Washtenaw Community College Comprehensive Report

ROB 212 Robotics II
Effective Term: Winter 2023

Course Cover

College: Advanced Technologies and Public Service Careers
Division: Advanced Technologies and Public Service Careers
Department: Advanced Manufacturing
Discipline: Robotics
Course Number: 212
Org Number: 14430
Full Course Title: Robotics II
Transcript Title: Robotics II
Is Consultation with other department(s) required: No
Publish in the Following: College Catalog , Time Schedule , Web Page
Reason for Submission: Three Year Review / Assessment Report
Change Information:
Consultation with all departments affected by this course is required.
Course description
Pre-requisite, co-requisite, or enrollment restrictions
Outcomes/Assessment
Objectives/Evaluation
Rationale: We are updating the master syllabus with newer content so that we can assess it.
Proposed Start Semester: Fall 2022
Course Description: In this course, students will learn to create advanced level robot programs. The primary emphasis of this course is to introduce students to advanced programming practices and entry-level integration. Students will learn to utilize fixture and part-based offsets, nested loops, shifting offsets, input and output configuration, and methods for robot integration.

Course Credit Hours

Variable hours: No
Credits: 4
Lecture Hours: Instructor: 30 **Student:** 30
Lab: Instructor: 60 **Student:** 60
Clinical: Instructor: 0 **Student:** 0

Total Contact Hours: Instructor: 90 **Student:** 90
Repeatable for Credit: NO
Grading Methods: Letter Grades
Audit
Are lectures, labs, or clinicals offered as separate sections?: NO (same sections)

College-Level Reading and Writing

College-level Reading & Writing

College-Level Math

Requisites

Prerequisite
ROB 101 minimum grade "C"
and
Prerequisite
ROB 110 minimum grade "C"

General Education

General Education Area 7 - Computer and Information Literacy
Assoc in Arts - Comp Lit
Assoc in Applied Sci - Comp Lit
Assoc in Science - Comp Lit

Request Course Transfer

Proposed For:

Student Learning Outcomes

1. Recognize fixture and part-based offsets.
   Assessment 1
   Assessment Tool: Outcome-related multiple-choice and short-answer mid-term questions
   Assessment Date: Fall 2025
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students
   How the assessment will be scored: Answer key
   Standard of success to be used for this assessment: 70% of students will score 70% or higher.
   Who will score and analyze the data: Departmental faculty

2. Interpret and apply nested loops and shifting offsets in a robot program.
   Assessment 1
   Assessment Tool: Outcome-related short-answer mid-term exam questions
   Assessment Date: Fall 2025
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students
   How the assessment will be scored: Answer key
   Standard of success to be used for this assessment: 70% of students will score 70% or higher.
   Who will score and analyze the data: Departmental faculty

3. Recognize the components of input/output (I/O) types and identify the information needed for correct configuration.
   Assessment 1
   Assessment Tool: Outcome-related final exam questions
   Assessment Date: Fall 2025
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students
   How the assessment will be scored: Answer key
   Standard of success to be used for this assessment: 70% of students will score 70% or higher.
   Who will score and analyze the data: Departmental faculty

4. Demonstrate methods for integrating an industrial robot with a programmable logic controller (PLC).
   Assessment 1
   Assessment Tool: Outcome-related final exam questions

Assessment Date: Fall 2025
Assessment Cycle: Every Three Years
Course section(s)/other population: All sections
Number students to be assessed: All students
How the assessment will be scored: Answer key
Standard of success to be used for this assessment: 70% of students will score 70% or higher.
Who will score and analyze the data: Departmental faculty

Assessment 2

Assessment Tool: Student achievement checklist
Assessment Date: Fall 2025
Assessment Cycle: Every Three Years
Course section(s)/other population: All sections
Number students to be assessed: All students
How the assessment will be scored: Departmentally-developed rubric
Standard of success to be used for this assessment: 70% of students will score 70% or higher.
Who will score and analyze the data: Departmental faculty

Course Objectives

1. Create work objects and user frames.
2. Utilize work objects and user frames in a program.
3. Identify repeatable and important features of fixtures and parts for the purpose of creating offsets.
4. Create 2- and 3-dimension palletizing programs.
5. Identify how the program pointer is affected by nested loops.
6. Identify how shifting offsets are affected by fixture and tool-based offsets.
7. Identify the differences between digital (discrete), analog, and group inputs and outputs.
8. Identify the wiring point for a digital input or output.
9. Set up and configure digital input and output signals.
10. Read and convert a number from binary to decimal and back.
11. Set up and configure group input and output signals.
12. Create and utilize world zones and reference positions.
13. Utilize test and select statements in a robot program.
14. Identify methods of preventing crashes between two robots or with another automated system.

New Resources for Course

Course Textbooks/Resources

Textbooks
Manuals
Periodicals
Software

Equipment/Facilities

Reviewer	Action	Date
Faculty Preparer:		
Sean Martin	*Faculty Preparer*	*Feb 08, 2022*
Department Chair/Area Director:		
Allan Coleman	*Recommend Approval*	*Feb 08, 2022*
Dean:		
Jimmie Baber	*Recommend Approval*	*Feb 09, 2022*
Curriculum Committee Chair:		
Randy Van Wagnen	*Recommend Approval*	*May 31, 2022*

Assessment Committee Chair:

Shawn Deron	*Recommend Approval*	*Jun 13, 2022*

Vice President for Instruction:

Kimberly Hurns	*Approve*	*Jun 14, 2022*

WASHTENAW COMMUNITY COLLEGE
COURSE-SYLLABUS APPROVAL FORM (CSAF)

For help screens, select a field and press F1

SECTION I. COURSE SUBMISSION INFORMATION

1. **Course:** (Enter proposed discipline, number & title here. If changing the number or title of an existing course, give old number or title in box 4 below.)

Discipline/No: ROB 212 **Title:** Robotics II

Division Code: TEC Department Code: IND Requested Start Term: F98

2. **Type of Approval:** (applies to both new courses and changes)
- ☒ Full Approval
- ☐ Conditional Approval
- ☐ This proposal has received conditional approval previously.

Term Offered: _____

3. **Reason for Submission:** This Course is being submitted for: (check all that apply)
- ☐ New Course Approval (Skip the rest of Section I and go directly to Section II.)
- ☐ Five-year Syllabus Review ☐ No changes to course
- ☐ Major Change(s)
- ☒ Minor Change(s) (If not due for review, submit sections I, II, and revised parts of Section III.)
- ☐ Reactivation of Inactive Course
- ☐ Termination (Submit Sections I and II only.)

4. **Change Information:** (Check all that apply. Make proposed changes in Section III, Course Syllabus.)

Minor Changes
- ☒ Course Discipline/Number (was INM 212)
- ☐ Course Title (was _____)
- ☐ Course Description
- ☐ Capacity (capacity was: _____)
- ☐ Pre or Corequisites within Department
- ☐ Course Objectives (minor changes)
- ☐ Distribution of Contact Hours (contact hours were: lect: _____ lab _____ clin _____ exp _____)
- ☐ Distance Learning - minor (Attach Preliminary Approval Form for Distance Learning & the Section Handout.)
- ☐ Other _____

Major Changes (Major changes will be reviewed by Curriculum Committee.)
- ☐ Credit hours (credits were: _____)
- ☐ Core Element Approval ☐ first time ☐ add additional elements
- ☐ Core Element Removal (Elements to be removed _____)
- ☐ Grading
- ☐ Pre or Corequisites outside Department
- ☐ Course Objectives (major changes)
- ☐ Total Contact Hours (total contact hours were: _____)
- ☐ Honors (Complete Part G of Section III, Honors Addendum.)
- ☐ Distance Learning - major (Attach Preliminary Approval Form for Distance Learning & the Student Handout for the Distance Section.)
- ☐ Other _____

5. **Rationale for changes:**
Students are confused when attempting to register. They are unable to find the courses for 'Robotics' in the time-schedule and bulletin

SECTION II. COURSE REVIEW INFORMATION AND SIGNATURES

1. **Department Review** (To be completed by department chair; if recommendation is no, initial and return to preparer with rationale attached.)

Will additional resources be required? ☐ yes ☒ no (If yes, explain _____)
Have departments that may be affected by this course been consulted? ☒ yes ☐ no (Explain _____)
Does the department support approval of this course? ☒ yes ☐ no

Print: George Agin Signature: George Agin Date: 3/5/98
Faculty/Preparer

Print: George Agin Signature: George Agin Date: 3/5/98
Department Chair

2. **Division Review** (To be completed by division dean; if recommendation is no, initial and return with rationale attached.)

If additional resources are needed, have they been secured? ☐ yes ☐ no ☒ No new resources are needed.
Is this a curricular priority for your division? ☒ yes ☐ no (Comment _____)
What is your estimate of projected enrollment? 15

Recommendation ☒ Yes ☐ No Roger R. Burley 3/10/98
Division Dean's Signature Date

3. **Curriculum Committee Review** (Attach additional comments if necessary.)

Recommendation ☐ Yes ☐ No _____ _____
Curriculum Committee Chair's Signature Date

4. **Vice President for Instruction and Student Services Approval** (Attach additional comments if necessary.)

Recommendation ☒ Yes ☐ No _____ 3/13/98
Vice President's Signature Date

Data File 3-16-98 ACS Code 133 Catalog File Date 3-16-98 CIP File Date _____
Core Elements Approved _____ New Syllabus Date _____

INTM 212
ROB

IM 212

ROBOTICS II
MASTER LESSON PLAN

URSE: CONTINUOUS PATH UNIMATE (2005F)

TERIALS: Equipment manual, Continuous path supplement, handouts, chalkboard, overhead projector.

JECTIVE: Upon completion of course student will be able to program, repair, troubleshoot, and maintain the UNIMATE dustrial Robot 2005F Series.

INTRODUCTION

A. Procedure:
   1. Lecture subject.
   2. Demonstrate (Instructor)
   3. Exercise: 5 step program (Student)

B. Unimation History:
   1. Original patents filed 1952 by George Devoe, Chief Engineer for Sperry Rand Corp.
   2. Unimation organized in 1962 by Condec and Pullman Corp.
   3. First UMNIMATES shipped to customers in 1963 (1900 Series).
   4. 2000A Series introduced in 1968.
   5. 4000A and 2000B Series introduced in 1972.
   6. 4000B Series introduced in 1974.
   7. 2005F Series (Continuous Path introduced in 1975.
   8. 2000B Series (Heavy Duty Wrist) introduced in 1976.
   9. PUMA Series introduced in 1979.
   10. APPRENTICE Series introduced in 1980.
   11. 9000 Series introduced in 1981.

I. UNIMATE DESCRIPTION

A. Description of Motion (Relate to Human Arm):
   1. Three major motions (Rotary, Out/In, Down/Up).
   2. Two minor motions (Bend, Yaw).
   3. Explain Clamp/Weld functions.

B. Describe Drive Components of Motions (servo valves, actuators, chains, sprockets, drive shafts, gear box).

II. DESCRIPTION OF TEACH CONTROL

A. Control Buttons:
   Explanation and demonstration of all Teach Control buttons.

B. Practical Exercise:
   1. Demonstrate Point-To-Point movement.
   2. Demonstrate Velocity (Continuous Path) vs. Point-To-Point movement.
   3. Each student to use Teach Control.

V. DESCRIPTION OF CONTROL PANEL (at console) (Read Chapters 2 & 3)

A. Describe Switches/Buttons:

Teach a short program and demonstrate functions of switches/buttons on Control Panel.

B. Practical Exercise:
Each student to record a short program and demonstrate an understanding of Control Panel functions.

EXPLANATION OF SYSTEM - BASIC BLOCK DIAGRAMS (classroom)

A. Teach Mode:
1. Teach Control
2. Servo valve
3. Actuator
4. Encoder

B. Repeat Mode:
1. Memory
2. Encoder
3. Comparator
4. Servo valve
5. Actuator

I. EXPLANATION OF ACCURACIES 1, 2, AND 3 (STS only)
A. Defination of Accuracy.
B. Explanation of How Accuracy is Accomplished:
1. Encoder.
2. Analogy: tape measure vs. encoder.
C. Explain Why Other Than Fine Accuracy is Used:
1. Save time
2. Save wear on mechanical drive components.
D. Explain Time/Velocity Relationship:
E. Explain Path Arm Will Travel Using Different Accuracies:
1. Arm not reaching Taught points in space.
2. Arm travels shorter distance.
3. Less time in slower speeds.
F. Explain How Accuracy is Taught:
1. Accuracy Selector.
2. Adjustment of ACC. 2 and ACC. 3 potentiometers.
G. Practical Exercise:
Draw "the" eight-step program on chalkboard and explain procedure for teaching.
1. Teaching the different accuracies.
2. Teaching steps out of sequence.
3. Adjustment of accuracy potentiometers.
4. Emphasis on path change when potentiometer settings are changed.
H. Summarize Accuracies 1, 2, and 3.

II. DESCRIPTION OF TEACH PANEL (classroom)

A. Explanation of OX/WX Interlocks:
1. Relays to send signals to, or receive from, external equipment.
2. Causes external equipment to operate.
3. Causes UNIMATE to stop until external equipment cycle is completed.
B. Description of Operate External (OX):

1. An electrical signal sent from the UNIMATE to enable/disable external equipment.
2. Utilization of external power source through isolated contacts of relay. Rated at 120VAC, 3A.
3. OX relay activated at beginning of step on which it is taught.
4. Signal lasts duration of step.
5. Procedures for teaching an OX function.

C. Description of Wait External (WX):
1. The closing of a normally open limit switch allows the UNIMATE to proceed to the next position.
2. External voltage NOT to be applied to WX circuits.
3. Example of limit switch on chalkboard.
a. Open when arriving at position (stop).
b. Closed when arriving at position (continue).
c. Closed before reaching position but open when arriving (stop).

D. Description of WX Override:
1. Will override all WX signals.
2. Will override Time Delay signals.

E. Description of Time Delay (not used in Velocity mode):
1. Adjustable 0-12 second time delay.
2. Cannot be programmed on consecutive steps.
3. Time delay starts at beginning of step.
4. The length of time selected on TD potentiometer will be the same for all TD steps in program.
5. Explanation of "cascading" as it relates to the TD function on UNIMATE robots.

F. Summarize Operate External, Wait External, and Time Delay.

III. INTERLOCK JUNCTION BOX - CUSTOMER ACCESS PANEL

Location and Description

X. PROGRAM SELECTOR SWITCH

A. Memory Description and Location:
1. Plated Wire vs. CMOS
2. Maintenance procedures for CMOS memory.
3. Relationship of Program Selector Switch and memory.

B. Explanation of RANDOM PROGRAM SELECTION (RPS):
1. Typical interfacing procedures.
2. Programming procedures for RPS function.

. SAFETY SUMMARY

Review Pages ix - xi in Equipment Manual.

I. SAFETY CONSIDERATIONS

A. Limiting UNIMATE Movement:
1. Mechanical stops.
a. External to UNIMATE - "I" beam.
b. Internal - actuator stroke limiters.
2. Electrical Stops.

Interfacing with Interlock Junction Box.

B. Restricting Movement of Personnel/Equipment into Reach of the UNIMATE:
   1. Barrier fences with interlock circuits.
   2. Rope off area.
   3. Mark floor area UNIMATE can reach.
   4. Post warning signs.

II. INSTALLATION OF THE UNIMATE

A. Location:
   1. On a solid, preferably concrete, floor.
   2. Be able to reach all program areas.
   3. Base level within 5 degrees.
   4. Boom as horizontal as possible for majority of steps.
   5. Centerline of boom as perpendicular as possible to the major work area.

B. Mounting:
   1. Firmly fastened (refer to UNIMATE Equipment Manual)
   2. Accuracy is relative to UNIMATE base.

C. Service Area:
   Three feet on all sides for servicing and cooling.

III. HYDROMECHANICAL

A. Motor:
   1. Electric with thru shaft
   2. 10 hp

B. Pump:
   1. Vickers vane pump
   2. 17 gpm

C. Reservoir:
   1. Vented
   2. 22 gal. capacity

D. Oil, Hydraulic:
   1. Non-detergent, petroleum base
   2. Filtered to 3 microns, 1.5 absolute
   3. Fire resistive fluid available (Pyqraul or Quaker)

E. Filters:
   1. Full flow
   2. 3 micron outer paper; 25 micron inner metal

F. Valve, Unloading:
   1. Maintains system pressure
   2. Factory set at 750 - 950 psi

G. Valve, Check:
   Checks reverse flow when unloading valve unloads.

H. Accumulator:
   Bladder type; 2 1/2 gal charged to 525 psi N2

I. Guage, Pressure:
   Liquid dampened

J. Valve, Dump:
   Allows return of oil under pressure to reservoir

K. Valve, Servo:
   1. DC activated

2. 24 gpm
3. One per motion

L. Valves, Relief:
1. Rotary motion - 1100 psi.
2. Bend/Yaw motion - 480 psi.
3. Return repair

M. Feedthru System:
1. Description
a. Oil under pressure is fed to the inner cavity of a concentric assembly.
b. Oil under return pressure fed to outer cavity.
c. Fedthru standpipe is stationary.
d. Dynamic part of Feedthru system is Feedthru Manifold attached to rotating trunk.
e. Feedthru manifold contains 3 chevron seals.
f. Note direction of seals for installation.
2. Troubleshooting
a. Take UNIMATE "pulse" and enter in logbook.
b. Listen for bypass of oil from pressure side to return side.
c. Explain seal replacement procedure.

N. Fixed Base:
1. Describe function of following components:
a. Backlash control piston
b. Metered oil input
c. Return oil output
2. Troublesnooting fixed-base rotating trunk area.
a. Clogged return line
b. Defective rotary actuator seal(s)
c. Backlash control piston seal

IV. SERVO VALVE

A. Description and Function - General:
An infinate position valve that directs the flow of hydraulic oil to one side or the other of an actuator. The volume of this flow is directly proportional to the distance the motion has to travel to the taugnt point.

B. Description and Function- First Stage Servo Valve:
1. 4 ports: pressure, return, control ports(2)
2. Trace pressure flow to filter cavity.
3. Trace pressure flow through restrictor inlets to nozzles.
4. Two coils in torque motor.
5. Current supplied to one side deflects armature and causes flapper to restrict one nozzle.
6. Pressure increases and is tranfered to rear of spool. Spool then shifts and carries feedback wire with it.
7. Torque supplied by the spool through the feedback wire centers the flapper. When torque on feedback wire equals torque on coil, spool shifts no furtner.
8. The larger the input signal to the torque motor the further the spool shifts; the further the spool shifts the larger the opening to control ports thus creating an increase in volume flow

which leads to faster motion.

C. Description of Dynamic Pressure Feedback (DPF):
   1. Pressure transducers added to Rotary and Down/Up motions.
   2. When a servo valve starts to close and pressure peaks, an electric signal is produced.
   3. Signal is fed back to open the servo valve and relieve pressure.
   4. Reduces spring action (bounce).
   5. Only active in Repeat mode on Velocity steps.

D. Nulling Servo Valves:
   1. Purpose:
      To achieve equal speed in both directions for each motion.
   2. Considerations before nulling:
      a. Is present state of servo valve affecting execution of program?
      b. Is oil at operating temperature?
      c. Is a spare servo valve on hand?
   3. Procedure:
      a. Initial adjustment by eye so that the motion appears to be traveling at near equal speed in both directions.
      b. Using UNIMATE Tester, time motion in creep speed should be equal,
         plus or minus 1.
      c. Readjust if necessary.

E. Practical Exercise:
   Students, in groups of two, will perform nulling procedures on UNIMATE.

F. Troubleshooting:
   1. Drifting: motion(s) moves at a near constant rate.
      a. Valve out of null
      b. Sticking servo valve
      c. Faulty actuator
      d. Plugged nozzle
   2. Motion stops short of taught point:
      a. Contaminated servo valve
      b. Tight actuator seal
      c. Creep speed set too low
      d. Mechanical binding

V. MEMORY STEP DATA FORMAT AND TESTER ORIENTATION

A. Description of Table:
   The table shows the location of all information that can be taught into the memory. It consists of eight groups (words) with each group capable of sixteen bits (1's or 0's). Only 11 bits of each group are used for encoder position codes or auxiliary information. The sixteenth bit is used for odd parity.

B. Odd Parity:
   1. While writing into the memory, odd parity generation on the 9181 boards is accomplished as follows:
      The fifteen bits of information per group is sent to the 9181 boards. The parity generators on these boards look at the incoming bits and determine if the number of 1's in each group is

odd or even. If the total number of 1's is even the parity generator will generate the sixteenth bit. Thus each group will have an odd number of bits recorded into memory.

2. Odd parity while reading the memory.
   During Repeat, parity checking is done to ensure that each group is sending an odd number of bits of information from memory. If an even number is detected the UNIMATE is placed into an electrically inhibited state.

C. Tester and Test Panel:
   1. Allows adjustment and troubleshooting procedures to be accomplished.
   2. Gives the ability to read what is written into the memory.
   3. Group mode allows the changing of information in one group without changing the other seven.
   4. Worthwhile aid when programs have been changed without noting changes on program sheet.

I. ENCODER

A. Description:
   1. Relative position indicator that identifies the location of a motion in space.
   2. Mechanically driven by motion drive system.
   3. Binary explanation.
   4. Photoelectric, 15 bit capacity
   5. Resolution of each encoder to within .010 inches
   6 Repeatability of the UNIMATE to within .050 inches

B. Description of Model Encoder Components (3 track):
   1. Clear disc
   2. Three segmented concentric tracks, 50% clear, 50% masked
   3. Edge view showing segmented disc, drilled cover, drilled mask, light source, parabolic mirror, photoelectric cells

C. Encoder Zeroing - Purpose:
   1. To have a known starting place and a specific code for it.
   2. Allows replacement or rezeroing of encoders without having to reprogram.

D. Considerations Before Zeroing:
   1. If programming had been accomplished while one or more encoders were not correctly zeroed, rezeroing will cause the motion(s) to be displaced. If the displacement is not large only the accuracy i steps will need to be reprogrammed.
   2. If encoders are rezeroed new tapes must be made.

E. Practical Exercise:
   Students in groups of two, will perform encoder zeroing procedures as explained.

F Troubleshooting:
   1. Motion moves to incorrect location; codes on tester match.
      Encoder zeroed incorrectly
   2. Motion moves to taught location in wrong direction.
      Encoder zeroed incorrectly
   3. Motion goes to taught location and shakes.
      More than one bit transitioning at a time

4. UNIMATE will not move in repeat; "W" board IT2 LED and Encode Monitor LED on.
   Encoder lamp defective (out, dim, dark spot).

II. BLOCK DIAGRAMS

A. The purpose of the Teach/Repeat block diagrams is to act as an aid while troubleshooting the UNIMATE. As you look at any block on the diagrams you can clearly see what signals are going into and out of that block. A signal can be traced from its source to its destination and any component that interrupts this signal can easily be identified and replaced. Unimation's maintenance philosophy is to isolate the problem to an easily replaceable component thus minimizing machine downtime.

B. Tracing a Motion Signal in Teach Mode:
   1. Pressing a plus or minus button on the Teach Control will send that signal to the Servo Direction board.
   2. This signal is latched onto the Servo Direction board and sent to the Servo Power Amplifier board.
   3. The signal is modified here and sent to either the plus or minus coil of the servo valve.
   4. The spool of the servo valve shifts, directing oil under pressure to one end of an acutuator.

C. Teaching Information into the Memory:
   1. Information comes from 3 areas when the Record button is depressed:
      a. Encoders
      b. Teach Panel
      c. Teach Control
   2. Description of 1 - 8 Group Scanner.
   3. Purpose of the Input boards (parity).
   4. Sequence of Events when Record Button is Depressed.
      a. Signal sent to Write/Read board to activate system clock which drives the 1 - 8 Group Scanner on the Address board.
      b. Group Scanner syncronizes the addressing of the 8 groups of input information and the gating of this information into memory.
      c. After scanning the 8th group, the system clock and Group Scanner is deactivated and the next

D. Tracing a Signal in Repeat Mode (PTP):
   1. System clock on Write/Read board activated to drive 1 - 8 Group Scanner on Address board.
   2. Group Scanner syncronizes the outup information from memory which is sent to the Comparator board. The Comparator also receives the positional codes from the encoders and compares each.The differencers will manifest themselves as a proportional DC voltage sent to the Servo Power Amplifier board and as a plus or minus signal to the Servo Direction board.
   3. The Servo Direction board then sends the plus or

minus directional signal to the Servo Power Amplifier board where it is modified.

4. This directional signal is then sent to the servo valve, shifting its spool a distance directly proportional to the DC voltage applied.
5. The flow of oil to the actuator is also directly proportional, resulting in a proportional velocity for the motion.
6. Explanation of all signals shown in Repeat block diagram.

III. TROUBLESHOOTING LIGHTS

A. Purpose:
To facilitate troubleshooting the UNIMATE in an electrically inhibited state during Repeat mode.

B. Components:
1. Write/Read board
2. Total Coincidence board
3. True Total Coincidence board
4. Interpolation Timer board
A dimly lit LED during PTP portions of the program has no significance.

ej 9/01

Course Descriptions

Division: Technology
Industrial Technology Department

ROB 174: ROB Co-op Education I 1-3 Credit(s)

Last Updated: Fall 1999
Current Syllabus Date: Fall 1993

Prereqs: Consent required
Coreqs: None
0 lecture, 0 lab, 0 clinical, 0 other, 0 total contact hours
Fullfills Core Elements: None
Course Description:
In this course, students gain skills from a new experience in an approved, compensated industry-related position. Together with the instructor and employer, students set up work assignments and learning objectives to connect classroom learning with career-related work experience. This is the first of two possible co-op experiences. Instructor consent is required to register for this course.

This course used to be: INM 174

ROB 212: Robotics II 4 Credit(s)

Last Updated: Fall 1999
Current Syllabus Date: Winter 2001

Prereqs: [redacted] ROB 121 OR CONSENT
Coreqs: None
30 lecture, 60 lab, 0 clinical, 0 other, 90 total contact hours
Fullfills Core Elements: 7 9 11 18 19
Course Description:
This class concentrates on programming techniques FOR INDUSTRIAL ROBOTS. Students learn to program different types of robots incorporating inputs and outputs into their programs. The course is based on a series of student projects that, step by step, introduce each new command or concept. Students spend most of the class time in the lab and are expected to spend extra hours during scheduled open labs.
Students who have experience equivalent to ROB 121 may contact the instructor for permission to waive the pre-requisites

JZV 4/17/01

This course used to be: INM 212

ROB 223: Robotics III 4 Credit(s)

Last Updated: Fall 1999
Current Syllabus Date: Winter 2001

Prereqs: ROB 212
Coreqs: None
30 lecture, 60 lab, 0 clinical, 0 other, 90 total contact hours
Fullfills Core Elements: 7 9 11 18
Course Description:
Students learn to work with peripheral devices in various robotic workcells. Experiments include part recognition, counting, distance measuring, sorting, and palletizing. Programmable controllers are interfaced with robots in an integrated manufacturing cell. The students are introduced to robotic simulation, vision systems, and bar coding.

This course used to be: INM 223

ROB 224: Robotics IV 4 Credit(s)

Last Updated: Fall 1999
Current Syllabus Date: Winter 1996

Prereqs: ROB 223
Coreqs: None
30 lecture, 60 lab, 0 clinical, 0 other, 90 total contact hours
Fullfills Core Elements: 7 8 9 11 12 18 19
Course Description:
This course involved advanced programming of robots and programmable controllers in an integrated workcell. Problems related to maintenance and trouble-shooting constitute a major segment of the course. A group project involving the design and construction of a workcell that simulates some industrial process is an enjoyable conclusion to this program.

This course used to be: INM 224