



**I. COURSE DESCRIPTION:**

This course introduces the student to three phase AC transformers, motors, loads and associated equipment. Lab exercises will provide the students with hands-on experience with typical commercial AC motor control circuit connections.

The student will develop an understanding of the hardware and software associated with the Allen Bradley 5 family PLCs. PLC programming techniques using RS logic 5 software, will be used to design, document and commission basic to intermediate PLC lab assignments.

**II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:**

Upon successful completion of this course, the student will demonstrate the ability to:

**1. *Connect, test and analyze single phase and poly phase transformers.*****Potential Elements of the Performance:**

- Describe and demonstrate the operation of single-phase transformer in terms of polarity, impedance and winding ratios.
- Describe and demonstrate the operation of three phase transformers in wye and delta configurations.
- Describe and demonstrate three phase transformer connections for RLC balanced loads.
- Describe and demonstrate single and three phase autotransformers for reduced voltage motor starting

**2. *Connect, test and analyze wound rotor motors.*****Potential Elements of the Performance:**

- Identify the mechanical parts, windings and connections for three phase wound rotor induction motors.
- Describe and demonstrate the operation of a three phase wound rotor induction motor and its external control circuits.
- Connect and describe the effects of differing resistances in the rotor circuit of a wound rotor motor under varying loads.

**3. *Connect, test and analyze synchronous and squirrel cage motors.*****Potential Elements of the Performance:**

- Describe and demonstrate the operation of synchronous motors in power factor correction and constant speed applications
- Describe and demonstrate the controller circuit for a two-speed squirrel cage motor.

**4. Describe the function and basic operation of a PLC and understand the related terminology including numbering systems.**

Potential Elements of the Performance:

- Describe the function of a PLC and state its applications
- State the major advantages of a typical logic controller ( PLC ) over conventional hardware relay systems
- Identify the four major components of a typical PLC and describe the function of each
- Identify the two distinct types of memory
- Understand decimal, binary, octal, hexadecimal, binary coded decimal (BCD) numbering systems
- Perform conversions from one system to another

**5. Understand the I/O addressing and hardwiring requirements.**

Potential Elements of the Performance:

- Define the term discrete and the term analog
- Describe the I/O section of a PLC
- Define the term interposing relay
- Define the term optical isolation
- Relate I/O addressing to physical location
- Describe the proper wiring connections for input/output devices and their corresponding modules
- Describe how basic AC and DC input and output modules work and identify a hard-wiring diagram

**6. Develop and demonstrate basic programming techniques for AB 5 PLCs.**

Potential Elements of the Performance:

- Describe basic programming techniques
- Understand the Examine ON, OFF, timers, counters, move, limit test, sequencers and Internal Storage instructions
- Describe the Force On and Off features and hazards that could be associated with both
- Program basic PLC functions offline
- Program PLCs to control
- Hard-wire PLCs to field equipment and input/output cards
- Create documentation to add to a PLC program

**7. Demonstrate the ability to write basic PLC programs to control various electrical equipment in the lab, hardware and run the programs on a PLC.**

Potential Elements of the Performance:

- Download a program to a PLC attached to a PC
- Download a program to a PLC from a remote PC over ethernet through a gateway server to Data Highway and then to a particular PLC in the Lab

- Edit online programs
- Upload a program to a PC from a PLC
- Program basic PLC functions online
- Program PLCs to control Motors, traffic lights
- Download a program to a local PLC and run a program
- Download a program to a remotely located PLC from room B 1035 to room B 1060 over the Ethernet network to a gateway server to the AB data Highway to a particular PLC and run a program
- Hard-wire PLCs to field equipment and I/O cards
- Hardwire PLCs to control motors and traffic lights

### III. TOPICS:

1. Single phase and poly phase transformers.
2. Wound rotor motors.
3. Synchronous motors.
4. Squirrel cage motors.
5. Overview of PLC terminology and principles
6. Overview of industrial controls and automation hardware/software.
7. Overview of RS Logic 5 software
8. Basic PLC programming and hardwiring

### IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

- Notes supplied by instructor
- Hand tools
- Safety Glasses

### V. EVALUATION PROCESS/GRADING SYSTEM:

Test 1 (machines)	15 %
Practical Test 1 (machines)	15 %
Test 1 (PLCs )	15 %
Practical Test 1 (PLCs)	15 %
Lab Write-ups (machines)	20 %
Lab Write-ups (PLCs)	20 %

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Total 100 %

While marks are not given for attendance, marks may be deducted for classes missed. See Special Notes section.

The following semester grades will be assigned to students in apprenticeship courses:

<b>Grade</b>	<b><u>Definition</u></b>	<i>Grade Point Equivalent</i>
A+	90 – 100%	4.00
A	80 – 89%	3.00
B	70 - 79%	2.00
C	60 - 69%	1.00
D	50 – 59%	0.00
F (Fail)	49% and below	
CR (Credit)	Credit for diploma requirements has been awarded.	
S	Satisfactory achievement in field /clinical placement or non-graded subject area.	
U	Unsatisfactory achievement in field/clinical placement or non-graded subject area.	
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.	
NR	Grade not reported to Registrar's office.	
W	Student has withdrawn from the course without academic penalty.	

## VI. SPECIAL NOTES:

### Disability Services:

If you are a student with a disability (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with your professor and/or the Disability Services office. Visit Room E1101 or call Extension 2703 so that support services can be arranged for you.

### Retention of Course Outlines:

It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other postsecondary institutions.

### Communication:

The College considers **WebCT/LMS** as the primary channel of communication for each course. Regularly checking this software platform is critical as it will keep you directly connected with faculty and current course information. Success in this course may be directly related to your willingness to take advantage of the **Learning Management System** communication tool.

In order to maintain a passing grade the student must obtain a minimum 50% average in all subject sections of the course, 1. Theory, 2. Practical and 3. Demonstration and Write up.

In order to have a mark assigned to the write-ups the student must attach the lab demonstration sign off sheet with all labs signed off by the instructor.

Pagers and cell phones should be turned off or set to vibrate mode during class. Please show courtesy to the class by restricting conversation to in-class topics, and raise your hand to gain attention when asking a question or raising a point of discussion.

Safety is the most important aspect in this course and any compromise in student safety by any other student will not be tolerated. Students that observe any unsafe lab condition and/or act must report it to the instructor immediately. Student safety in the labs is the number one priority. Students are to contact the instructor before working on any live equipment that they are not familiar with or have not been instructed in the safety procedures of that particular equipment.

Students must wear all Sault College required personal protective equipment (PPE) during lab activities. Failure to do this will result in expulsion from the lab activity and a grade of zero being assigned. Students are expected to be wearing their required PPE prior to entering the lab. The instructor will advise what specific PPE is required (safety glasses will definitely be required). Unsafe conduct in the lab will not be tolerated.

Students may not wear earphones of any kind (i.e. for play back of recorded music/voice) during lab activities or test sittings. This does not include hearing aids required for hearing impaired.

Any request to deviate from the aforementioned course outline requirements must be made to the instructor in writing or via Sault College email. If permission is granted it must also be granted in writing or via Sault College email. Verbal requests/permissions are not acceptable. It is the student's responsibility to maintain a copy of all such requests and associated permissions.

Since all final work must be performed on special network PLCs located at the college, there is limited time to run tested and demonstrated labs at the college, therefore reading, review questions, planning and offline programming must be done outside of class hours.

If a student misses a test or a lab he/she must have a valid reason (i.e. medical or family emergency – documentation will be required). In addition, the instructor **must** be notified **prior** to the test sitting or lab class. If this procedure is not followed the student will receive a mark of zero on the test or lab with no make-up option.

Plagiarism:

Students should refer to the definition of “academic dishonesty” in *Student Code of Conduct*. Students who engage in academic dishonesty will receive an automatic failure for that submission and/or such other penalty, up to and including expulsion from the course/program, as may be decided by the professor/dean. In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced, and to credit the author of the material, it is the policy of the department to employ a documentation format for referencing source material.

Course Outline Amendments:

The professor reserves the right to change the information contained in this course outline depending on the needs of the learner and the availability of resources.

Substitute course information is available in the Registrar's office.

**VII. PRIOR LEARNING ASSESSMENT:**

Students who wish to apply for advance credit transfer (advanced standing) should obtain an Application for Advance Credit from the program coordinator (or the course coordinator regarding a general education transfer request) or academic assistant. Students will be required to provide an unofficial transcript and course outline related to the course in question.

Credit for prior learning will also be given upon successful completion of a challenge exam or portfolio.

**VIII. LAB REQUIREMENTS:**

1. All lab reports are to be computer generated. Hand written reports will not be accepted.
2. All lab reports are to include a title page with the following information:
  - Lab title and number
  - Due date
  - Date submitted
  - Course number
  - Names of group members
  - Instructor's name
3. Lab reports are to include all procedures and observations listed in the order they were performed/taken and numbered to match the lab handout.
4. Every lab report is to conclude with a summary (whether requested in the lab document or not). The summary is to be 1 page (double spaced, Arial size 12 font, maximum 1 inch margins) in length and is to be an analysis of the results. The summary is not to be a regurgitation of the results. It is expected that students will use course notes, library resources and Internet research to assist in writing lab summaries. Labs submitted with a substandard summary will receive a grade of 0.
5. One lab report submission per group. Maximum 2 members per group.
6. Lab reports submitted with grammatical and/or spelling errors will receive a grade of 0. Word processors have spell check, it is expected students will use it.
7. Lab reports are due at the beginning of class 1 week after the scheduled period in which it was done. Late submissions will receive a grade of 0.
8. Students are not permitted to work on live equipment outside of regular class time. If a student misses all or part of a lab class he/she will not be permitted to submit the corresponding lab report.
9. Students must supply their own hand tools and safety glasses. Students will not be permitted in the lab without safety glasses and must wear the safety glasses whenever working on or around live equipment. Students must never work alone in the lab. Unsafe work habits will not be tolerated.

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***Return Bottom Section to Instructor.***

I have read and understand the above Lab Requirements:

Name (print): \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_