Vanier College

Faculty of Applied Technologies

Industrial Electronics

Instrumentation - Automation - Robotics

Program Revision Interim Report
Proposed Implementation Fall 2008

Approved by the Program Revision Committee:	31 October, 2007
Approved by the Faculty of Applied Technology:	7 November, 2007
Approved by the Academic Advisory Committee:	20 March, 2008
Approval by Academic Council:	27 March, 2008
Approved by the Board of Directors:	8 April, 2008

243.C0 Industrial Electronics Technology

Type of Certification:	Diploma of College Studies, DEC
Year of approval:	2005
Number of credits:	91 2/3 credits
Program-specific component:	2,055 hours of instruction
General education components:	660 hours of instruction
Total duration:	2,715 hours of instruction
Conditions for Admission:	To be admitted to the program students must meet the general conditions for admission set out in section 2 of the *College Education Regulations*, as well as the following requirements, when applicable. - Mathematics 436 - Physical Science 436

Program Objectives

Introduction

The task of this Program Revision is being achieved and realised in a spirit and intent of improving the Industrial Electronics Program and its delivery, so that the Program will better serve our students, the job market, and the community.

The Faculty and Department welcomed the revision of the Industrial Electronics Program. The revised Program Competencies as stated by MELS now give the Faculty and Department the opportunity to improve the Program, through a more rational integration and sequencing of competencies and elements of the competencies within the program courses. The revision facilitates the integration of multiple courses to contribute to the competencies rather than having to adhere to one competency per course, as was dictated by the previous program revision. The demands of industry and changing technology compels the College to provide an up-to-date program to prepare its graduates for entry level positions in industry.

While the volume of knowledge that the Industrial Electronics Technologist requires in order to be competent, employable, competitive, and productive has increased, the time allotted to train and educate the student has not. The revised program grid, **Industrial Electronics 243.C0**, as presented was carefully designed to implement and balance all competencies in a logical order. The program should be engaging, and challenging while still meeting industry demands, requirements and standards, and MELS stated competencies.

The student is introduced to different aspects of the profession, technologies, and the fundamental concepts and principles related to the field. Then throughout the program these are reinforced while the student is taught application and integration, as required to meet the competencies. The student constructs a consistent body of practical knowledge, skills, and attitudes, and becomes an independent life-long learner, continuing to build on his/her education in the years following graduation.

The revised competencies add important practical skills that are required by our graduates in the current job market. The more theoretical and abstract elements that are rarely used by a working technologist have been reduced in favour of practical skills directly aimed at the manufacturing industry. The revised program better prepares our graduates for entry level positions as Industrial Electronics Technologists.

Specifically, the new competencies increase emphasis on:

- safety in the workplace,
- custom fabrication and prototyping skills,
- adherence to industry standards,
- technical documentation,
- planned and preventative maintenance,

– chemical process control,
– system installation and start-up,
– integration and troubleshooting,

reduce emphasis on:

– mathematical procedures and analysis,
– theoretical physics,
– theoretical problem solving,
– system analysis,
– a systems approach.

This shift in pedagogical direction is long overdue, and is in line with what industry has long been seeking. In fact a recent series of articles in "InTech"[1] clearly supports this change in direction from a traditional theoretical approach to a more practical one. This shift in pedagogy provides the student with the practical and applied skills required to function at the entry level as an engineering technologist.

Desired Outcome[2]

Industrial Electronics Technologists work for companies in the primary, secondary and tertiary sectors of manufacturing, in fields such as those of primary metal processing, forestry and pulp and paper, chemistry, plastics, pharmaceuticals, food and beverages, the manufacture of transportation equipment and electrical supplies, printing, etc. They also work as sales representatives and as technical support in engineering consulting firms.

The main tasks of the industrial electronics technologist among others include: troubleshooting and maintenance; preventive maintenance; installation; programming; and start-up of control system components. In collaboration with engineers, they also participate in the design and modification of automated systems and electrical installations. They may also be responsible for purchasing materials within a given budget, and providing technical support to customers.

Among other responsibilities, Industrial Electronics Technologists play a crucial role in the event of a manufacturing line malfunction. They are responsible for quickly repairing or replacing defective components and devices such as sensors, conditioners, controllers, motors, drive systems and electrical distribution systems, as well as mechanical devices such as valves and pneumatic and hydraulic components. As part of their job, the Industrial Electronic Technologists may meet with, among others, engineers (electrical, electronic, computer, mechanical, industrial), chemists, computer specialists, production

1 InTech (published by ISA Instrumentation Systems and Automation Society)
October 2006 Student to engineer Should the teaching of process control be changed
November 2006 Educating the engineer Ready for industry? Control coursework under scrutiny

2 The following was adapted from the MELS document 243.C0

technicians, process operators, electrical mechanics, electricians and draftspersons etc.. The Industrial Electronics Technologist can adapt to work either independently or in a team, depending on the task at hand. For example, troubleshooting, preventive maintenance, programming and updating documents are usually done individually, while design projects, modifications and production halts generally require the services of a team that includes Industrial Electronics Technologists.

The technological environment in which the Industrial Electronics Technologist works is made up of distributed and computerised systems, as well as industrial control system components, such as measuring devices, sensors, transmitters, programmable controllers, electronic controllers, control networks, valves, variable-speed drives, and mechanical components. This technological environment is constantly changing. Computerised production means that the industry is now implementing integrated computer systems. Traditional tools such as clip-on ammeters, multimeters, pressure gauges and signal generators are now accompanied by protocol testers, portable computers, and data acquisition and processing software.

Graduates of the Program will be expected to demonstrate an ability to work in teams and be open to new technologies. More specifically, they will be expected to be able to find and interpret technical documentation, apply practical problem-solving techniques and implement solutions with a hands-on approach in order to install, maintain, troubleshoot and assist in the design of equipment. The acquisition of these basic competencies will foster in our graduates the ability to integrate into the various workplaces, by providing them with generalised transferable work skills and knowledge; rather than providing them with an in-depth theoretical knowledge about specific subjects and specific equipment.

Program-specific component
(65 credits)

042Y	To process information about places in which industrial electronics technicians work
042Z	To do shop work.
0431	To manage and use a computer station in an industrial setting.
0432	To produce industrial electronics drawings.
0433	To plan work activities.
0434	**To install devices in a control system.**
0435	To solve mathematical problems in industrial electronics.
0436	To verify extra-low voltage signals and power supplies.
0437	To inspect power electronics equipment.
0438	To analyze the operation of a process.
0439	To operate control systems.
043A	To program control units.
043B	To adjust the devices in the measuring chain.
043C	To adjust the final controlling elements.
043D	To program a supervisory system.
043E	**To help start up a control system.**
043F	**To do preventive maintenance on control system equipment.**
043G	**To troubleshoot a control system.**
043H	**To participate in the design of a control project.**

The Specific Competencies are indicated in bold. These Specific Competencies deal with tasks directly related to the practice of the profession.

The grid of Competencies shows the relationship between the general competencies on the horizontal axis and the specific competencies on the vertical axis. The symbol (✓) indicates a correlation between a general and a specific competency.

Program Specific Competencies

Industrial Electronics 243.C0	**Competency Number**	general competencies													
specific competencies		To process information about places in which industrial electronics technician work	To do shop work	To manage and use a computer station in an industrial setting	To produce industrial electronics drawings	To plan work activities	To solve mathematical problems in industrial electronics	To verify extra-low voltage signals and power supplies	To inspect power electronics equipment	To analyze the operation of a process	To operate control systems	To program control units	To adjust the devices in the measuring chain	To adjust the final controlling elements	To program a supervisory system
Competency Number		042Y	042Z	0431	0432	0433	0435	0436	0437	0438	0439	043A	043B	043C	043D
To install devices in a control system	434	✔	✔	✔	✔	✔	✔	✔	✔						
To help start up a control system	043E	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
To do preventive maintenance on control system equipment	043F	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
To troubleshoot a control system	043G	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
To participate in the design of a control project	043H	✔		✔	✔	✔	✔			✔		✔			✔

Grid of Competencies

General Education Component Common to All Programs (16 2/3 credits)

0004 To analyze and produce various forms of discourse.

0005 To apply a critical approach to literary genres.

0006 To apply a critical approach to a literary theme.

00B2 To apply a logical analytical process to how knowledge is organized and used.

000G To apply a critical thought process to world-views.

0017 Appliquer les notions de base de la communication en français courant.

or

7000A Communiquer en français avec une certaine aisance.

or

000B Communiquer avec aisance en français.

or

000C Traiter d'un sujet culturel et littéraire.

0064 To establish the role that being physically active plays amongst the lifestyle behaviours which promote health.

0065 To improve one's effectiveness when practising a physical activity.

0066 To demonstrate one's responsibility for being physically active in a manner which promotes health.

General education component adapted to the Industrial Electronics Program (6 credits)

000L To communicate in the forms of discourse appropriate to one or more fields of study.

000U To apply a critical thought process to ethical issues relevant to the field of study.

0018 Appliquer des notions fondamentales de la communication en français, liées à un champ d'études.

Or

000Q Communiquer en français dans un champ d'études particulier.

Or

000R Communiquer avec aisance en français dans un champ d'études particulier.

Or

000S Disserter en français sur un sujet lié au champ d'études.

Complementary general education component (4 credits)

000V To estimate the contribution of the social sciences to an understanding of contemporary issues.

000W To analyze one of the major problems of our time using one or more social scientific approaches.

000X To explain the general nature of science and technology and some of the major contemporary scientific or technological issues.

000Y To resolve a simple problem by applying the basic scientific method.

000Z To communicate with limited skill in a modern language.

0010 To communicate on familiar topics in a modern language.

0067 To communicate with relative ease in a modern language.

0011 To recognize the role of mathematics or informatics in contemporary society.

0012 To use various mathematical or computer concepts, procedures and tools for common tasks.

0013 To consider various forms of art produced by aesthetic practices.

0014 To produce a work of art.

Program Design

The design of courses and a course grid poses many challenges and requires many compromises, but must be done with a clear objective in mind. For the Industrial Electronics Program this objective is:

- To teach the entry-level required to install, maintain, calibrate, and program automated equipment used in Manufacturing, and to provide the student with the required knowledge for further learning.
- That each course and semester provide the student with a focus on a specific discipline(s) and technology applications, as well as provide the student with an opportunity to integrate knowledge and techniques. Courses in the early semesters need to be focused on fundamentals of topics.
- That Competencies are better covered in more than one course. Courses are then designed to include specific elements that relate directly to the fundamental applications and subject of the course.
- That Lab activities should focus more on industrial applications, and additional project oriented courses should be included.
- That the material in each course as well as throughout the Program follow a proper sequence and that there is a clear link between courses.
- That courses provide a balance between theory and practice (labs) in a structured and coherent sequence.
- That project activities and work be done apart from courses that need lab activities that directly support the theory, and that specific courses be dedicated to project work. This type of project work will provides the student with a sense of accomplishment, and allows integration of the different courses within the Semester and Program. Specific "Integration" courses in the Revised Grid have been included that address this.
- Students graduating from Industrial Electronics often work in small companies, may venture out on their own, or represent companies as sales representatives. For this reason we included a course in Professional Practice that includes a business component.
- That a Stage be added into the final year of the Program.

In addition to what has been said, in the design of the course grid, several, sometimes conflicting, principles were adhered to namely:

The grid needs to be balanced for the student.

Courses need to follow a logical sequence.

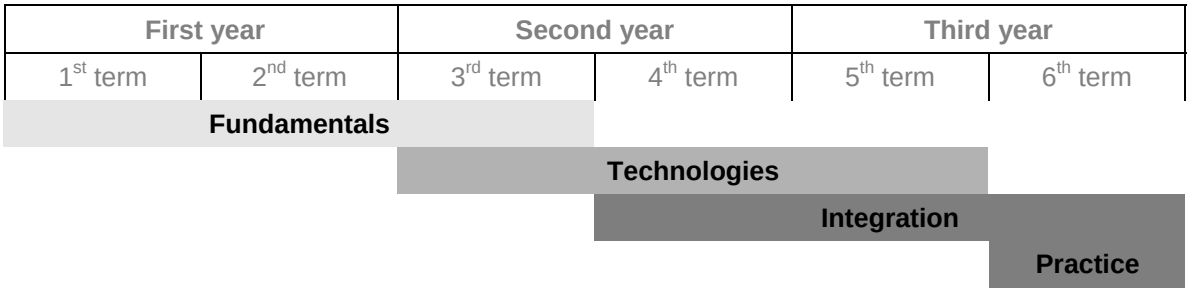
Related courses need to be as close together as possible.

Allow for entry into the program in the winter semester.

Comply with the decisions made by the Faculty Dean and the Academic Dean relating to course ponderation and the number of Department (243) Specific courses[3].

Students in the Industrial Electronics Program need to learn first; the fundamentals of electronics and manufacturing, and be able to work safely in the work place. Second; they must master the specific skills and applicable technologies such as Programmable Logic Controllers (PLC), Proportional Integral and Differential (PID) Process Controllers, and Motor Drives. Thirdly; the student needs an understanding of how the technology is integrated into manufacturing and automated systems, and lastly; how to practice their acquired competencies.

The following provides a graphical representation of this.



As stated in the MELS document:

"The environment in which industrial electronics technicians work is made up of distributed and computerized systems, as well as industrial control systems, such as measuring devices, sensors, programmable controllers, electronic controllers, control networks, valves, variable-speed drives, etc. This technological environment is constantly changing. Computerized production means that the industry is now implementing integrated computer systems. Traditional tools such as clip-on ammeters, multimeters, pressure gauges and signal generators are now accompanied by protocol testers, portable computers, data acquisition and processing software, etc."

This clearly indicates that the Industrial Electronics Technologist is required to learn more diverse skills and subjects to be familiar with the different aspects of this environment. It is for this reason that the Revised Program now has more courses than the present Program.

The revised Program Competencies as stated by MELS now give the Faculty and Department the opportunity to improve the Program, through a more rational integration and sequencing of competencies and elements of the competencies within the program courses. The revision facilitates the integration of multiple courses to contribute to the

[3] The number of contact hours for the Applied Science course was set at 4 hours. The number of Department (243) courses was limited to 26 courses plus a stage.

competencies rather than having to adhere to one competency per course as was dictated by the previous program revision. The demands of industry and changing technology compels the College to provide an up-to-date program to prepare its graduates for entry level positions in industry.

This revision will give the College, Faculty, and Department the opportunity to put forward a new up-to-date innovative, original, and relevant Industrial Electronics Program.

Stage

The program specific competencies do not include a stage component, nor do they require the integration of the student into the workforce prior to graduation. Students from programs where the work is done in office areas and/or with a variety of standard equipment can be integrated and productive while on stage. The integration of industrial electronics students into the manufacturing industry workforce requires additional employer specific training in order for the student to be productive and work safely. The employer, in accordance with their specific requirements, standards, and procedures, provides this training to new graduates before they are allowed to work on the floor without direct supervision. For safety and production reasons, many manufacturers do not favour students in the production workplace for the purpose of a stage.

The following potential restrictions need to be considered when placing students on stage in the industrial electronics manufacturing sector:

- in many companies students need specialised, additional training to function on specific manufacturing equipment,
- manufacturing companies have specific safety requirements that must be met through proper training and/or certification before a worker is allowed on the floor,
- students are not allowed on the manufacturing floor without direct supervision at all times,
- company policies may require that students be paid for work done and therefore companies do not consider stage positions viable,
- union contracts often prevent companies from having stage students.

Notwithstanding the above, the Department and the Program Revision Committee both support that giving students the opportunity to participate in a “stage” in industry, would be beneficial to the students.

During the last year, students will be required to complete a stage of 75 hours.

This work-training period (or stage) spent in industry during the final semester of studies is an important asset. It gives students the opportunity to acquire on-the-job experience that is essential to have on a resume.

The stage or Internship Program provides students with *real world* experience in industry. The Faculty and the Department will assist students in making valuable contacts with various placements in industry.

Industrial Electronics Technologists find many job openings in private business and the public sector, in small, medium and large-size businesses.

Sixth semester students will be scheduled so that they are attending classes 4 out of five days. The fifth day they will be scheduled to attend their stage.

The following two pages show:

- The proposed program grid, ponderation (theory, lab and homework) hours for each course, and credits assigned to each course in the program.

- Sequential Organisation of Competencies, or Course-Competency Matrix, which shows all competencies and the courses that, contributes to each competency.

Program Grid Industrial Electronics 243.C0

Semester 1 Fall					
Course Number	Title	Ponderation Lec	Lab	Homework	Credits
243-123-VA	The Profession	1	2	1	1.33
243-142-VA	Industrial Manufacturing	2	2	1	1.67
243-133-VA	Electrical Technology	3	2	1	2.00
203-104-VA	Applied Science	2	2	1	1.67
420-708-VA	Intro to Computers	1	3	2	2.00
Program Specific	**Total**	**9**	**11**	**6**	**8.67**
Contact Hr. 20					
603-101	English 1	2	2	4	2.67
345-102	Humanities 1	3	0	3	2.00
109-103	Physical Education 1	1	1	1	1.00
General Education		6	3	8	5.67
Total Contact Hr. 9					
8 Courses		15	14	14	**14.33**
Total Contact Hr. 29			Hr / Wk. 43		

Semester 2 Winter					
Course Number	Title	Ponderation Lec	Lab	Homework	Credits
243-251-VA	Technical Documentation	1	3	1	1.67
243-233-VA	Analog Circuits	2	2	1	1.67
243-234-VA	Digital Circuits	2	2	1	1.67
243-225-VA	Safety in the Work Place	2	1	1	1.33
201-206-VA	Intro to Applied Math	2	2	2	2.00
Program Specific	**Total**	**9**	**10**	**6**	**8.33**
Contact Hr. 19					
603-102	English 2	2	2	3	2.33
345-103	Humanities 2	4	0	3	2.33
	Complementary 1	3	0	3	2.00
General Education		9	2	9	6.67
Total Contact Hr. 11					
8 Courses		18	12	15	**15.00**
Total Contact Hr. 30			Hr / Wk. 45		

Semester 3 Fall					
Course Number	Title	Ponderation Lec	Lab	Homework	Credits
243-341-VA	Introduction to Automation	3	4	3	3.33
243-393-VA	Shop Work	1	3	2	2.00
243-334-VA	Signal Processing	3	2	2	2.33
201-305-VA	Applied Math	2	2	2	2.00
Program Specific		**9**	**11**	**9**	**9.67**
Contact Hr. 20					
603-HSD	English B	2	2	3	2.33
602-10x	French 1	2	1	3	2.00
109-104	Physical Education 2	0	2	1	1.00
General Education		4	5	7	5.33
Total Contact Hr. 9					
7 Courses	**Total**	13	16	16	**15.00**
Total Contact Hr. 29			Hr / Wk. 45		

Semester 4 Winter					
Course Number	Title	Ponderation Lec	Lab	Homework	Credits
243-471-VA	Process Control	3	2	2	2.33
243-462-VA	PLC Programming	2	2	2	2.00
243-443-VA	Integration & Maintenance	1	3	2	2.00
243-435-VA	Power Electronics	3	3	3	3.00
Program Specific		**9**	**10**	**9**	**9.33**
Contact Hr. 19					
603-103	English 3	2	2	2	2.00
602-HSB/C/D	French B	2	1	3	2.00
345-HAS	Humanities B	3	0	3	2.00
109-105	Physical Education 3	1	1	1	1.00
General Education		8	4	9	7.00
Total Contact Hr. 12					
8 Courses	**Total**	17	14	18	**16.33**
Total Contact Hr. 31			Hr / Wk. 49		

Semester 5 Fall					
Course Number	Title	Ponderation Lec	Lab	Homework	Credits
243-511-VA	Distributed Automation	2	2	2	2.00
243-512-VA	Project Planning & Design	2	2	3	2.33
243-583-VA	Instrumentation	2	2	2	2.00
243-584-VA	Actuators	2	2	2	2.00
243-546-VA	Installation and Calibration	2	3	2	2.33
243-597-VA	Mechanisms	2	2	3	2.33
243-625-VA	Professional Practice	2	1	2	1.67
Program Specific		**14**	**14**	**16**	**14.67**
Contact Hr. 28					
	Complementary 2	3	0	3	2.00
General Education		3	0	3	2.00
Total Contact Hr. 3					
7 Courses	**Total**	17	14	19	**16.67**
Total Contact Hr. 31			Hr / Wk. 50		

Semester 6 Winter					
Course Number	Title	Ponderation Lec	Lab	Homework	Credits
243-671-VA	Advanced Automation	2	2	3	2.33
243-612-VA	Project Implementation	2	4	2	2.67
243-643-VA	Designing and Modifying	2	4	2	2.67
243-624-VA	Electrical Code	2	2	2	2.00
243-646-VA	System Startup	2	4	2	2.67
243-628-VA	Stage	0	5	1	2.00
Program Specific		**10**	**21**	**12**	**14.33**
Contact Hr. 31					
General Education		0	0	0	0.00
Total Contact Hr. 0					
6 Courses	**Total**	10	21	12	**14.33**
Total Contact Hr. 31			Hr / Wk. 43		

Comprehensive Assesment
English Exit

Rev: 14 March, 2008

	Fall	Winter	Total	Required
Program Specific				
Total Credits	33.00	32.00	**65.00**	65.00
Total Hr	1020	1035	**2055**	2055
General Education				
Total Credits	**13.33**	**13.33**	26.67	26.67
Total Hr	**330**	**330**	660	660
Program				
Total Credits	**46.33**	**45.33**	91.67	91.67
Total Hr	**1350**	**1365**	2715	2715

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Electrical Engineering Technologies
Industrial Electronics
Instrumentation - Automation – Robotics

Industrial Electronics 243.C0

Sequential Organization of Competencies	To process information about values in which industrial electronics technician work	To do shop work	To manage and use a computer station in an industrial setting	To produce industrial electronics drawings	To observe work activities	To install devices in a control system	To solve mathematical problems in industrial electronics	To verify extra-low voltage signals and power supplies	To inspect power electronics equipment	To analyze the operation of a process	To operate control systems	To program control units	To adjust the devices in the measuring chain	To adjust the final controlling elements	To program a supervision system	To help start up a control system	To do preventive maintenance on control system equipment	To troubleshoot a control system	To participate in the design of a control project
	042Y	042Z	0431	0432	0433	0434	0435	0436	0437	0438	0439	043A	043B	043C	043D	043E	043F	043G	043H
Term 1																			
The Profession	✓										✓								
Industrial Manufacturing	✓	✓								✓	✓								
Electrical Technology							✓	✓					✓						
Applied Science										✓									
Intro to Computers			✓																
Term 2																			
Technical Documentation		✓	✓	✓											✓	✓			✓
Analog Circuits							✓	✓				✓							
Digital Circuits							✓	✓											
Safety in the Work Place					✓	✓					✓		✓				✓		✓
Intro to Applied Math							✓												
Term 3																			
Introduction to Automation				✓				✓		✓	✓	✓				✓		✓	
Shop Work		✓				✓													✓
Signal Processing							✓	✓					✓					✓	✓
Applied Math							✓												
Term 4																			
Process Control				✓			✓	✓		✓	✓	✓		✓					✓
PLC Programming				✓							✓	✓		✓	✓				
Integration & Maintenance				✓		✓		✓		✓	✓						✓	✓	
Power Electronics				✓			✓	✓	✓								✓		
Term 5																			
Distributed Automation			✓	✓							✓				✓			✓	✓
Project Planning & Design				✓	✓		✓				✓								
Instrumentation							✓	✓		✓			✓						
Actuators								✓		✓				✓					
Installation and Calibration				✓	✓	✓	✓			✓	✓		✓	✓		✓			
Mechanisms				✓			✓			✓				✓			✓		
Professional Practice	✓		✓	✓															
Term 6																			
Advanced Automation							✓			✓								✓	
Project Implementation		✓		✓	✓		✓		✓			✓	✓	✓		✓			
Designing and Modifying				✓	✓		✓					✓							✓
Electrical Code						✓	✓		✓							✓	✓		✓
System Startup				✓	✓				✓		✓					✓		✓	
Stage						✓							✓			✓	✓	✓	✓

Rev: 8 April, 2008