COLLEGE OF DUPAGE

**ELECTROMECANICAL TECHNOLOGY ELMEC 2600-000 / ELCT 2112 SP2014**

**Servo Control & MOTOR CONTROL**

SYLLABUS

B.OZA 630-650-0936 baloza@netscape.com

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| --- | --- | --- |
| **TU** | **06:00 PM - 09:50 PM** | **TEC 2023 - Lectures**  **TEC 2023- Labs** |

Credit Hours: 3 Lecture Hours (week): 2 Contact Hours (week): 4 Lab Hours (week): 2

# COURSE DESCRIPTION

An introduction to motion control, including: servo motors, DC servo drivers with control circuits, alternating current (AC) motors, steppers, actuators, sensors, fundamentals of basic control principles, and industrial and engineering applications of motion control systems.

# REPEATABLE FOR CREDIT: No

**PRE-ENROLLMENT CRITERIA**:

Recommended: ELMEC 1110 Motor Fundamentals with a grade of "C" or better, or equivalent. or Consent of Instructor:

# COURSE OBJECTIVES

Upon successful completion of the course the student should be able to do the following: General Course Objectives:

1 Identify the basic components of motion control systems

2.Identify the system structure of motion control systems

3.Analyze and develop programs in motion control systems

4.Analyze and interpret the basic principles of servo and stepper control systems

5.Perform on-line programming on motion control systems

6.Use software and hardware packages to set, measure, analyze and program basic motion control parameters as well as simulate and build basic motion control systems

7.Demonstrate hands-on experience with personal computers, data acquisition and motion control systems

8.Identify the open loop control, feed forward control, proportional control, derivative and integral action systems

9. Understand the electronic and mechanical parts of an automated system.

10. Understand and explain the principal operations of the mechatronic subsystems in a complex system.

11. Understand and implement safety regulations required for operation of the system.

12. Diagnose and resolve equipment problems by utilizing technical assessment skills that include planning, reliability, logical thinking, and ability to use drawings, schematics and documentation.

13. Differentiate between thermal, mechanical, fluid and electrical power systems in a variety of settings.

**TOPICAL OUTLINE:**

1. Introduction and basic principles of motion control
2. Sensors, basic principles, accuracy and repeatability
3. Servo-control, open and closed loop control
4. Digital control and signal processing
5. Programming languages for motion control systems
6. Industrial and engineering applications of motion control systems
7. System integration and motion control system evaluation

**INSTRUCTOR**

**Instructor Name: B.OZA (630)650-0936 , baloza@netscape.com**

# REQUIRED TEXT & SUPPIES

Industrial Automated Systems by Terry Bartelt

Delmar Publishing, ISBN 1-4354-888-1

Experiments: Experiments in Industrial Control Electronics Flash Drive

# ASSIGNMENTS,LABS & EXAMINATIONS

Weekly Assignments will be assigned after lectures and are typically due the following week. Most labs will be done in class during lab time and a due date for each lab will be preannounced.

A Mid-term and Final examination will be given on pre-announced dates.

# CLASS PREPERATION, ATTENDANCE, & TARDINESS POLICY

Class preparation and attendance are essential if students are to receive maximum benefit from this class. Class preparation includes completion of reading and assignments by the due dates. Class attendance is strongly encouraged but your course grades will not be affected by periodic absences or tardiness, provided that the required work is completed and submitted on or before the due dates. Tardy students may enter the room in a fashion that will not disrupt a class in progress.

# MAKE-UP POLICY

If you cannot attend class on the scheduled date for a exam, please let the instructor know beforehand so that a make-up can be arranged. Failure to pre-arrange a make-up may result in the loss of points for the exam. Allowing a make-up exam is the sole discretion of the instructor. Assignments and Labs may be turned in late with points being deducted.

# GRADE

**(100%-90%=A, 89%-80%=B, 79%-70=C, 69%-60%=D, 59%-0%=F)**

|  |  |
| --- | --- |
| Examinations | 50% |
| Weekly Assignments | 25% |
| Labs | 25% |
| COURSE GRADE | 100% |

# ACADEMIC INTEGRITY/DISHONESTY POLICY

Any violations of College of DuPage Board policies 5050 & 5715 regarding academic integrity and/or dishonesty will be referred automatically to the appropriate College authorities for disposition. See appropriate pages in the college catalog for definitions and regulations.

# WITHDRAWAL POLICIES

**Withdrawing from a course:** You may withdraw up until the “Last Day to Withdraw without Instructor Permit” (see the Registration Calendar) through myACCESS or in person at the Registration office, Student Resource Center (SRC), Room 2048.

After the “Last Day to Withdraw without Instructor Permit” date (see the Registration Calendar), you may withdraw only with your instructor’s written permission. The instructor’s permission to withdraw must be brought or faxed to the Registration office. The registration fax number is (630) 790-3785. You will NOT be automatically withdrawn.

**Medical Withdrawals:** Requests for medical withdrawals should be made to the office of the Director of Admissions, Registration and Records, SRC 2048B, (630) 942-4284. Requests should be made in writing and accompanied by documentation from a physician or medical institution to verify the medical condition, date of onset and estimated length of treatment. Request forms for medical withdrawals are reviewed individually. Refunds are issued when appropriate within the guidelines of the College of DuPage refund policy. You will receive written notification of the decision within two (2) weeks from the office of the Director of Admissions, Registration and Records.

# INCOMPLETE GRADE POLICY

The instructor of record may give an incomplete or “I” grade when a student has been unable to complete the course within the prescribed time due to unforeseen circumstances. The student is responsible for contacting the instructor of record or, when the instructor of record is no longer employed at the college, the appropriate dean regarding course completion. Course work must be

completed within the time limits prescribed by the instructor of record but not to exceed twelve (12) months from the end of the term in which the “I” grade was assigned. The “I” grade may be changed within the time limit prescribed by the instructor of record. If the “I” has not been changed by the instructor of record at the end of the twelve (12) month period, the “I” will automatically change

to an “F.” During the time the “I” is on the student’s record, it will not be calculated into the grade point average.

# CLASSROOM POLICIES/STUDENT CONDUCT

In order to achieve the course objectives, it is essential that you enjoy the class in addition to complying with the above requirements and the rules and policies of College of DuPage contained in the catalog and other College material. If you are having course/College related problems, please feel free to talk to me so that we can resolve them to your satisfaction and benefit. All class work is done individually, but students may assist fellow classmate

**ELECT 2600-000-CALENDAR AND ASSIGNMENTS**

**(SUBJECT TO CHANGE BASED ON THE CLASS PROGRESS)**

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| --- | --- | --- | --- |
| **2014 Week** | **Topics, Textbook** | **Homework and**  **Reading Assignment** |  |
| **1** | Introduction,  Review of ELECT  1100,1101 and 1151 Basics Chapter 1:  Introduction to Industrial  Control Systems | Problem Questions:  Chapter 1, page 15, Q’s  1- | Safety, Test Instruments, DMM  Measuring: Volts Current, Ohms  **Video on Safety** |
| **2** | Chapter 3:Review Thyristors | Problem questions: Chapter 3, page 67, even Q’s 1-26  IAS Instructor Guide.doc | **LVL Module 25987 *Solution***  **DC Machines**  **Experiment 11: Thyristor**  **Speed Control** |
| **3** | Chapter 4:  The Controller Operation | Problem questions:  Chapter 4, page 90, Q’s 1-16  IAS Instructor Guide.doc |  |
| ***4*** | *Chapter 4 cont’d*  *The Controller Operation* | *Problem questions:*  *Chapter 5, page 90, Q’s*  *17-32*  *IAS Instructor Guide.doc* |  |
| ***5*** | ***Quiz 1*** |  | ***Lab*** |

|  |  |  |  |
| --- | --- | --- | --- |
| ***6*** | *Chapter 5:*  *Summary Review from ELMEC 1110*  *DC Motor* | *Problem questions: Chapter 5, page 115, even Q’s*  *IAS Instructor Guide.doc* | ***LVL Module 25987\_00.pdf Solution 25990 Investigations in the Electric Power***  ***Technology: DC Machines Experiment 1: Prime Mover and Torque Measurement Experiment 2 and 3: Direct***  ***Current Motor, Part 1 and 2*** |
| ***7*** | *Chapter 6:*  *Summary Review from ELMEC 1110*  *AC Motors* | *Problem questions: Chapter 6, page 144, even Q’s*  *IAS Instructor Guide.doc* | ***LVL Module 11627 Solution* Electric Power and Control: Experiment The Wound-Rotor Induction Motor Part 1 and 2.** |
| **8** | **Mid-term Exam** |  | **Lab Makeup** |
| **9** | Chapter 8: Review  DC Drives  Chapter 9: Review  AC Drives | Problem questions: Chapter 8, page 174, even Q’s  Problem questions: Chapter 9, page 203, even Q’s  **Classroom/Home Reading Assignment:**  Industrial Control Training System 8036:  Motor Drives.  Unit 1. AC Drives  Experiment 1-1 AC Drive  Overview;  Unit 2 DC Drives  Experiment 2-1 DC  Drive Overview | **LVL Module on Industrial**  **Controls 8036, 85082 *Solution*;**  **Troubleshooting; Unit 1 and 4**  **Introduction to**  **Troubleshooting and**  **Troubleshooting DC and AC**  **Drive Circuits; Experiment 1-3:**  **Troubleshooting a Basic**  **Electric Circuit Experiment 4-1:**  **Troubleshooting of AC Drive**  **Circuit**  **Experiment 4-3:**  **Troubleshooting of DC Drive**  **Circuit** |
| **10** | Chapter 7:  Servo Motors | Problem Questions:  Chapter 7, page 160,  Q's 1-14  IAS Instructor Guide.doc | **LVL Module 29979 *Solution* MOSFET AC Motor Drives:**  **Experiment 3: Constant V/f**  **Ratio PWM Inverter Induction**  **Motor Drive**  **Experiment 4: Operation of a**  **Synchronous Motor as a**  **Stepper Motor** |
| **11** | Chapter 7, cont'd: Servo Motors | Problem Questions:  Chapter 7, page 160, Q's 15-30  IAS Instructor Guide.doc | **LVL FMS Module 85092 *Solution* Servo Control:**  **Job Sheet 1: Tuning the Digital**  **Servo Drive**  **Job Sheet 2: Testing the**  **Digital Servo Drive** |
| **12** | **Quiz** |  | **Lab Makeup** |
| **13** | **Spring Break** | **Spring Break** | **Spring Break** |
| **14** | Chapter 19  Review  Industrial  Detection Sensors and Interfacing. | Problem questions: Chapter 19, page 465, even Q’s 1-38 Reading Assignment, class/home:  LVL Module 8036-40 Sensors **39654** ***Solution*** Experiment 1:  Introduction to Sensors | **Lab Manual for Industrial Automated Systems:**  **Experiment 6 Optocoupler**  **Experiment 34 Timing**  **Functions of Sensors**  **IAS Lab Manual Solution.pdf** |
| **15** | Chapter 24  Elements of  Motion Control | Problem questions: Chapter 24, page 609, even Q’s 1-38  IAS Instructor Guide.doc | **LVL 8036-40 Module 39654**  ***Solution* Sensors**  **Experiment 4: Capacitive proximity Switch**  **Industrial Control Training System 8036 Module 85980 Solution: Motor Drives.**  **Unit 1. AC Drives Experiment**  **1-3 Ramp and Torque Boost** |
| **16** | Chapter 25 Review:  Motion Control  Feedback Devices | Problem questions: Chapter 25, page 639, even Q’s 1-33  IAS Instructor Guide.doc | **Lab Manual for Industrial Automated Systems:**  **Experiment 38 Incremental**  **Encoders**  **Experiment 39 Absolute**  **Encoder**  **IAS Lab Manual Solution.pdf** |
| **17** | Chapter 26  Fundamentals of  Servomechanisms  **Final review** | Problem questions:  Chapter 26, page 660,  Q’s 1-33  IAS Instructor Guide.doc | **LVL 8036-40 Module 39654**  ***Solution* Sensors**  **Experiment 7: Motor Operated**  **Circuit Using Sensors**  **Lab Manual for Industrial Automated Systems:**  **Experiment 45 Silicon**  **Controlled Rectifier (SCR)**  **IAS Lab Manual Solution.pdf** |
| **18** | **FINAL EXAM** | **Check the online schedule for exact times and dates** |  |

\* Labs will utilize Instructor Demonstrations and Lab-volt simulators

\*\* Read each chapter and complete the odd numbered review questions UNLESS OTHERWISE

NOTED

\*\*\* Students will work in groups of 2-4 on lab assignments and projects as determined by instructor

From the grant agreement’s Part IV  Special Conditions, Item 15, Intellectual Property Rights, the following needs to be on all products developed in whole or in part with grant funds:

“This workforce solution was funded by a grant awarded by the U.S. Department of Labor’s Employment and Training Administration. The solution was created by the grantee and does not necessarily reflect the official position of the U.S. Department of Labor. The Department of Labor makes no guarantees, warranties, or assurances of any kind, express or implied, with respect to such information, including any information on linked sites and including, but not limited to, accuracy of the information or its completeness, timelines, usefulness, adequacy, continued availability, or ownership. This solution is copyrighted by the institution that created it. Internal use, by an organization and/or personal use by an individual for  non-commercial purposes, is permissible. All other uses require the prior authorization of the copyright holder.”