MILLERSVILLE UNIVERSITY  
Department of Applied Engineering, Safety & Technology

ITEC 425 IN DUSTRIAL ROBOTIC SYSTEMS  
3 s.h.

CATALOG DESCRIPTION
This course focuses on the study of industrial robotics and modern machine vision technology. Topics include the evaluation, justification, programming, safety, and integration of industrial robotic devices with machine vision systems. 2 hours lecture, 3 hours lab. Prerequisite: ITEC 325.

OBJECTIVES
At the completion of this course, a student will be able to:

1. Summarize key historical developments in the area of robots and automated machines.
2. Critique current literature published in the field of robotics.
3. Describe the fundamental concepts of the robotic controller, power supply and manipulator.
4. Describe the applications and limitations of robots in our society.
5. Describe and use different types of machine sensors.
6. Design algorithms and develop programs using modern control methodologies for industrial robotics.
7. Draw inferences about the future of robotics and automation.
8. Determine and judge “end-of-arm tooling” needs for a given application.
9. Assess applications appropriate for automated control technologies.
10. Appraise robotic systems by arm configuration, controller, power supply, technological level/intelligence and task capability.
11. Justify robots and other automated solutions via safety, productivity, quality and cost considerations.
12. Perform Internet/library and laboratory research activities on current automated applications and technologies.
13. Integrate and use modern machine vision technology in conjunction with the industrial robot.

COURSE OUTLINE
I. Introduction to Robotics
   A. What is a robot?
   B. Why are robots needed?
   C. Overview of robotic applications
II. History of Robotics
    A. Universal machines
    B. The Industrial Revolution
    C. Remote manipulators
    D. Key events in recent history of robotics
III. Robotic Components and Operation
     A. Basic robotic components
        1. Controller
        2. Power source
           a. Pneumatic
           b. Hydraulic
           c. Electronic
        3. Manipulator
     B. Operation of robotic systems
        1. Open loop vs. closed loop
        2. Servo vs. stepper motor
IV. End-of-Arm Tooling
   A. Rules of thumb for design and development
   B. Types and classifications of end-of-arm tooling
      1. Traditional
         a. Standard
         b. Vacuum
         c. Magnetic
         d. Air pressure
      2. Special purpose
      3. Multiple-function
   C. Calculating gripper payload and force

V. Sensor Basics
   A. The role of sensors
   B. Classes of sensors
   C. Interfacing natural signals to digital controllers (analog to digital converters)
   D. Sensor areas for robots
   E. Electrical noise and robot sensor information
   F. Shaft encoders
      1. Absolute-readout (direct)
      2. Incremental (pulse)
   G. Strain gauges
      1. Piezoelectric
      2. Hall-effect
   H. Vision systems
      1. Sensor types
      2. Image detection and understanding
      3. Limitations
   I. Tactile systems
      1. Single-point
      2. Multiple-point
      3. Types
   J. Range detectors
   K. Proximity detectors

VI. Work Cell Applications of Industrial Robots
   A. Welding
   B. Material handling
   C. Processing
   D. Assembly
   E. Transportation
   F. Palletizing
   G. Bin picking

VII. Robot Maintenance
   A. Preventative
   B. Emergency
   C. Safety

VIII. Robotics and Safety
   A. Levels of danger
   B. Safety aids
   C. Common injuries
   D. The law and safety
   E. Safety features within the work cell
   F. Standards

IX. Artificial Intelligence
   A. Levels
   B. Expert systems
   C. Natural languages
   D. Fuzzy logic
   E. Benefits
X. Classification of Robots
   A. Arm configuration
   B. Controller
   C. Power supply
   D. Level of technology
   E. Tasks done
   F. Design
   G. LERT classification system

XI. Future of Robotics
   A. Short term
   B. Long term
   C. Research

XII. Justification for the Use of Automation
   A. Economic justification
      1. Payback period (P)
      3. Return-on-investment (ROI)
      4. Discounted cash flow
      5. Net present worth (NPW)
   B. Social impact of automation
      1. Education and retraining of workers
      2. Organized labor
      3. Resistance to change
   C. Safety

XIII. Application Programming - Teaching/Programming Techniques
   A. Point-to-point
   B. Controlled path point-to-point
   C. Continuous path
   D. On-line teach pendant control
   E. On-line PC programming
   F. Off-line PC programming

XIV. Machine Vision
   A. Programming Techniques
      1. Measurement
      2. Counting
      3. Decoding
      4. Location
   B. Benefits
      1. Reduce defects
      2. Increase yield
      3. Track and trace
      4. Comply with regulations
   C. Fundamental of Lighting
      1. Illumination Principles
      2. Types/Sources of lighting
      3. Lighting variants and accessories
REQUIRED TEXTS & MATERIALS


Safety glasses (ANSI approved)

A calculator (with scientific notation and trigonometric functions). Note: cell phones are not allowed for use on examinations.

COURSE REQUIREMENTS
Students are expected to participate in or complete the following activities:

1. Complete and submit all required laboratory experiments.
2. Write and de-bug several robotic computer programs, and implement the programs for both "on line" and "off line" simulations.
3. Write and submit two article reviews dealing with current robotic applications.
4. Satisfactorily complete all examinations, labs, article reviews, and assigned work.
5. Participate in all assigned clean-up activities at the end of each class session.
6. Regularly attend all lecture and laboratory sessions in their entirety. An attendance record will be maintained by the instructor during both lecture and laboratory segments. The attendance policy adopted by the Department of Applied Engineering, Safety & Technology will be in effect; unauthorized absences exceeding the number permitted in the departmental policy (3) will result in removal from the course, and a grade of "F" will be assigned. A copy of the departmental policy concerning attendance is included in this syllabus.

EVALUATION
Laboratory Experiments (9 @ 4% each) 36.0%
Midterm Lab Exam/Manipulative (MELFA-Basic V)* 12.0%
Final Lab Exam/Manipulative (MELFA-Basic V + InSight)* 12.0%
Exams* (2 @ 17.5% each) 35.0%
White Paper/Article Reviews (1 @ 5% each) 5.0%
Bonus White Paper/Article Review (1) 3.0%
Total 103.0%

*Each student is allowed to use a single page (8.5"x11") hand written reference sheet

Scale:

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<td>87 – 89.9</td>
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<tr>
<td>below 60</td>
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Should the end-of-semester mean score for the class fall below 75%, each student will receive a curve to fit the mean of 75%.

Grades will not be based upon criteria such as need, appearance, race, age, sex, or social status. Once determined, grades will not be changed except in the case of clerical errors that cause the student's true level of ability to be underestimated.
ASSESSMENT OF COURSE OBJECTIVES (identified in italics following the objective)

After a series of planned experiences, the student will be able to:

1. Summarize key historical developments in the area of robots and automated machines. *(Exams)*
2. Critique current literature published in the field of robotics. *(Article Reviews)*
3. Describe the fundamental concepts of the robotic controller, power supply and manipulator. *(Exams)*
4. Describe the applications and limitations of robots in our society. *(Exams)*
5. Describe and use different types of machine sensors. *(Exams)*
6. Design algorithms and develop programs using modern control methodologies for industrial robotics. *(Laboratory Experiments & Exams)*
7. Draw inferences about the future of robotics. *(Exams)*
8. Determine and judge “end-of-arm tooling” needs for a given application. *(Exams & Laboratory Experiments)*
9. Assess applications appropriate for automated control technologies. *(Exams)*
10. Appraise robotic systems by arm configuration, controller, power supply, technological level/intelligence and task capability. *(Exams)*
11. Justify robots and other automated solutions via safety, productivity, quality and cost considerations. *(Exams & Laboratory Experiments)*
12. Perform Internet/library and laboratory research activities on current robotic-related applications and technologies. *(Article Reviews)*
13. Integrate and use modern machine vision technology in conjunction with the industrial robot. *(Laboratory Experiments & Exams)*

SAFETY PROCEDURES

A. OSHA approved eye protection shall be worn by all individuals in the laboratory whenever activity is in progress.
B. Smoking is not permitted during classroom activities (within the laboratory or outdoor sessions).
C. Individuals shall not operate equipment unless they have been authorized by the instructor to do so.
D. Tools and equipment shall not be removed from the laboratory.
E. Be familiar with the location of all fire extinguishers, power disconnect buttons, and other safety equipment contained within the laboratory.
F. ALL accidents must be reported to the instructor immediately.

ATTENDANCE

MILLERSVILLE UNIVERSITY ATTENDANCE POLICY

EFFECTIVE SPRING 2003

Approved by Faculty Senate 12/4/02; Administrative approval 1/10/03

The University supports departmental and faculty class attendance policies that are reflective of and consistent with University approved guidelines. Faculty will include their class attendance policy in their syllabi given to all students in their classes at the start of the semester.

University approved guidelines:

1. **Students are expected to attend all classes.** It is the student’s responsibility to complete all course requirements even if a class is missed. If a student misses class for an officially excused reason, then he/she is entitled to make up the missed work but only at the convenience of the faculty member. Responsibility for materials presented in, assignments made for, and tests/quizzes given in regularly scheduled classes lies solely with the student.

2. **The University policy is that faculty will excuse absences for the following reasons:**
   a. personal illness,
   b. death or critical illness in the family,
   c. participation in a university-sponsored activity,
   d. jury duty,
3. Faculty judge the validity of student absences from class within the University’s approved guidelines and may require documentation for excused absences. Faculty will evaluate any reason, other than those listed above, for a student missing class and determine whether the absence is justified. In these circumstances, a student may make up missed work at the discretion of the instructor.

4. In the case of foreseeable absences, students are encouraged to notify the faculty member in advance. A student who will miss class due to participation in an official University activity must notify the instructor well in advance of the activity to assure that the absence is excused.

Appeals:
As with any academic issue, students may exercise their right to appeal adverse attendance decisions. Please refer to the current undergraduate catalog for the complete Academic Appeal procedure.

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AEST DEPARTMENT ATTENDANCE POLICY
Adopted May 4, 1998

Students are expected to attend all scheduled classes in accordance with the above policy. To the extent that this does not happen, the following shall apply:

1. The limit of unauthorized absences depends upon the number of scheduled days per week as follows:
   - Fall and spring semesters
     • three per semester for a course scheduled three days per week
     • two per semester for a course scheduled one or two days per week
   - Winter and summer sessions
     • two per session

2. Each late arrival and early departure will count as one-half of an unauthorized absence.

3. Participation in outside-of-the-classroom educational activities and intercollegiate contests shall be communicated to the instructor prior to the absence. Failure to do so will convert these authorized absences to “unauthorized absences.”

4. Students whose “unauthorized” absences exceed the policy stated in item #1 are liable to dismissal from the course with a grade of ‘F’ or ‘Z.”

STUDENTS WITH SPECIAL NEEDS
The instructor will provide reasonable accommodations to any student with special needs. The student is encouraged to inform the instructor of any condition that requires such accommodations. Also, it is the student’s responsibility to contact the Office of Learning Services, Room 348, Lyle Hall (Phone 872-3178) to request an official approval for providing any special accommodations and present a copy of this official document to the instructor.

TITLE IX STATEMENT
Millersville University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to meet this commitment and to comply with Title IX of the Education Amendments of 1972 and guidance from the Office for Civil Rights, the University requires faculty members to report incidents of sexual violence shared by students to the University’s Title IX Coordinator. The only exceptions to the faculty member’s reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project.
BIBLIOGRAPHY


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