San Bernardino Valley College
Curriculum Approved: November 8, 2004

I. COURSE INFORMATION:

A. Division: Technical
Department: Electricity/Electronics
Course ID: ELEC 218B
Course Title: Controlling Industrial Electricity
Units: 4
Lecture: 3 hours
Laboratory: 3 hours
Prerequisite: ELECTR 115 and ELECTR 116
Corequisite: None
Dept. Advisory: None

B. Catalog and Schedule Description: The study of DC, AC, and polyphase motor operation, mechanical and programmable machine controls, relays and programmable controllers, ladder logic diagrams and the communication network linking the programmer, the controller, and the machine.

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: One

III. EXPECTED OUTCOMES:

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

A. Apply the principles of electronic relays to drum switches and DC motor controls.
B. Explain the most common functions of a DC motor controller.
C. Discuss the chief causes of trouble in electrical controls.
D. Discuss the two general methods of starting AC induction motors and the two-wire and three-wire configurations.
E. Interpret transistor switching, SCRs, and the microprocessors function in motor controls.
F. Explain and be familiar with the operation of an electronic programmable controller.
G. Construct ladder diagrams from existing circuits.
H. Program electric control circuits from ladder diagrams.
I. Troubleshoot a machine control system of programmer to controller to machine.

IV. COURSE CONTENT:

A. Magnetism and Electromagnetism
   1. Nature of magnetism, polarity, theory
   2. Attraction, repulsion, reluctance
   3. Electromagnetism
B. Direct Current Motor Controls
   1. Drum start & reverse control, series motor, shunt motor, compound motor - DC reversing with a DPDT knife switch - DC magnetic controls
C. Alternating Current Motor Controls
   1. Single phase motor manual controls
   2. Split phase motor reversing controls
   3. Magnetic controls - AC contactors and relays
   4. Two-wire control - three-wire control
   5. Pushbutton and multiple control stations
   6. Multi-speed controls
D. Switching Logic and Digital Electronics
   1. Switching logic - switching theorems
   2. Truth table - sum of the products
   3. Products of the sums - digital electronics
   4. Binary numbers - binary to decimal conversion
   5. Decimal to binary conversion - logic gates

E. Industrial Solid State Devices and Controls
   1. Diodes - liquid crystal display - transistors
   2. Transistor switching circuits - SCR controls
   3. Triacs - diacs - integrated circuit types
   4. Microprocessor systems
   5. Solid state motor controls - speed controls
   6. Programmable controls

F. Allen-Bradley Bulletin 1745, SLC 100, Programmable Controller
   1. Programming basics - relay type instructions
   2. Timer instructions - counter instructions
   3. Fine time base instruction - MCR and ZCL instructions - sequencer instructions shift register instructions - program editing maintenance and troubleshooting

V. METHODS OF INSTRUCTION: (Please check all that apply and add any additional not listed.)

X Lecture
X Class and/or small group discussion
_____ Critical evaluation of texts, newspapers, journal articles, and other printed research
_____ Critical evaluation of films, videotapes, audiotapes, or other media forms
X Classroom demonstrations
_____ Field trips
_____ Guest speakers
X Other: Practical laboratory projects applying different control methods.
_____ Other:
_____ Other:

VI. TYPICAL OUT-OF-CLASS ASSIGNMENTS:

A. Reading Assignment. Reading assignments are required and may include (but are not limited to) the following: After reading the chapter on Magnetism and Electromagnetism, discuss in small groups the Electromagnetism.

B. Writing Assignment. Writing assignments are required and may include (but are not limited to) the following: Write term paper on a control system. Include the instruction set and the operation sequence.

C. Critical Thinking Assignment. Critical thinking assignments are required and may include (but are not limited to) the following:
   1. Design a machine that will fold a piece of paper in half then stack the folded papers in a receiver tray. Next write a ladder logic program that will control the process.
   2. Configure your programmable logic controller with two inputs and three outputs then enter a switching program and verify the proper operation.

VII. EVALUATION:

A student's grade will be based on multiple measures of performance and will reflect the objectives explained above. A final grade of "C" or better should indicate that the student has the ability to successfully apply the principles and techniques taught in this course. These evaluation methods may include, but are not limited to, the following (Please check all that apply, and add additional ones not listed):

_____ Portfolios
X Projects
X Written papers or reports
X Presentations (oral and visual)
_____ Work performance (internships or field work)
X Lab work
X Comprehensive examinations (cumulative finals or certifications)
_____ Peer evaluation
_____ Self evaluation
_____ Classroom participation

_____ Homework
_____ Other:
_____ Other:
_____ Other:

VIII. TYPICAL TEXTS:

A. Kenneth Rexford, Electrical Control for Machines, 6th Edition, Delmar, New York, 2004
B. Richard Cox, Technician's Guide to Programmable Controllers, 4th Edition, Delmar, New York, 2001
C. Christopher Kilian, Modern Control Technology: Components and Systems, 2nd Edition, Delmar, New York, 2001

IX. OTHER SUPPLIES REQUIRED OF STUDENTS:

Scientific calculator

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PREREQUISITE/COREQUISITE/ADVISORY
COURSE GRID FORM

Target Course: ELEC 218B Controlling Industrial Electricity

Prerequisite Course: ELECTR 115 Alternating Current Circuit Analysis

Instructions:
1) List exit competencies (skills) from Prerequisite Course. These skills are listed in the "Student Outcomes" section of the Course Outline ("upon completion of the course, the student should be able to…")
2) Indicate which of the listed exit competencies (skills) are necessary entry skills needed for success in the target course. Mark with an "X" each needed skill.
3) Indicate the degree of importance of each needed entry skill for course success, using the following rating scale:

1=Critical 2=Very Helpful 3=Desirable

Skills Analysis

Entry Skills in Target Course	Exit Skills Provided by Prerequisite Course (Mark with an X if needed and indicate Prerequisite Course if more than one).	Degree of Importance (Rate 1 – 3)
1. Define magnetism, electromagnetism, and electromagnetic induction.	X	1
2. Explain the generation of AC voltage from electro-mechanical generators.	X	2
3. Define reactance; inductive/capacitive, units of measurement, their source, and their relation to resonance.	X	1
4. Describe the interaction between volts, ohms, current, and frequency in AC series and parallel circuits.	X	1
5. Apply circuit analysis to series and parallel and complex circuits.	X	1
6. Use rectangular and polar number systems, in series and parallel variational analysis.	X	3
7. Distinguish between half-wave, full-wave, and bridge rectifier circuits.	X	1
8. Analyze the filtering process of an LC pi filter network.	X	1

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COURSE GRID FORM

Target Course: ELEC 218B Controlling Industrial Electricity

Prerequisite Course: ELECTR 116 Alternating Current Circuit Laboratory

Instructions:

1) List exit competencies (skills) from Prerequisite Course. These skills are listed in the "Student Outcomes" section of the Course Outline ("upon completion of the course, the student should be able to…")
2) Indicate which of the listed exit competencies (skills) are necessary entry skills needed for success in the target course. Mark with an "X" each needed skill.
3) Indicate the degree of importance of each needed entry skill for course success, using the following rating scale:

1=Critical 2=Very Helpful 3=Desirable

Skills Analysis

Entry Skills in Target Course	Exit Skills Provided by Prerequisite Course (Mark with an X if needed and indicate Prerequisite Course if more than one).	Degree of Importance (Rate 1 – 3)
1. Explain the oscilloscopes operation and controls and be able to use it to measure voltage and time.	X	2
2. Use the function generators operation and controls.	X	2
3. Explain the layout of a QT board and be able to construct circuits on it.	X	2
4. Use a multi-meter to measure voltage, check for continuity, and verify polarity.	X	1
5. Describe electrical safety procedures.	X	1