COURSE OUTLINE

ELEC-220
Electro-Mechanical Devices
3 Semester Hours

HOWARD COMMUNITY COLLEGE

Description

Upon completion of this course, the student will be able to analyze electro-mechanical systems from a variety of applications in industrial and hospital environments. Students will learn the construction, characteristics and applications of relays, motors and other electro-mechanical devices along with associated circuits to control them. Automatic controllers (servomechanisms, PLC's, etc.) will be studied. The actual devices learned in theory will be utilized during the laboratory sessions with emphasis on proper operation and measurement techniques will appropriate test instruments. Prerequisite: ELEC-211 and ELEC-213.
(2 hours lecture, 3 hours lab)

Overall Course Objectives

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

1. Name the three parts of an industrial control circuit and describe the general function of each part.
2. Describe how relays and solid-state logic can be used to make decisions, distinguish between normally open (OFF-transistor) and normally closed (ON transistor) relay contacts and describe in detail the operation of a part-classifying system using solid-state and relay logic.
3. Name and explain the operation of various circuits used for input signal conditioning and output amplifiers used in solid-state logic.
4. Contrast the software logic of a programmable logic controller to the logic of a hard-wired circuit, name the three parts of a PLC and describe each part's function and define the following terms associated with input/output function of a PLC: rack, slot, module and terminal.
5. List the sequence of events in a PLC's scan cycle and scan time and define the following terms associated with the processor function of a PLC: user program, instruction-rung, input image table, output image table, and CPU.
6. Relate ladder logic to Boolean symbols and explain the operation of the three relay-type instructions that are available with a PLC: examine-ON, examine-OFF, and output-energize.
7. Given a ladder-logic representation of a user program, enter that program into memory by using the programming devices keyboard.
8. Describe the structure and operating principles of stepping motors and stepper motor controllers and list the desirable features of stepper motors.
9. Describe the basic operations of SCR's, define SCR parameters and explain details of their operation in controller circuits for motors.
10. Describe the basic operation of UJT's and PUT's, define their parameters, and explain details of the operation of relaxation oscillators, and trigger circuits for thyristors.
11. Explain the operation of a triac in controlling both alternations of an ac supply driving a resistive load, define and discuss the electrical parameters (gate trigger, holding current, etc.) and explain the operation of breakover-type devices in the triggering circuits of triacs (discuss advantages of using these devices).

12. Explain the operation of op amp integrators and differentiators and calculate the reset rate and reset time.
13. Explain the generalized closed-loop block diagram, state the purpose of each block and explain each of the five general closed-loop control mode's characteristics.
14. Explain the detailed advantages and disadvantages of each of the five control modes and how they are combined to improve system performance.
15. Define the term transducer and explain the operation and use of transducers in control systems.

Major Topics

I. Relay and Solid-State Logic
  A. Electro-Mechanical Components
    (1) Switches
    (2) Relays
  B. Solid-State Switches
  C. Relay and Solid-State Ladder Logic Diagrams

II. Programmable Logic Controllers (PLC's)
  A. Interpreting Ladder Logic
  B. Programming Ladder Logic
    (1) Boolean
    (2) Op Code

III. Stepper Motor
  A. Operation and Characteristics
  B. Controller

IV. Thyristors
  A. SCR Motor Control Circuits
  B. UJT and PUT
    (1) Relaxation Oscillator
    (2) Trigger for Thyristors
  C. TRIACS and DIACS
    (1) Data Sheets
    (2) Control Circuits
  D. Zero-Cross Switching

V. Servo Systems
  A. Op Amp Integration and Differentiation
  B. Open Loop vs. Closed Loop
  C. Five Basic Controller Modes
    (1) ON-OFF
    (2) Proportional
    (3) Proportional-Integral
    (4) Proportional-Derivative
    (5) PID
  D. Analog and Digital PID
  E. Motor Control Circuits

Course Requirements

Grading/exams: Grading procedures will be determined by the individual faculty member but will be calculated on the basis of tests, quizzes, labs, semester project and class participation. Class and lab attendance is required for all sessions.
Writing: Semester project report and essay questions on tests.
Math: Boolean algebra, algebra and trigonometry, and graphical techniques are used to analyze control circuits and systems.
Oral: Presentation of semester project.

Other Course Information

This course is a course in Biomedical Engineering Technology and Electronic Technology programs.