important	35	Intermediate	31
Mathematical Reasoning	Somewhat Important	30	Intermediate	31
Dynamic Flexibility	Somewhat Important	25	Intermediate	29
Flexibility of Closure	Somewhat Important	30	Intermediate	29
Category Flexibility	Somewhat Important	25	Intermediate	29
Gross Body Coordination	Somewhat Important	35	Intermediate	26
Selective Attention	Somewhat Important	35	Intermediate	26
Oral Comprehension	Not Important	20	Intermediate	26
Response Orientation	Somewhat Important	25	Intermediate	26
Time Sharing	Somewhat Important	25	Intermediate	26
Speed of Closure	Somewhat Important	25	Intermediate	26
Far Vision	Somewhat Important	30	Intermediate	26
Stamina	Somewhat Important	30	Intermediate	26
Perceptual Speed	Somewhat Important	35	Intermediate	26
Spatial Orientation	Somewhat Important	35	Intermediate	26
Originality	Somewhat Important	25	Basic	23
Inductive Reasoning	Somewhat Important	25	Basic	23
Peripheral Vision	Not Important	10	Basic	20
Written Expression	Not Important	10	Basic	20
Fluency of Ideas	Not Important	15	Basic	20
Speech Clarity	Not Important	15	Basic	17
Gross Body Equilibrium	Somewhat Important	25	Basic	17
Rate Control	Not Important	15	Basic	17
Oral Expression	Not Important	15	Basic	17
Hearing Sensitivity	Not Important	10	Basic	17
Speech Recognition	Not Important	10	Basic	14
Auditory Attention	Not Important	15	Basic	14
Glare Sensitivity	Not Important	10	Basic	11
Sound Localization	Not Important	5	Basic	11
Night Vision	Not Important	5	Basic	11

Source: O*NET Database 11

Current Occupation

51-4011.00 - Computer-Controlled Machine Tool Operators, Metal and Plastic

Operate computer-controlled machines or robots to perform one or more machine functions on metal or plastic work pieces.

Occupational Knowledge

Knowledge	Importance	Imp (0-100)	Level	Lvl (0-100)
Mechanical	Very Important	80	Advanced	66
Production and Processing	Important	62	Advanced	51
Mathematics	Important	62	Advanced	51
Computers and Electronics	Somewhat Important	48	Intermediate	45
Engineering and Technology	Somewhat Important	43	Intermediate	45
Education and Training	Somewhat Important	38	Intermediate	43
Customer and Personal Service	Somewhat Important	43	Intermediate	42
Administration and Management	Somewhat Important	39	Intermediate	37
Design	Somewhat Important	37	Intermediate	36
Public Safety and Security	Somewhat Important	29	Intermediate	30
English Language	Somewhat Important	36	Intermediate	30
Psychology	Somewhat Important	26	Intermediate	29
Clerical	Not Important	20	Intermediate	28
Chemistry	Not Important	23	Intermediate	25
Physics	Somewhat Important	27	Basic	24
Sales and Marketing	Not Important	19	Basic	21
Personnel and Human Resources	Not Important	18	Basic	17
Transportation	Not Important	13	Basic	16
Building and Construction	Not Important	14	Basic	15
Communications and Media	Not Important	14	Basic	14
Telecommunications	Not Important	13	Basic	14
Law and Government	Not Important	10	Basic	13
Food Production	Not Important	10	Basic	12
Sociology and Anthropology	Not Important	10	Basic	12
Economics and Accounting	Not Important	11	Basic	12
Foreign Language	Not Important	9	Basic	10
Philosophy and Theology	Not Important	7	Basic	10
Therapy and Counseling	Not Important	10	Basic	9
Geography	Not Important	6	Basic	8
Biology	Not Important	6	Basic	8
Medicine and Dentistry	Not Important	8	Basic	7
History and Archeology	Not Important	6	Basic	7
Fine Arts	Not Important	6	Basic	6

Source: O*NET Database 11

Occupational Skills

Skill	Importance	Imp (0-100)	Level	Lvl (0-100)
Operation Monitoring	Very Important	86	Advanced	72
Operation and Control	Very Important	82	Advanced	65
Mathematics	Important	68	Advanced	62
Equipment Maintenance	Important	62	Advanced	60
Instructing	Important	67	Advanced	60
Quality Control Analysis	Important	74	Advanced	59
Active Learning	Important	61	Advanced	58
Troubleshooting	Important	65	Advanced	57
Equipment Selection	Important	57	Advanced	56
Learning Strategies	Important	60	Advanced	55
Active Listening	Important	73	Advanced	54
Critical Thinking	Important	56	Advanced	54
Reading Comprehension	Important	60	Advanced	51
Complex Problem Solving	Important	51	Intermediate	49
Speaking	Important	55	Intermediate	49
Writing	Somewhat Important	40	Intermediate	46
Operations Analysis	Somewhat Important	42	Intermediate	46
Coordination	Somewhat Important	44	Intermediate	45
Time Management	Important	53	Intermediate	45
Monitoring	Somewhat Important	48	Intermediate	45
Social Perceptiveness	Somewhat Important	40	Intermediate	43
Systems Analysis	Somewhat Important	40	Intermediate	41
Repairing	Somewhat Important	42	Intermediate	39
Service Orientation	Somewhat Important	41	Intermediate	38
Systems Evaluation	Somewhat Important	38	Intermediate	38
Technology Design	Somewhat Important	32	Intermediate	38
Installation	Somewhat Important	41	Intermediate	37
Programming	Somewhat Important	44	Intermediate	33
Judgment and Decision Making	Somewhat Important	37	Intermediate	33
Persuasion	Somewhat Important	31	Intermediate	32
Management of Personnel Resources	Somewhat Important	33	Intermediate	31
Management of Material Resources	Somewhat Important	37	Intermediate	31
Science	Not Important	20	Basic	22
Negotiation	Not Important	19	Basic	19
Management of Financial Resources	Not Important	19	Basic	16

Source: O*NET Database 11

Occupational Abilities

Ability	Importance	Imp (0-100)	Level	Lvl (0-100)
Control Precision	Important	63	Advanced	59
Auditory Attention	Important	69	Advanced	59
Reaction Time	Important	72	Advanced	57
Selective Attention	Important	63	Advanced	55
Oral Comprehension	Important	56	Advanced	54
Hearing Sensitivity	Important	72	Advanced	54
Depth Perception	Important	60	Advanced	52
Oral Expression	Important	56	Advanced	52
Far Vision	Important	60	Advanced	52
Manual Dexterity	Important	60	Advanced	52
Visualization	Important	50	Advanced	50
Multilimb Coordination	Important	56	Advanced	50
Problem Sensitivity	Important	72	Advanced	50
Arm-Hand Steadiness	Important	66	Advanced	50
Finger Dexterity	Important	56	Advanced	50
Static Strength	Important	50	Intermediate	48
Deductive Reasoning	Important	60	Intermediate	48
Written Comprehension	Important	56	Intermediate	48
Near Vision	Important	66	Intermediate	48
Flexibility of Closure	Important	56	Intermediate	48
Information Ordering	Important	63	Intermediate	48
Perceptual Speed	Important	56	Intermediate	48
Speech Recognition	Important	56	Intermediate	46
Response Orientation	Important	50	Intermediate	46
Visual Color Discrimination	Important	56	Intermediate	46
Rate Control	Important	63	Intermediate	45
Category Flexibility	Important	50	Intermediate	45
Number Facility	Somewhat Important	44	Intermediate	43
Speech Clarity	Important	53	Intermediate	43
Speed of Closure	Somewhat Important	47	Intermediate	43
Inductive Reasoning	Important	53	Intermediate	43
Extent Flexibility	Somewhat Important	35	Intermediate	43
Time Sharing	Somewhat Important	44	Intermediate	41
Trunk Strength	Important	56	Intermediate	41
Written Expression	Important	53	Intermediate	41
Originality	Somewhat Important	41	Intermediate	39
Wrist-Finger Speed	Important	50	Intermediate	39
Fluency of Ideas	Somewhat Important	38	Intermediate	39
Memorization	Somewhat Important	41	Intermediate	38
Speed of Limb Movement	Somewhat Important	41	Intermediate	38
Mathematical Reasoning	Important	50	Intermediate	38
Glare Sensitivity	Somewhat Important	38	Intermediate	36
Gross Body Coordination	Somewhat Important	38	Intermediate	34
Dynamic Strength	Somewhat Important	38	Intermediate	32
Stamina	Somewhat Important	38	Intermediate	32
Sound Localization	Somewhat Important	38	Intermediate	32
Spatial Orientation	Somewhat Important	31	Intermediate	25
Peripheral Vision	Somewhat Important	25	Basic	23
Gross Body Equilibrium	Not Important	22	Basic	20
Night Vision	Not Important	22	Basic	20
Explosive Strength	Not Important	6	Basic	7
Dynamic Flexibility	Not Important	3	Basic	2

Source: O*NET Database 11

Current Occupation

51-4122.00 - Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders

Set up, operate, or tend welding, soldering, or brazing machines or robots that weld, braze, solder, or heat treat metal products, components, or assemblies.

Occupational Knowledge

Knowledge	Importance	Imp (0-100)	Level	Lvl (0-100)
Mechanical	Important	64	Advanced	58
Production and Processing	Important	61	Advanced	57
Education and Training	Somewhat Important	45	Intermediate	49
Engineering and Technology	Somewhat Important	41	Intermediate	46
Administration and Management	Somewhat Important	49	Intermediate	43
Computers and Electronics	Somewhat Important	38	Intermediate	41
Customer and Personal Service	Somewhat Important	43	Intermediate	40
Public Safety and Security	Important	52	Intermediate	39
Mathematics	Somewhat Important	41	Intermediate	36
Personnel and Human Resources	Somewhat Important	36	Intermediate	35
English Language	Somewhat Important	40	Intermediate	32
Design	Somewhat Important	34	Intermediate	31
Psychology	Not Important	16	Basic	22
Clerical	Somewhat Important	29	Basic	21
Chemistry	Not Important	20	Basic	20
Building and Construction	Not Important	19	Basic	17
Sales and Marketing	Not Important	19	Basic	17
Communications and Media	Not Important	14	Basic	15
Transportation	Not Important	17	Basic	14
Physics	Not Important	13	Basic	13
Sociology and Anthropology	Not Important	10	Basic	13
Economics and Accounting	Not Important	16	Basic	11
Telecommunications	Not Important	10	Basic	8
Law and Government	Not Important	8	Basic	7
Medicine and Dentistry	Not Important	3	Basic	5
Therapy and Counseling	Not Important	3	Basic	3
History and Archeology	Not Important	2	Basic	3
Philosophy and Theology	Not Important	2	Basic	2
Foreign Language	Not Important	3	Basic	2
Biology	Not Important	1	Basic	2
Fine Arts	Not Important	1	Basic	1
Geography	Not Important	1	Basic	1
Food Production	Not Important	1	Basic	1

Source: O*NET Database 11

Occupational Skills

Skill	Importance	Imp (0-100)	Level	Lvl (0-100)
Active Learning	Important	59	Advanced	57
Learning Strategies	Important	56	Advanced	53
Coordination	Important	53	Advanced	51
Reading Comprehension	Important	63	Advanced	50
Active Listening	Important	63	Intermediate	49
Equipment Selection	Important	57	Intermediate	49
Equipment Maintenance	Important	59	Intermediate	48
Operation and Control	Important	53	Intermediate	48
Critical Thinking	Important	53	Intermediate	47
Instructing	Important	59	Intermediate	47
Operation Monitoring	Important	54	Intermediate	45
Troubleshooting	Important	53	Intermediate	45
Monitoring	Important	54	Intermediate	43
Social Perceptiveness	Somewhat Important	37	Intermediate	42
Quality Control Analysis	Important	55	Intermediate	41
Speaking	Somewhat Important	47	Intermediate	41
Repairing	Somewhat Important	49	Intermediate	38
Complex Problem Solving	Somewhat Important	39	Intermediate	37
Persuasion	Somewhat Important	32	Intermediate	37
Time Management	Somewhat Important	43	Intermediate	37
Writing	Somewhat Important	36	Intermediate	36
Installation	Somewhat Important	34	Intermediate	36
Service Orientation	Somewhat Important	33	Intermediate	32
Technology Design	Somewhat Important	33	Intermediate	32
Mathematics	Somewhat Important	32	Intermediate	31
Judgment and Decision Making	Somewhat Important	43	Intermediate	31
Operations Analysis	Not Important	22	Intermediate	30
Systems Evaluation	Somewhat Important	32	Intermediate	29
Negotiation	Somewhat Important	32	Intermediate	28
Management of Material Resources	Somewhat Important	28	Intermediate	27
Science	Not Important	22	Intermediate	26
Systems Analysis	Somewhat Important	34	Intermediate	26
Management of Personnel Resources	Not Important	23	Intermediate	26
Programming	Not Important	13	Basic	11
Management of Financial Resources	Not Important	3	Basic	2

Source: O*NET Database 11

Occupational Abilities

Ability	Importance	Imp (0-100)	Level	Lvl (0-100)
Control Precision	Very Important	75	Intermediate	46
Information Ordering	Important	63	Intermediate	45
Manual Dexterity	Important	64	Intermediate	44
Near Vision	Important	59	Intermediate	41
Problem Sensitivity	Important	56	Intermediate	39
Arm-Hand Steadiness	Important	54	Intermediate	38
Static Strength	Somewhat Important	39	Intermediate	37
Wrist-Finger Speed	Somewhat Important	45	Intermediate	36
Finger Dexterity	Somewhat Important	44	Intermediate	36
Written Comprehension	Somewhat Important	45	Intermediate	35
Reaction Time	Somewhat Important	40	Intermediate	35
Visualization	Somewhat Important	41	Intermediate	34
Extent Flexibility	Somewhat Important	41	Intermediate	34
Perceptual Speed	Somewhat Important	39	Intermediate	33
Multilimb Coordination	Somewhat Important	41	Intermediate	32
Deductive Reasoning	Somewhat Important	35	Intermediate	31
Memorization	Somewhat Important	25	Intermediate	29
Trunk Strength	Somewhat Important	34	Intermediate	28
Selective Attention	Somewhat Important	31	Intermediate	27
Time Sharing	Somewhat Important	28	Intermediate	27
Inductive Reasoning	Somewhat Important	30	Intermediate	27
Number Facility	Somewhat Important	31	Intermediate	26
Response Orientation	Somewhat Important	28	Intermediate	26
Written Expression	Somewhat Important	32	Intermediate	26
Speed of Limb Movement	Somewhat Important	25	Intermediate	26
Explosive Strength	Somewhat Important	28	Intermediate	26
Hearing Sensitivity	Not Important	24	Intermediate	26
Category Flexibility	Somewhat Important	26	Intermediate	26
Oral Comprehension	Somewhat Important	28	Intermediate	25
Flexibility of Closure	Somewhat Important	29	Intermediate	25
Auditory Attention	Not Important	24	Intermediate	25
Oral Expression	Somewhat Important	25	Basic	24
Rate Control	Somewhat Important	25	Basic	24
Sound Localization	Not Important	19	Basic	24
Depth Perception	Not Important	24	Basic	22
Dynamic Strength	Somewhat Important	25	Basic	22
Visual Color Discrimination	Not Important	21	Basic	22
Dynamic Flexibility	Somewhat Important	29	Basic	21
Gross Body Coordination	Not Important	22	Basic	21
Spatial Orientation	Somewhat Important	26	Basic	21
Far Vision	Not Important	15	Basic	20
Originality	Not Important	15	Basic	19
Speed of Closure	Not Important	16	Basic	19
Speech Clarity	Not Important	20	Basic	18
Fluency of Ideas	Not Important	21	Basic	18
Stamina	Not Important	24	Basic	17
Glare Sensitivity	Not Important	13	Basic	16
Mathematical Reasoning	Not Important	19	Basic	16
Speech Recognition	Not Important	14	Basic	14
Peripheral Vision	Not Important	13	Basic	14
Gross Body Equilibrium	Not Important	9	Basic	11
Night Vision	Not Important	1	Basic	6

Source: O*NET Database 11

Program Assessment Plan

Robotics Automated Systems Technology (Extended)

Statement of Purpose

The purpose of this program is to prepare students for careers in industry and business, to update student's education for an existing career, or to prepare students for transfer to baccalaureate programs. Students are provided with both a theoretical and practical knowledge base. The specific goal of the program is to graduate competent technicians who have an understanding of robot systems and their integration into automated applications. The curriculum will give the students the firm foundation in robot motion, logic, mechanical configurations, and maintenance. It will provide knowledge base for the application of interpolated motion, programmable logic controllers, and sensors that are incorporated into unique automation systems.

Catalog Description

The Robotics/Automated Systems Technology Program leads to an Associate in Applied Science Degree and is designated as an Extended Degree
Program in that the student must complete a minimum of 73 or more required credit hours. The program is designed to prepare students for career opportunities in the robotics and automation fields. This program will offer students a background in many areas of technology:

- Computer Integrated Manufacturing Applications
- Mechanical Drives and Linkages
- Programmable Controllers
- Robotic Controllers
- Robotic Programming Applications
- Robotic Welding Systems
- Sensor Technology

The Robotics/Automated Systems Technology Program prepares students for the jobs of the future.

Program Assessment Plan

Robotics Automated Systems Technology (Extended)

Learning Outcomes

Students will program the motion and logic for an automated system to correctly execute the application.

	Benchmark	Assessment Method	Timeline
1.	Eighty (80%) percent of the students will complete the final robotic application programs in the ROB 1620 motion ad logic program structure.	Eighty (80%) percent of the students will complete ROB 1620 final application rubric of programming instruction usage and structure of for the application, by meeting eighty (80%) of the items defined in the rubric as to specification.	05/08
2.	Eighty (80%) percent of the students will complete the robot program documentation with a grade of C or higher.	Documentation of the program print-outs for the labs in ROB 2400 including process documentation and description of programming solution based on a program and narrative format standards required for the course.	05/08
3.			
4.			
5.			

Program Assessment Plan

Robotics Automated Systems Technology (Extended)

Learning Outcomes

Students will master problem analysis and solving skills in order to complete assignments.

	Benchmark	Assessment Method	Timeline
1.	Eighty (80%) percent of the students will complete the troubleshooting questions on the ROB 2500 final with a grade of C or higher.	Final exam.	05/08
2.	Eighty (80%) percent of the students will complete eighty (80%) percent troubleshooting problems on the controllers in the ROB 2500 final lab practical.	Determining the problem on the robotic system and identifying based on the supporting documenting the observable cause in their field service report.	05/08
3.			
4.			
5.			

Program Assessment Plan

Robotics Automated Systems Technology (Extended)

Learning Outcomes

Students will develop written technical communications skills.

	Benchmark	Assessment Method	Timeline
1.	Students will achieve an average of 80% in the evaluation by faculty against the assignments criteria and technical writing standards.	Student will submit narrative reports in the following courses: ROB 1620 on maintenance procedures and ROB 2400 on robotic applications, based on the requirements defined in the assignment's rubric.	05/08
2.			
3.			
4.			
5.			

Program Assessment Plan

Robotics Automated Systems Technology (Extended)

Learning Outcomes

Students will demonstrate critical thinking by programming the motion and logic for an automated system to correctly execute the application.

	Benchmark	Assessment Method	Timeline
1.	Eighty (80%) percent of the students will complete the robot program documentation with a grade of C or higher.	Execution of the application and supporting documentation of the program print-outs for the labs in ROB 2400 including process documentation and description of programming solution based on a program and narrative format standards required for the course.	05/08
2.			
3.			
4.			
5.			

Program Findings Report

Robotics Automated Systems Technology

4/1/2007 to 3/31/2008

Statement of Purpose

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The Robotics/Automated Systems Technology Program prepares students for the jobs of the future.

Program Findings Report

Robotics Automated Systems Technology (Extended)

4/1/2007 to 3/31/2008

Learning Outcome ID 921

Students will program the motion and logic for an automated system to correctly execute the application.

Benchmark 1

Eighty (80%) percent of the students will complete the four robotic application programs in the ROB 2400.

Assessment Method 1	Findings 1	Benchmark Met 1		Dates
Robotic programming labs in ROB 2400, will be completed within the minimum specifications identified in each lab for the motion and logic requirements of the application.	Students completed them within minimum specifications the motion and logic requirements of the applications.	Yes	**Assessed** **Received**	05/07 05/07

Learning Outcome ID 921

Students will program the motion and logic for an automated system to correctly execute the application.

Benchmark 2

Eighty (80%) percent of the students will complete the robot program documentation with a grade of C or higher.

Assessment Method 2	Findings 2	Benchmark Met 2		Dates
Documentation of the program print-outs for the labs in ROB 2400 including flowchart, process documentation and description of programming solution.	An effort in the previous courses to have students include program documentation is evident in the results of the assessment. Students provided documentation on positional data, numeric data, and branching structures in their programs. Process documentation expanded on the data with process descriptions and an explanation of the program structure. The program documentation is based upon	Yes	**Assessed** **Received**	05/07 05/07

specific requirements on format. The process documentation, a narrative paper, is based on an outline of requirements. Although the functional requirements were meet, the format varied from student to student. A narrative research paper, for example in a composition class, is based on recognized standards to provide consistency in format. Requiring the students to follow a format in the process document would provide uniformity for grading the program structure description.

Program Findings Report

Robotics Automated Systems Technology (Extended)

4/1/2007 to 3/31/2008

Learning Outcome ID 922

Students will master problem analysis and solving skills in order to complete assignments.

Benchmark 1

Eighty (80%) percent of the students will complete ROB 2400 programming within 4 major revisions.

Assessment Method 1	Findings 1	Benchmark Met 1		Dates
The number of revisions based on the original flowchart submitted prior to programming their application solution to complete the minimum specified requirements for the application program.	Nine students were assessed but the number who performed at or above the level was not measurable. Software use by students does not have automatic revision tracking or change tracking. The instructor cannot authenticate student progress in the number of major revision to the program. Flowcharting is discontinued in the robotics curriculum.	No	**Assessed**	05/07
			Received	05/07

Learning Outcome ID 922

Students will master problem analysis and solving skills in order to complete assignments.

Benchmark 2

Eighty (80%) percent of the students will complete the troubleshooting questions on the ROB 2500 final with a grade of C or higher.

Assessment Method 2	Findings 2	Benchmark Met 2		Dates
Final exam.	Troubleshooting questions on the comprehensive final are divided into the following sections for two robot systems: indicators, fuses, and connections. The majority of students correctly answered the questions in the indictor and fuses sections. The questions in the indicator and fuse	Yes	**Assessed**	05/07
			Received	05/07

Program Findings Report

Robotics Automated Systems Technology (Extended)

4/1/2007 to 3/31/2008

sections requires the student to correctly identify the indicator/fuse function or symptom on the controller based on previous lab exercises. On the questions concerning connections, a number of incorrect answers occurred in those sections. These questions require a higher order of thinking for the student to interpret the controller's prints to define the operational characteristics of the connection in the system.

Learning Outcome ID 922

Students will master problem analysis and solving skills in order to complete assignments.

Benchmark 3

Eighty (80%) percent of the students will complete seven out of the nine troubleshooting problems on the controllers in the ROB 2500 lab practical.

Assessment Method 3	Findings 3	Benchmark Met 3		Dates
Correctly determining the problem on the robotic system and identifying supporting documenting in their field service report.	Of the seventeen students, three did not complete the all ten of the practical troubleshooting problems. Two students misidentified the reasons and/or did not complete all ten of the problems, but were within the 80% benchmark. Two students did not complete all ten of the problems. Students were provided a schedule as to when and what robots were available during the five weeks allowed to complete the assignment. A sign-up sheet for each robot controller provided a	Yes	**Assessed**	05/07
			Received	05/07

queue for student access to the equipment. This method of implementing the assessment to ratio of equipment to students allowed for the students to individually work on the problems in the ten (10) robot controllers.
The majority of the students correctly followed the procedures and completed the requirements of the assessment. Identification of the fault is the primary concern of the assessment, of the completed fault identifications, 98% of the faults were successfully diagnosed.

Program Findings Report

Robotics Automated Systems Technology (Extended)

4/1/2007 to 3/31/2008

Learning Outcome ID 923

Students will develop written technical communications skills.

Benchmark 1

Students will achieve an average of 80% in the evaluation by faculty against the assignments criteria and technical writing standards.

Assessment Method 1	Findings 1	Benchmark Met 1		Dates
Student will submit narrative reports in the following courses: ROB 1520 on maintenance procedures, ROB 1620 on robotic application, and ROB 2400 for application programming.	Students in the above robotics course were able to demonstrate a level of technical communications for the assignments. In the ROB 1520, students at the start of the course had problems in providing a synopsis of a specific maintenance procedures derived from various sources in the supplied manufacture's documentation. As students became familiar with interpreting the documentation, the written submission provided the precise information pertaining to the repair procedure and did not include unnecessary steps. Students in the ROB 1620 submitted three progressive documents on changing requirements based on a single application. The students in their final submission included the requirements of the assignment detailing the data within and structure of the program to complete the application. The problems which occurred in the earlier submissions are due to the assignment being in the last half of the	Yes	**Assessed** **Received**	05/07 05/07

semester. This did not provide the students with sufficient time to demonstrate improvement between the first and second submission.

OAKLAND
COMMUNITY
COLLEGE

Curriculum Review Committee

CRC Recommendations to the College Academic Senate

Robotics Review
May 16, 2008
Faculty Coordinator: John Sefcovic

- In 2008-2010 replacement equipment will need to be purchased to stay current (hardware, software, and computers).
- The technology department is working on a video to assist in internal and external marketing and program awareness. The program needs resources to help market the Robotics program.
- There is a strong need to publicize this program to secondary schools Tech Prep programs and the articulation agreements with post-secondary(FSU/LTU/EMU)
- Robotics to consider a quick response to marketability regarding certificates/certificates of achievement for students to be multi-skilled.
- Robotics has a course sequencing plan to better serve students. Robotics might consider all counselors having this document as a handout to students.
- A decrease in sections filled to capacity could be due to economy and how media presents this information regarding this industry. FT faculty will monitor.
- Learning Outcomes for new certificate needs to be completed.
- In the program description it might be helpful to add credit hours needed to complete the associates degree.