BCIT®

Course Outline

A POLYTECHNIC INSTITUTION
School of Manufacturing, Electronics and Industrial Processes
Program: Robotics and Automation

ROBT 3341
Robot Applications

Start Date:	September, 2006					**End Date:**	December, 2006		
Total Hours:	90	**Total Weeks:**	15			**Term/Level:**	3	**Course Credits:**	6
Hours/Week:	6	**Lecture:**	3	**Lab:**	3	**Shop:**		**Seminar:**	**Other:**

Prerequisites

Course No.	Course Name
MATH 2342	Calculus for Robotics
PHYS 2164	Applied Physics 2 for Robotics
ROBT 1270	C Programming

ROBT 3341 is a Prerequisite for:

Course No.	Course Name
ELEX 4336	Feedback Systems

Course Description

Discusses various robot configurations, the coordinate systems in which they operate and kinematics of robot motion. Investigates specifications such as accuracy, repeatability and load capability, and their importance in various applications. Machine elements used in automated equipment and associated machinery will be investigated.

Evaluation

Assignments	10%
Midterm Exam, Quizzes	30%
Labs	20%
Final Exam	40%
TOTAL	100%

Comments:

- Cheating and plagiarism penalties will be as per BCIT policy.
- You must pass both the lab and exam portions in order to pass the course.
- A lab write-up is required for each lab.

Course Learning Outcomes/Competencies

Upon successful completion of this course, the student will be able to:

- Describe the components of automation systems.
- Perform direct and inverse kinematic analysis and trajectory planning for a variety of robot configurations.
- Program a variety of commercial robots using lead through, teach pendants and off-line programming systems.
- Integrate robots with peripheral automation equipment.
- Calculate motor torque requirements based on static and dynamic forces.
- Perform mechanical design of robot manipulator or positioning system tooling and positioning equipment.

Verification

I verify that the content of this course outline is current.

Authoring Instructor	Date: SEPT 6/06

I verify that this course outline has been reviewed.

Program Head/Chief Instructor	Date: SEPT. 6/06

I verify that this course outline complies with BCIT policy.

Dean/Associate Dean	Date: 2006/09/06

Note: Should changes be required to the content of this course outline, students will be given reasonable notice.

Instructor(s)

Brent Dunn	Office Location:	SW9-201	Office Phone:	604-432-8755
	Office Hrs.:	By appointment	E-mail Address:	Brent_Dunn@bcit.ca
Stephen Perraton	Office Location:	SW3-1975	Office Phone:	604-432-8876
	Office Hrs.:	By appointment	E-mail Address:	Stephen_Perraton@bcit.ca

Learning Resources

Required:

Course materials are distributed in class

Assignments, solutions, and reference material available on course web site at my.bcit.ca

Note: Important course notices are emailed to students using myBCIT. Make sure that you monitor your myBCIT email.

Recommended:

Information for Students

Note: Please refer to BCIT policy number 5002, Student Regulations Policy, for additional information. Policies are available at http://www.bcit.ca/about/administration/policies.shtml.

Ethics: BCIT assumes that all students attending the institute will follow a high standard of ethics. Incidents of cheating or plagiarism may, therefore, result in a grade of zero for the assignment, quiz, test, exam or project for all parties involved and/or expulsion from the course.

Assignments: Assignments, lab reports or projects must be done on an individual basis unless otherwise specified by the instructor. Late assignments, lab reports or projects will be devalued 10% per day late to a maximum of 3 days late.

Makeup Tests, Exams or Quizzes: There will be **no** makeup tests, exams or quizzes. If you miss a test, exam or quiz, you will receive zero marks. Exceptions may be made for **documented** medical reasons or extenuating circumstances. In such a case, it is the responsibility of the student to inform the instructor **immediately**.

Attendance: The attendance policy as outlined in BCIT Policy 5002 will be enforced.

Illness: If you miss an evaluation such as an assignment, quiz, exam, or project, or you miss 3 or more consecutive days of class, you must provide the department with a BCIT Student Medical Certificate (available at http://www.bcit.ca/admission/downloads.shtml). At the discretion of the instructor, you may be asked to complete the work that you missed or the work may be prorated.

Attempts: Students must successfully complete a course within a maximum of three attempts. Students with two attempts in a single course must get written permission from the Associate Dean to attempt the course for the third time. Students who have not successfully completed a course within three attempts will not be eligible to graduate from the program.

Advancement: Students who fail three or more courses in a term cannot advance to the next term and may be asked to discontinue from the program.

Course Outline Changes: The material or schedule specified in this course outline may be changed by the instructor. If changes are required, they will be announced in class.

Assignment Details

Completed assignments should be neat and well organized. All assignments should include the Date, Course Number and the Student's Name, Technology and Set. On laboratory reports, the names of lab partners must also be included.

Schedule

Week Number	Lecture Topics
1	**Introduction to Robotics** • list the basic components in a robot system • list applications for robots
2,3	**Manipulator Configurations** • explain prismatic and revolute joints • describe Cartesian, cylindrical, spherical, revolute, and SCARA manipulators • calculate the work envelope for various robot configurations **End-of-Arm Tooling** • list various mechanical, vacuum and magnetic tools and grippers
4	**System Specifications** • explain common system specifications and their importance to an application (number of axes, load carrying capacity, speed/cycle time, work envelope, repeatability, precision and accuracy, operating environment, tool orientation, interfacing capability)
4	**Sensors** • describe the types of internal and external state sensors (joint position and velocity sensors, proximity sensors, vision, force and torque, touch)
5	**Robot Kinematics** • calculate the tool position given the joint positions (direct kinematics) • calculate the joint positions given the tool position (inverse kinematics)
6-8	**Robot Control Methods and Path Profiling** • explain open loop vs. closed loop control • describe a basic controller architecture — file system, memory, path controller, profiler, axis controllers, programmer/user interface, forward and inverse kinematics modules • compute joint trajectories using path following algorithms (joint interpolated, straight line, circular) • compute position, velocity and acceleration at any time using various profiling algorithms (trapezoidal, parabolic velocity profiles)
9-14	**Mechanical Components and Torque Requirements** • design simple motion systems using the following transmission systems – rotary to rotary motion — belts, chains, gears, harmonic drives – rotary to linear motion — rack and pinion, belts, bands, lead screws, slides • considers efficiency, accuracy and repeatability of mechanical components • calculate force and/or torque requirements for linear motion • calculate torque requirements for rotary motion • calculate torque requirements for combined linear/rotary systems • consider friction and other inefficiencies in calculations

Lab Sessions

The lab sessions cover *some* of the material from the lecture. Some of the material in the lab (e.g., programming, interfacing) will not be covered in the lectures as it is expected that this material was covered in previous courses. The lab schedule does not always follow the lectures.

The objectives of the lab sessions are to:

- become familiar with the mechanical construction of robots and positioning systems.
- program industrial robots and positioning systems.
- interface robots to production equipment.

Prerequisites

You should be familiar with the following material in order to complete the lecture and lab material in the course:

- trigonometry
- C programming with command line interface (MFC and dialog boxes are not necessary)
- basic interfacing circuitry (resistors, NPN and PNP transistors, buffers)
- displacement, velocity, acceleration relationships
- work, power, energy
- calculating loads in structural members