ALGONQUIN COLLEGE

Curriculum Review Committee
PROGRAM MODIFICATION
Information for CRC

BIT-PLT Photonics and Laser Technology
Carleton-Algonquin

Title Change ☒
Curriculum Change ☒
Program Vocational Learning Outcomes Change ☒

Credential:

College Certificate □
Ontario College Certificate □
Ontario College Diploma □
Ontario College Advanced Diploma ☒
Ontario College Graduate Certificate □

Full-time ☒
Part-time □

Proposed Start Date: Fall 2012

Intermediate Stage □
Final Stage ☒

Proposal Presentation Date: March 3, 2011

Template Last Revised: September 2009

Proposal to Modify Program

Type of Program

☒ **Ontario College Credential**

- ☐ **Certificate**
- ☐ **Diploma**
- ☒ ***Advanced Diploma***
- ☐ **Graduate Certificate**

☐ **College Certificate**

1. **Current program title and APS Number** (Provide the MTCU approved title)
   BAT- Bachelor of Applied Technology – Photonics (# 6443X0)

2. **Modification(s) proposed** (Describe the proposed modification of title, duration, program content, quota or campus of program delivery)
   BIT-PLT Photonics and Laser Technology (#……..)
   Carleton-Algonquin Joint Program

3. **Rationale for the proposed modification(s)**

The BIT-PLT Photonics and Laser Technology program fills a gap in photonics education, aimed at producing highly qualified personnel required for Ontario to be competitive in this trillion dollar global industry. Graduates will be qualified to lead production teams or engage in research activities in the multi-sector photonics industry, and may continue their studies with post-graduate degrees. Clearly, there remain substantial career opportunities in this industry, but these opportunities are linked to higher education. With respect to higher education, it would be difficult for Algonquin to continue to compete against universities for degree programs and for this reason it is recommended that a joint degree offering would be the best course of action. Successful discussions with Carleton University have concluded in a viable curriculum and the Carleton Senate approval process is under way for the BIT-PLT Photonics and Laser Technology program.

4. **Proposed date of implementation of the modification**
   Fall 2012

5. **College contact responsible for this proposal**
   Name: **Dr. Wahab Almuhtadi, P.Eng.**
   Title: **Professor**
   Telephone Number: (613) 727-4723 x 3403 Email: almuhtw@algonquincollege.com

6. **Required appendices.**
   - ❖ For a title change, provide **APPENDIX IV** program advisory committee support. **(Adv Comte meeting Jan. 20, 2011)**
   - ❖ For duration change, provide **APPENDIX I** program outcomes, course descriptions and course learning requirements, and indicate where changes in either have been made. Also, provide **APPENDIX IV**, program advisory committee support. **(Adv Comte meeting Jan. 20, 2011)**
   - ❖ For content changes, provide **APPENDIX I,** program outcomes, course descriptions, and course learning requirements, and indicate where the changes have been made. Also, provide **APPENDIX IV** program advisory committee support and if appropriate, **APPENDIX II**, evidence of need for the program. **(Adv Comte meeting Jan. 20, 2011)**
   - ❖ For program outcome changes, provide **APPENDIX I,** program of study comparison (if applicable), program outcomes comparison, vocational outcomes mapping, course descriptions and course learning requirements. Also, provide **APPENDIX IV** program advisory committee support and if appropriate, **APPENDIX II**, evidence of need for the program. **(Adv Comte meeting Jan. 20, 2011)**

7. **Date of Board of Governors' meeting at which the proposal was approved (**for Ontario College Credential Programs).

8. **President's Signature** **Date**

Ia. Program of Study Modifications – Table Summary Comparisons

APPENDIX I

Provide program of study comparison, program outcomes, course descriptions and course learning requirements, and indicate where the changes have been made. For Ontario College Credential Certificate and Diploma programs please include Essential Employability Skills and General Education. Both maps are available on the CRC Blackboard Website.

Comparison of Present and Proposed Programs - LEVEL ONE (YEAR 1 – Fall)

Current Program of Study						Proposed Program of Study					
Name of Course	Total Course Hours					Name of Course	Total Course Hours				
	Theory		Lab		Total		Theory		Lab		Total
	In Class	Online	In Class	Online			In Class	Online	In Class	Online	
MAT6443 Calculus I	45		15		60	BIT1200 Mathematics I for Photonics	45		15		60
PHY2210 Kinematics and Dynamics	30		30		60	BIT1203 Physics I for Photonics	45		45		90
DAT0111 Engineering Computation Fundamentals	30		15		45	PLT1000 Problem Solving	45		15		60
SAF8208 Occupational Health and Safety	45				45	PLT1001 Laser Safety, WHMIS & Ethics	15		30		45
PHY2111 Trends in Photonics	30	15			45	PLT1002 Trends in Photonics	15		30		45
PHY2110 Optics and Waves	30		45		75	See 1yr Winter PLT1005 introduction to optics					
TOTAL HOURS	210	15	105		330	**TOTAL HOURS**	165		135		300

Comparison of Present and Proposed Programs - LEVEL TWO (YEAR 1 – Winter)												
Current Program of Study						**Proposed Program of Study**						
Name of Course	**Total Course Hours**					**Name of Course**	**Total Course Hours**					
	Theory		**Lab**		**Total**		**Theory**		**Lab**		**Total**
	In Class	**Online**	**In Class**	**Online**			**In Class**	**Online**	**In Class**	**Online**	
MAT8202 Calculus II	45		15		60	BIT1201 Mathematics II for Photonics	45		15		60
						BIT1204 Physics II for Photonics	45		45		90
PHY2211 Optics/Optical Fibers I (Principles)	30		45		75	PLT1003 Optics/Optical Fibers I (Principles)	30		30		60
See 2yr Winter PHY2411 Manufacturing Photonics Components						PLT1004 Manufacturing Photonics Components	30		30		60
See 1yr Fall PHY2110 Optics and Waves						PLT1005 Introduction to optics	30		45		75
ELN2210 Electrotechnology	30		45		75	See 2yr Fall PLT2101 Circuits and Signals					
DAT0112 Engineering Computation, Automation and Simulation	30		15		45						
TOTAL HOURS	135		120		255	**TOTAL HOURS**	180		165		345

Comparison of Present and Proposed Programs - LEVEL THREE (YEAR 2 – Fall)

Current Program of Study						Proposed Program of Study					
Name of Course	Total Course Hours					Name of Course	Total Course Hours				
	Theory		Lab		Total		Theory		Lab		Total
	In Class	Online	In Class	Online			In Class	Online	In Class	Online	
MAT8203 Linear Algebra	30		15		45						
See 3yr Winter MAT8204 Differential Equations						BIT2004 Differential equations	45		45		90
See 2yr Winter MAT8205Statistics						BIT2300 Intro to Statistics for Photonics	45		15		60
PHY2312 Optics/Optical Fibers II (Devices)	30		30		60	PLT2000 Optics/Optical Fibers II (Devices)	30		45		75
PHY2311 Fundamentals of Light Sources	30		45		75	PLT2001 Fundamentals of Light Sources	30		30		60
See 1yr Winter ELN2210 Electrotechnology						PLT2005 Circuits and Signals	45		45		90
PHY2310 Semiconductors and Logic	30		30		60	See 2yr Winter PLT2102 Semiconductors					
ELN2310 Interfacing	30		30		60	See 2yr Winter PLT2006 Intermediate Programming					
TOTAL HOURS	150		150		300	**TOTAL HOURS**	195		180	15	375

Comparison of Present and Proposed Programs - LEVEL FOUR (YEAR 2 – Winter)												
Current Program of Study						**Proposed Program of Study**						
Name of Course	**Total Course Hours**					**Name of Course**	**Total Course Hours**					
	Theory		**Lab**		**Total**		**Theory**		**Lab**		**Total**
	In Class	**Online**	**In Class**	**Online**			**In Class**	**Online**	**In Class**	**Online**	
MAT8205 Statistics	45				45						
See also 3yr Winter MAT8206 Advanced Calculus						BIT2203 Multi Variate Calculus	45		15		60
ELN2410 Fiber Optic Communications I	30		45		75	PLT2002 Fiber Optic Communications I	30		45		75
PHY2410 Laser System	30		30		60	PLT2003 Laser System	30		30		60
See 2yr Fall ELN2310 Interfacing Programming						PLT2004 Intermediate Programming	45		45		90
See 2yr Fall PHY2310 Semiconductors and Logic						PLT2006 Semiconductors	45		30		75
WKT8000 Coop Education Work Term Prep*	15				15	COOP1000 Work Term Prep*	15				15
ENL8810 Technical Communications	45				45						
MAT8204 Differential Equations	30		15		45	See 2yr Fall BIT2202 Differential equations					
PHY2411 Manufacturing Photonics Components	30		30		60	See 1yr Winter PLT1006 Manufacturing Photonics Components					
TOTAL HOURS	225		120		345	**TOTAL HOURS**	**210**		**165**		**375**

** Coop Work Term:*

Comparison of Present and Proposed Programs - LEVEL FOUR (YEAR 2 – Summer)												
PHY2901 Work Term I.						COOP10001 Work Term						

Comparison of Present and Proposed Programs - LEVEL FIVE (YEAR 3 – Fall)											
Current Program of Study						**Proposed Program of Study**					
Name of Course	**Total Course Hours**					**Name of Course**	**Total Course Hours**				
	Theory		**Lab**		**Total**		**Theory**		**Lab**		**Total**
	In Class	**Online**	**In Class**	**Online**			**In Class**	**Online**	**In Class**	**Online**	
See 2yr Winter ELN2410 Fiber Optic Communications I						PLT3000 Fiber Optic Communications II	30		45		75
PHY2510 Photonics Manu. Systems	30		45		75	PLT3001 Photonics Manu. Systems	30		30		60
ELN2510 Control Systems	30		30		60	PLT3002 Real-Time Systems (0.5)	45		30		75
See 3yr Winter PHY2610 Electro Magnetic Theory						PLT3003 Electro Magnetics I	45		45		90
See 2yr Winter ENL8810 Technical Communications						PLT3008 Communication Skills for PLT	45				45
PHY2512 Thin Film and Vacuum	30		45		75						
PHY2511 Advanced Optical Systems	30		45		75	See 3yr Winter PLT3004 Design of Optical Components and Systems					
TOTAL HOURS	120		165		285	**TOTAL HOURS**	**195**		**150**		**345**

Comparison of Present and Proposed Programs - LEVEL SIX (YEAR 3 – Winter)												
Current Program of Study						**Proposed Program of Study**						
Name of Course	**Total Course Hours**					**Name of Course**	**Total Course Hours**					
	Theory		**Lab**		**Total**		**Theory**		**Lab**		**Total**
	In Class	**Online**	**In Class**	**Online**			**In Class**	**Online**	**In Class**	**Online**	
MGT8500 Business Principles	30			30	60	BIT2001 Introduction to Business	45				45
See 3yr Fall PHY2511 Advanced Optical Systems						PLT3004 Design of Optical Components and Systems	30		45		75
See 4yr Winter PHY2810 Solid State Physics						PLT3005 Solid State Physics	45		0		45
						PLT3006 Physical Electronics	45		45		90
PHY2610 Electro Magnetic Theory	45				45	PLT3007 Electro Magnetics II	45		30		75
PHY2612 Imaging/Image Signal Processing	30		30		60				0		
PHY2611 Opto-electronics Devices	30		45		75	See 4yr Fall PLT4001 Opto-electronics Devices			0		
MAT8206 Advanced Calculus	30		15		45	See 2yr Winter BIT2202 Multi Variate Calculus			0		
TOTAL HOURS	165		90	30	285	**TOTAL HOURS**	**210**		**120**		**330**

Coop Work Term:

Comparison of Present and Proposed Programs - LEVEL SIX (YEAR 3 – Summer)												
PHY2901 Work Term II.						COOP10002 Work Term						

Comparison of Present and Proposed Programs - LEVEL SEVEN (YEAR 4 – Fall)

Current Program of Study						Proposed Program of Study					
Name of Course	Total Course Hours					Name of Course	Total Course Hours				
	Theory		Lab		Total		Theory		Lab		Total
	In Class	Online	In Class	Online			In Class	Online	In Class	Online	
						BIT2002 Marketing in the IT Sec	45		0		45
PHY2712 Quantum Physics	45				45	PLT4000 Applications of Quantum Physics	45		30		75
See 3yr Winter PHY2611 Opto-electronics Devices						PLT4001 Optoelectronic Devices	30		30		60
PHY2711 Advanced Optical Theory	45				45	PLT4002 Applied Advanced Optics	30		45		75
PHY2713 Photonics Research Projects I			60		60	PLT4900 Photonics Research Projects	15		105		120
PHY 2710 Thermodynamics and Heat Transfer	30		15		45				0		
PHY2714 Material Science	30		30		60	See 4yr Winter PLT4003 Material Science			0		
TOTAL HOURS	150		105		255	**TOTAL HOURS**	**165**		**210**		**375**

Comparison of Present and Proposed Programs - LEVEL EIGHT (YEAR 4 – Winter)											
Current Program of Study						**Proposed Program of Study**					
Name of Course	**Total Course Hours**					**Name of Course**	**Total Course Hours**				
	Theory		**Lab**		**Total**		**Theory**		**Lab**		**Total**
	In Class	**Online**	**In Class**	**Online**			**In Class**	**Online**	**In Class**	**Online**	
See 4yr Fall PHY2714 Material Science with Lasers						PLT4003 Material Science with Lasers	30		30		60
PHY2811 Biomedical Photonics	30		30		60	PLT4004 Biomedical Photonics	30		30		60
						PLT4005 Fiber Optic Theory	45		45		90
PHY2812 Photonics Research Projects II			60		60	PLT4900 Photonics Research Projects	15		105		120
						Elective Arts and Humanities Elective	45				45
PHY2810 Solid State Physics	45				45	See 3yr Winter PLT3005 Solid State Physics					
MGT8501 Operations Management	30			30	60						
TOTAL HOURS	105		90	30	225	**TOTAL HOURS**	**165**		**210**		**375**

ONTARIO COLLEGES OF APPLIED ARTS AND TECHNOLOGY
CREDENTIALS VALIDATION SERVICE

APPENDIX A - Form 1 - Vocational Program Outcomes Comparison *

PROVINCIAL PROGRAM STANDARD VOCATIONAL LEARNING OUTCOMES / PROVINCIAL PROGRAM DESCRIPTION OUTCOMES Photonics Engineering Technology - **MTCU#61020**	**PROPOSED PROGRAM VOCATIONAL LEARNING OUTCOMES** **(PLT Photonics and Laser Technology)**
1. Apply the principles of mathematics and science to analyze and solve technical problems related to photonics technology. *(see #1 at PLT)*	1. Analyze and solve technical problems related to photonics and laser technology through the application of the principles of mathematics and science.
2. Communicate information effectively, credibly, and accurately by analyzing, interpreting, and producing basic graphics and other standard technical documents necessary for the installation, maintenance, repair, and manufacture of components. *(see #4 at PLT)*	2. Design, prototype, analyze, troubleshoot, as well as commission, install and repair a variety of photonics equipment and systems.
3. Manage and work within a team to design and meet target goals. *(see #8 at PLT)*	3. Create, run and monitor quality control and assurance programs.
4. Design, use, calibrate, and maintain test instrumentation systems. *(see #2 at PLT)*	4. Support the photonics and laser technology activities of an organization through the application of required skills in the areas of communication, documentation, information technology and teamwork.
5. Use a variety of techniques to identify and analyze systemic problems with photonic equipment and systems, and produce troubleshooting techniques to address these problems. *(see #5 at PLT)*	5. Discover and/or develop solutions and options for systemic problems with photonics and laser equipment and systems, and produce organizational methods to address these problems.
6. Design, assemble, and commission photonic systems to fulfill job requirements established specifications. *(see #2 and #7 at PLT)*	6. Monitor and evaluate effectiveness of safety, supply chain and project management systems in relation to photonics systems and processes.
7. Develop procedures to verify that photonic equipment and systems function at acceptable levels. *(see #7 at PLT)*	7. Create innovative strategies and/or products that meet identified needs.
8. Use computers, electronics, and mechanical systems to support the photonic environment. *(see #4 at PLT)*	8. Form, determine goals for, manage and work within a team to design and meet target goals.
9. Implement and conduct quality control and quality assurance procedures. *(see #3 at PLT)*	9. Evaluate one's own problem solving and decision making processes.*
10. Implement and conduct safety audits and safety assurance procedures. *(see #6 at PLT)*	10. Adapt to new situations and demands by applying and/or updating knowledge and skills.*
11. Establish and maintain inventory, records, and documentation systems. *(see #6 and #7 at PLT)*	11. Lead and contribute to photonics and laser technology research and development teams.*

12. Select for purchase equipment, components, and systems that fulfill the job requirements and functional specifications. *(see #6 and #7 at PLT)*	12. Adhere to relevant law, policies, regulations, standards, procedures, and ethical principles related to the photonics and laser technology field.
13. Apply knowledge to develop and implement appropriate safety procedures and standard shop practices to the workplace, to ensure safety of self and others. *(see #6 at PLT)*	
14. Perform tasks in accordance with relevant law, policies, procedures, standards, regulations, and ethical principles. *(see #12 at PLT)*	

Note: * #9, #10, and #11 in the proposed program are extra outcomes and exceed the outcomes of the existing provincial programs standard vocational learning outcomes.

FORM 1
Vocational Outcomes Mapping

MAPPING OF VOCATIONAL LEARNING OUTCOMES
PROGRAM NAME: *BIT-PLT Photonics and Laser Technology*

LEVEL ONE (YEAR 1 – Fall)												
Course Number	Course Name	Vocational Learning Outcomes										
		1	2	3	4	5	6	7	8	9	10	11	12
BIT1200	Mathematics I for Photonics	x		x	x			x	x	x			
BIT1203	Physics I for Photonics	x	x					x		x	x		
PLT1000	Problem Solving	x	x	x	x			x		x	x		
PLT1001	Laser Safety, WHMIS & Ethics			x			x					x	x
PLT1002	Trends in Photonics			x		x		x			x		x

Vocational Learning Outcomes – The graduate has reliably demonstrated the ability to:

1. **Implement the principles of mathematics and science to design, analyze and solve technical problems related to photonics technology.**
2. **Design, prototype, analyze, troubleshoot, as well as commission, install and repair a variety of photonics equipment and systems.**
3. **Create, run and monitor quality control and assurance programs.**
4. **Apply communication, documentation, computer applications, information technology, and teamwork skills to support the technology activities of an organization.**
5. **Apply critical thinking skills and research of external references to discover solutions and options for systemic problems with photonic equipment and systems, and produce organizational methods to address these problems.**
6. **Monitor and evaluate effectiveness of safety, supply chain and project management systems in relation to photonics systems and processes.**
7. **Create innovative strategies and/or products that meet identified needs.**
8. **Form, determine goals for, manage and work within a team to design and meet target goals.**
9. **Evaluate one's own problem solving and decision making processes.**
10. **Adapt to new situations and demands by applying and/or updating knowledge and skills.**
11. **Lead and contribute to a photonics production or research team.**
12. **Apply skills and responsibilities in accordance with relevant law, policies, regulations, standards, procedures, and ethical principles.**

CODE

X= Taught and/or Assessed
C= Culminating Performance
Note: For program proposals indicate with an X where the outcome is taught and/or assessed. Identify the culminating performances with a C. A minimum of two culminating performances should be identified for each program outcome.

MAPPING OF VOCATIONAL LEARNING OUTCOMES
PROGRAM NAME: *BIT-PLT Photonics and Laser Technology*

LEVEL TWO (YEAR 1 – Winter)												
Course Number	Course Name	Vocational Learning Outcomes										
		1	2	3	4	5	6	7	8	9	10	11	12
BIT1201	Mathematics II for Photonics	x	x	x			x	x		x	x		
BIT1204	Physics II for Photonics	x	x					x		x	x		
PLT1003	Optics/Optical Fibers I (Principles)	x	x	x		x	x	x		x	x	x	
PLT1004	Manufacturing Photonics Components		x	x	x	x	x		x		x	x	x
PLT1005	Introduction to optics	x	x	x	x	x		x	x	x	x	x	

Vocational Learning Outcomes – The graduate has reliably demonstrated the ability to:

1. **Implement the principles of mathematics and science to design, analyze and solve technical problems related to photonics technology.**
2. **Design, prototype, analyze, troubleshoot, as well as commission, install and repair a variety of photonics equipment and systems.**
3. **Create, run and monitor quality control and assurance programs.**
4. **Apply communication, documentation, computer applications, information technology, and teamwork skills to support the technology activities of an organization.**
5. **Apply critical thinking skills and research of external references to discover solutions and options for systemic problems with photonic equipment and systems, and produce organizational methods to address these problems.**
6. **Monitor and evaluate effectiveness of safety, supply chain and project management systems in relation to photonics systems and processes.**
7. **Create innovative strategies and/or products that meet identified needs.**
8. **Form, determine goals for, manage and work within a team to design and meet target goals.**
9. **Evaluate one's own problem solving and decision making processes.**
10. **Adapt to new situations and demands by applying and/or updating knowledge and skills.**
11. **Lead and contribute to a photonics production or research team.**
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MAPPING OF VOCATIONAL LEARNING OUTCOMES
PROGRAM NAME: *BIT-PLT Photonics and Laser Technology*

LEVEL THREE (YEAR 2 – Fall)												
Course Number	Course Name	Vocational Learning Outcomes										
		1	2	3	4	5	6	7	8	9	10	11	12
BIT2004	Differential equations	x	x	x	x		x	x		x	x		x
BIT2300	Intro to Statistics for Photonics	x	x	x	x		x	x		x	x		x
PLT2000	Optics/Optical Fibers II (Devices)		x	x	x	x		x	x	x	x		x
PLT2001	Fundamentals of Light Sources	x	x	x	x	x	x	x	x	x	x	x	
PLT2005	Circuits and Signals	x	x		x			x		x		x	

Vocational Learning Outcomes – The graduate has reliably demonstrated the ability to:

1. **Implement the principles of mathematics and science to design, analyze and solve technical problems related to photonics technology.**
2. **Design, prototype, analyze, troubleshoot, as well as commission, install and repair a variety of photonics equipment and systems.**
3. **Create, run and monitor quality control and assurance programs.**
4. **Apply communication, documentation, computer applications, information technology, and teamwork skills to support the technology activities of an organization.**
5. **Apply critical thinking skills and research of external references to discover solutions and options for systemic problems with photonic equipment and systems, and produce organizational methods to address these problems.**
6. **Monitor and evaluate effectiveness of safety, supply chain and project management systems in relation to photonics systems and processes.**
7. **Create innovative strategies and/or products that meet identified needs.**
8. **Form, determine goals for, manage and work within a team to design and meet target goals.**
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MAPPING OF VOCATIONAL LEARNING OUTCOMES
PROGRAM NAME: *BIT-PLT Photonics and Laser Technology*

LEVEL FOUR (YEAR 2 – Winter)												
Course Number	Course Name	Vocational Learning Outcomes										
		1	2	3	4	5	6	7	8	9	10	11	12
BIT2003	Multi Variate Calculus	x	x	x				x		x			
PLT2002	Fiber Optic Communications I	x	x	x	x	x	x	x	x	x	x	x	x
PLT2003	Laser System	x	x	x	x	x	x	x	x	x	x		x
PLT2004	Intermediate Programming	x	x		x			x			x		
PLT2006	Semiconductors	x	x	x	x			x		x	x		
COOP1000	Work Term Preparation	x	x	x	x	x	x	x	x	x	x	x	x

LEVEL FOUR (YEAR 2 – Summer)													
COOP 10001	Work Term I	x	x	x	x	x	x	x	x	x	x	x	x

Vocational Learning Outcomes – The graduate has reliably demonstrated the ability to:

1. **Implement the principles of mathematics and science to design, analyze and solve technical problems related to photonics technology.**
2. **Design, prototype, analyze, troubleshoot, as well as commission, install and repair a variety of photonics equipment and systems.**
3. **Create, run and monitor quality control and assurance programs.**
4. **Apply communication, documentation, computer applications, information technology, and teamwork skills to support the technology activities of an organization.**
5. **Apply critical thinking skills and research of external references to discover solutions and options for systemic problems with photonic equipment and systems, and produce organizational methods to address these problems.**
6. **Monitor and evaluate effectiveness of safety, supply chain and project management systems in relation to photonics systems and processes.**
7. **Create innovative strategies and/or products that meet identified needs.**
8. **Form, determine goals for, manage and work within a team to design and meet target goals.**
9. **Evaluate one's own problem solving and decision making processes.**
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MAPPING OF VOCATIONAL LEARNING OUTCOMES
PROGRAM NAME: *BIT-PLT Photonics and Laser Technology*

LEVEL FIVE (YEAR 3 – Fall)												
Course Number	Course Name	Vocational Learning Outcomes										
		1	2	3	4	5	6	7	8	9	10	11	12
PLT3000	Fiber Optic Communications II	x	x	x	x	x	x	x	x	x	x	x	x
PLT3001	Photonics Manu. Systems	x	x	x	x	x	x	x	x	x		x	x
PLT3002	Real-Time Systems (0.5)	x	x	x	x		x	x		x	x		
PLT3003	Electro Magnetics I	x	x	x	x		x	x		x			
PLT3008	Communication Skills for PLT				x		x	x	x			x	x

Vocational Learning Outcomes – The graduate has reliably demonstrated the ability to:

1. **Implement the principles of mathematics and science to design, analyze and solve technical problems related to photonics technology.**
2. **Design, prototype, analyze, troubleshoot, as well as commission, install and repair a variety of photonics equipment and systems.**
3. **Create, run and monitor quality control and assurance programs.**
4. **Apply communication, documentation, computer applications, information technology, and teamwork skills to support the technology activities of an organization.**
5. **Apply critical thinking skills and research of external references to discover solutions and options for systemic problems with photonic equipment and systems, and produce organizational methods to address these problems.**
6. **Monitor and evaluate effectiveness of safety, supply chain and project management systems in relation to photonics systems and processes.**
7. **Create innovative strategies and/or products that meet identified needs.**
8. **Form, determine goals for, manage and work within a team to design and meet target goals.**
9. **Evaluate one's own problem solving and decision making processes.**
10. **Adapt to new situations and demands by applying and/or updating knowledge and skills.**
11. **Lead and contribute to a photonics production or research team.**
12. **Apply skills and responsibilities in accordance with relevant law, policies, regulations, standards, procedures, and ethical principles.**

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MAPPING OF VOCATIONAL LEARNING OUTCOMES
PROGRAM NAME: *BIT-PLT Photonics and Laser Technology*

LEVEL SIX (YEAR 3 – Winter)												
Course Number	Course Name	Vocational Learning Outcomes										
		1	2	3	4	5	6	7	8	9	10	11	12
BIT2001	Introduction to Business				x			x		x	x	x	x
PLT3004	Design of Optical Components and Systems	x	x	x	x	x	x	x		x	x	x	
PLT3005	Introduction to Solid State Physics	x		x	x			x		x	x		
PLT3006	Physical Electronics	x	x	x	x	x	x	x		x	x		
PLT3007	Electro Magnetics II	x	x	x	x		x	x		x	x		

LEVEL SIX (YEAR 3 – Summer)													
COOP 100002	Work Term II	x	x	x	x	x	x	x	x	x	x	x	x

Vocational Learning Outcomes – The graduate has reliably demonstrated the ability to:

1. **Implement the principles of mathematics and science to design, analyze and solve technical problems related to photonics technology.**
2. **Design, prototype, analyze, troubleshoot, as well as commission, install and repair a variety of photonics equipment and systems.**
3. **Create, run and monitor quality control and assurance programs.**
4. **Apply communication, documentation, computer applications, information technology, and teamwork skills to support the technology activities of an organization.**
5. **Apply critical thinking skills and research of external references to discover solutions and options for systemic problems with photonic equipment and systems, and produce organizational methods to address these problems.**
6. **Monitor and evaluate effectiveness of safety, supply chain and project management systems in relation to photonics systems and processes.**
7. **Create innovative strategies and/or products that meet identified needs.**
8. **Form, determine goals for, manage and work within a team to design and meet target goals.**
9. **Evaluate one's own problem solving and decision making processes.**
10. **Adapt to new situations and demands by applying and/or updating knowledge and skills.**
11. **Lead and contribute to a photonics production or research team.**
12. **Apply skills and responsibilities in accordance with relevant law, policies, regulations, standards, procedures, and ethical principles.**

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MAPPING OF VOCATIONAL LEARNING OUTCOMES
PROGRAM NAME: *BIT-PLT Photonics and Laser Technology*

LEVEL SEVEN (YEAR 4 – Fall)												
Course Number	Course Name	Vocational Learning Outcomes										
		1	2	3	4	5	6	7	8	9	10	11	12
BIT2002	Marketing in the IT Sector		x			x		x			x		x
PLT4000	Applications of Quantum Physics	x		x			x		x	x	x		
PLT4001	Optoelectronic Devices	x	x	x	x	x	x	x		x	x	x	
PLT4002	Applied Advanced Optics	x	x	x	x	x	x	x		x	x	x	
PLT4900	Photonics Research Projects	C	C	C	C	C	C	C	C	C	C	C	C

Vocational Learning Outcomes – The graduate has reliably demonstrated the ability to:

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MAPPING OF VOCATIONAL LEARNING OUTCOMES
PROGRAM NAME: *BIT-PLT Photonics and Laser Technology*

LEVEL EIGHT (YEAR 4 – Winter)												
Course Number	**Course Name**	**Vocational Learning Outcomes**										
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
PLT4003	Material Science with Laser	x	x	x	x	x	x	x		x	x	x	
PLT4004	Biomedical Photonics	x	x	x	x	x	x	x		x	x	x	
PLT4005	Fiber Optic Theory	x	x	x	x	x	x	x		x	x	x	
PLT4900	Photonics Research Projects	C	C	C	C	C	C	C	C	C	C	C	C
PLT4006 Elective	Arts and Humanities Elective				x						x		x

Vocational Learning Outcomes – The graduate has reliably demonstrated the ability to:

1. Implement the principles of mathematics and science to design, analyze and solve technical problems related to photonics technology.
2. Design, prototype, analyze, troubleshoot, as well as commission, install and repair a variety of photonics equipment and systems.
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FORM 2
Essential Employability Skills Mapping

MAPPING OF ESSENTIAL EMPLOYABILITY SKILLS
PROGRAM NAME: *BIT-PLT Photonics and Laser Technology*

LEVEL ONE (YEAR 1 – Fall)											
Course Number	Course Name	Essential Employability Skills									
		1	2	3	4	5	6	7	8	9	10	11
BIT1200	Mathematics I for Photonics			x	x	x						
BIT1203	Physics I for Photonics	x	x	x		x	x	x		x	x	
PLT1000	Problem Solving	x		x	x		x	x		x	x	x
PLT1001	Laser Safety, WHMIS & Ethics	x	x		x		x	x		x		x
PLT1002	Trends in Photonics	x	x				x	x				

LEVEL TWO (YEAR 1 – Winter)											
Course Number	Course Name	Essential Employability Skills									
		1	2	3	4	5	6	7	8	9	10	11
BIT1201	Mathematics II for Photonics			x	x	x						
BIT1204	Physics II for Photonics	x	x	x		x	x	x		x	x	
PLT1003	Optics/Optical Fibers I (Principles)	x	x	x		x	x	x	x			x
PLT1004	Manufacturing Photonics Components	x	x		x		x	x		x	x	x
PLT1005	Introduction to optics	x	x	x		x	x	x		x	x	x

Essential Employability Skills – The graduate has reliably demonstrated the ability to:

1. **Communicate clearly, concisely, and correctly in the written, spoken and visual form that fulfills the purpose and meets the needs of the audience.**
2. **Respond to the written, spoken, or visual messages in a manner that ensures effective communication.**
3. **Execute mathematical operations correctly.**
4. **Apply a systematic approach to solve problems.**
5. **Use a variety of thinking skills to anticipate and solve problems.**
6. **Locate, select, organize, and document information from a variety of sources.**
7. **Analyze, evaluate, and apply relevant information from a variety of sources.**
8. **Show respect for the diverse opinions, values, belief systems, and contribution of others.**
9. **Interact with others in groups or teams in ways that contribute to effective working relationships and the achievement of goals.**
10. **Manage the use of time and other resources to complete projects.**
11. **Take responsibility for one's actions, decisions and consequences.**

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MAPPING OF ESSENTIAL EMPLOYABILITY SKILLS
PROGRAM NAME: *BIT-PLT Photonics and Laser Technology*

LEVEL THREE (YEAR 2 – Fall)											
Course Number	Course Name	Essential Employability Skills									
		1	2	3	4	5	6	7	8	9	10	11
BIT2004	Differential equations	x		x	x		x	x		x		x
BIT2300	Intro to Statistics for Photonics	x	x	x	x							
PLT2000	Optics/Optical Fibers II (Devices)	x	x	x		x	x	x		x	x	x
PLT2001	Fundamentals of Light Sources	x		x		x	x	x		x		
PLT2005	Circuits and Signals	x	x	x	x		x	x			x	

LEVEL FOUR (YEAR 2 – Winter)											
Course Number	Course Name	Essential Employability Skills									
		1	2	3	4	5	6	7	8	9	10	11
BIT2003	Multi Variate Calculus			x	x			x				
PLT2002	Fiber Optic Communications I	x	x	x		x	x	x		x	x	x
PLT2003	Laser System	x		x		x	x	x		x	x	x
PLT2004	Intermediate Programming	x	x	x	x		x	x			x	
PLT2006	Semiconductors	x	x	x		x	x	x			x	
COOP1000	Work Term Preparation	x	x						x			x

LEVEL FOUR (YEAR 2 – Summer)												
COOP 10001	Work Term I	xc	xc	xc	xc	xc	xc	xc	xc	xc	xc	xc

Essential Employability Skills – The graduate has reliably demonstrated the ability to:

1. **Communicate clearly, concisely, and correctly in the written, spoken and visual form that fulfills the purpose and meets the needs of the audience.**
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MAPPING OF ESSENTIAL EMPLOYABILITY SKILLS
PROGRAM NAME: *BIT-PLT Photonics and Laser Technology*

LEVEL FIVE (YEAR 3 – Fall)												
Course Number	Course Name	Essential Employability Skills										
		1	2	3	4	5	6	7	8	9	10	11
PLT3000	Fiber Optic Communications II	x	x	x		x	x	x		x	x	x
PLT3001	Photonics Manu. Systems	x	x	x		x	x	x		x	x	x
PLT3002	Real-Time Systems (0.5)			x		x	x	x	x			x
PLT3003	Electro Magnetics I	x	x	x	x		x	x	x			
PLT3008	Communication Skills for PLT	x	x		x				x	x		x

LEVEL SIX (YEAR 3 – Winter)												
Course Number	Course Name	Essential Employability Skills										
		1	2	3	4	5	6	7	8	9	10	11
BIT2001	Introduction to Business	x	x		x		x	x		x	x	x
PLT3004	Design of Optical Components and Systems	x	x	x		x	x	x		x	x	x
PLT3005	Introduction to Solid State Physics	x	x	x	x		x	x	x			
PLT3006	Physical Electronics	x	x	x		x	x	x	x		x	x
PLT3007	Electro Magnetics II	x	x	x		x	x	x	x			

LEVELSIX (YEAR 3 – Summer)												
COOP 10002	Work Term II	xc	xc	xc	xc	xc	xc	xc	xc	xc	xc	xc

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MAPPING OF ESSENTIAL EMPLOYABILITY SKILLS
PROGRAM NAME: *BIT-PLT Photonics and Laser Technology*

LEVEL SEVEN (YEAR 4 – Fall)												
Course Number	**Course Name**	**Essential Employability Skills**										
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
BIT2002	Marketing in the IT Sector	x	x			x	x	x	x	x	x	x
PLT4000	Applications of Quantum Physics	x	x	x		x	x	x				
PLT4001	Optoelectronic Devices	x	x	x	x		x	x	x		x	x
PLT4002	Applied Advanced Optics	x	x	x		x	x	x		x	x	
PLT4900	Photonics Research Projects	xc	xc	xc	xc	xc	xc	xc	xc	xc	xc	xc

LEVEL EIGHT (YEAR 4 – Winter)												
Course Number	**Course Name**	**Essential Employability Skills**										
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
PLT4003	Material Science with Laser	x	x	x		x	x	x		x	x	x
PLT4004	Biomedical Photonics	x	x	x	x		x	x		x	x	x
PLT4005	Fiber Optic Theory	x	x	x		x	x	x	x			
PLT4900	Photonics Research Projects	xc	xc	xc	xc	xc	xc	xc	xc	xc	xc	xc
PLT Elective	Arts and Humanities Elective	x	x		x		x	x	x			

Essential Employability Skills – The graduate has reliably demonstrated the ability to:

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FORM 3
General Education Course Mapping

GENERAL EDUCATION MAP
PROGRAM NAME: *BIT-PLT Photonics and Laser Technology*

Level	Core Courses	Elective Courses	Theme #
1	**PLT1003 Physics I**		5
2		**Arts and Humanities elective**	1, 2, 3, 4, 5
3			
4			
5			
6			
7			
8		**Arts and Humanities elective**	1, 2, 3, 4, 5

General Education Courses/Themes Required

General Education Requirement	Program Credential				
	Algonquin College Certificate	**Ontario College Certificate**	**Ontario College Diploma including NSDP**	**Ontario College Advanced Diploma**	**Ontario College Graduate Certificate**
Courses required	NA	1	3	3	NA
Courses that may be mandated	NA	1	2	1	NA
Minimum *Themes* learners must cover	NA	1	2	2	NA
Minimum *Themes* available to learners	NA	1	5	5	NA

General Education Themes

1. Arts in Society
2. Civic Life
3. Social and Cultural Understanding
4. Personal Understanding
5. Science and Technology

Arts and Humanities Elective Courses (Carleton University)

Students choose two courses from the following list,

- **CDNS** - Any appropriate course from Canadian Studies
- **ENST** - Any appropriate course from Environmental Studies
- **CHIN** - Any appropriate course from Chinese
- **ECON** - Any appropriate course from Economics

- **CRCJ** - Any appropriate course from Criminology and Criminal Justice
- **CLCV** - Any appropriate course from Classical Civilisation
- **CLST** - Any appropriate course from Comparative Literary Studies
- **CHST** - Any appropriate course from Child Studies
- **ENGL** - Any appropriate course from English
- **CGSC** - Any appropriate course from Cognitive Science
- **CCDP** - Any appropriate course from Comm. Courses for Disciplines & Professions
- **ENSC** - Any appropriate course from Environmental Science
- **FREN** - Any appropriate course from French
- **BUSI** - Any appropriate course from Business
- **ARTH** - Any appropriate course from Art History
- **ASLA** - Any appropriate course from American Sign Language
- **HUMS** - Any appropriate course from Humanities
- **ACUL** - Any appropriate course from Art and Culture
- **LALS** - Any appropriate course from Linguistics
- **JOUR** - Any appropriate course from Journalism & Communication
- **JAPA** - Any appropriate course from Japanese
- **ITAL** - Any appropriate course from Italian
- **INAF** - Any appropriate course from International Affairs
- **ISSC** - Any appropriate course from Interdisciplinary Studies
- **FILM** - Any appropriate course from Film Studies
- **HUMR** - Any appropriate course from Human Rights
- **ERTH** - Any appropriate course from Earth Sciences
- **HIST** - Any appropriate course from History
- **GREK** - Any appropriate course from Greek
- **GERM** - Any appropriate course from German
- **GEOM** - Any appropriate course from Geometrics
- **GEOG** - Any appropriate course from Geography
- **ALSS** - Any appropriate course from Applied Language Studies
- **FINS** - Any appropriate course from French Interdisciplinary Studies
- **ANTH** - Any appropriate course from Anthropology
- **EURR** - Any appropriate course from European & Russian Studies
- **LATN** - Any appropriate course from Latin
- **LAWS** - Any appropriate course from Law Studies
- **MCOM** - Any appropriate course from Mass Communication
- **MUSI** - Any appropriate course from Music
- **PADM** - Any appropriate course from Public Policy & Administration
- **PAPM** - Any appropriate course from Public Affairs & Policy Management
- **PHIL** - Any appropriate course from Philosophy
- **PSCI** - Any appropriate course from Political Science
- **PSYC** - Any appropriate course from Psychology
- **RELI** - Any appropriate course from Religion
- **RUSS** - Any appropriate course from Russian
- **SOCI** - Any appropriate course from Sociology
- **SOWK** - Any appropriate course from Social Work
- **SPAN** - Any appropriate course from Spanish
- **TSES** - Any appropriate course from Tech., Society, Environmental Studies
- **WOMN** - Any appropriate course from Women's Studies

Ic. Course Descriptions and Course Learning Requirements for Modified or New Courses

LEVEL 01 (YEAR 1 – Fall)

BIT1200 MATHEMATICS I FOR PHOTONICS

Tailored for students in the Photonics program, this course covers differentiation and integration of the elementary functions, definite and indefinite integrals, partial differentiation, sequences, series, and techniques and applications of integration.
Precludes additional credit for MATH 1004.
Prerequisite: restricted to students in the B.I.T. degree program.
Lectures three hours a week, tutorial/laboratory one hour a week.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Determine derivatives using the basic definition of the derivative (Delta Method)
2. Determine derivatives using derivative formulae for polynomials, products, quotients and chain rule
3. Determine derivatives of transcendental functions (trigonometric, logarithmic and exponential functions)
4. Use implicit differentiation
5. Solve rates of change problems
6. Sketch curves
7. Solve maximum and minimum problems in science and technology
8. Apply the applications of the derivative to student's specialty area
9. Introduce anti-derivatives

PLT1203 PHYSICS I FOR PHOTONICS

Mechanics, gravitation, oscillations, and thermodynamics. The application of calculus to solve problems in these areas of physics is introduced. This course is intended for students in the physical sciences and engineering. The laboratory is an essential and autonomous part of the course.
Precludes additional credit for PHYS 1001 and PHYS 1007.
Prerequisites: Grade 12 Physics or equivalent, plus Grade 12 Advanced Functions or Grade 12 Advanced Functions and Introductory Calculus or equivalent, plus one of MATH 1004 or MATH 1002 (the MATH course may be taken concurrently). Note that Grade 12 Calculus and Vectors or Grade 12 Geometry and Discrete Mathematics is strongly recommended.
Lectures three hours a week, laboratory or tutorial three hours a week.
Restricted to students in the B.I.T. degree program.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Define, use, calculate and analyze Nature of Physics (Science and scientific method; and Fundamental and derived quantities)
2. Define, use, calculate and analyze Linear Motion and Kinematics (One dimensional kinematics; Constant velocity motion; Constant acceleration-kinematic equations of falling bodies).
3. Define, use, calculate and analyze Two dimensional kinematics (Vector addition and components; Projectile motion; Circular motion)
4. Define, use, calculate and analyze Dynamics (Newton's laws of motion -force; Gravity - weight; Friction; Centripetal force)
5. Define, use, calculate and analyze Work and Energy (Physical definition of work; Vector dot product; Kinetic and potential energy; Conservation of energy, work-energy theorem)
6. Define, use, calculate and analyze Linear Momentum (Impulse; Conservation of linear momentum; One dimension; Two dimensions)
7. Define, use, calculate and analyze Rotational Motion (Vector cross product; Kinematics; Dynamics; Angular momentum; Rotational work and energy).

PLT1000 PROBLEM SOLVING

Introduction to systematic methods for problem solving in the context of object oriented programming. Defining and modeling problems, designing algorithms, testing, debugging and analysis of results. Numeric methods, data presentations, data abstraction, classes, class relationships, inheritance, error handling and program style and documentation.
Prerequisite: restricted to students in the B.I.T. degree program.
Precludes additional credit for NET 1000.
Lectures three hours a week, tutorial/laboratory one hour a week..

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Use Java to develop effective solutions of every day engineering problems.
2. Navigate, interoperate and customize Eclipse's workbench windows
3. Apply the standard code development cycle: code editing, compilation, testing and debugging.
4. Solve simple problems in Java by:
   - Defining simple variables of the primitive types
   - Applying arithmetic and logical operators to them
   - Formatting and outputting the results
5. Control the execution path of your program by using:
   - if / if else /if else if statements
   - switch statements
6. Iterate portions of your program by using:
   - while and do / while loops
   - for and for-each loops
7. Pass arguments to and receive return values from both library- and custom defined methods.
8. Create instances of classes from the standard Java class libraries.
9. Define custom problem-specific classes and instantiate objects of those custom types.
   - Interact with those objects by invoking their API methods.
   - Create and navigate class hierarchies

- Make use of polymorphic behavior of a set of different subclass objects by using references of a common super-class type.
- Extract common functionality in abstract interface types.
- Extending the API of a class by implementing multiple interfaces

10. Create Swing based GUIs including window panes, menus, toolbars, dialog boxes
11. Use libraries of graphics packages to present data in customizable plots.

PLT1001 LASER SAFETY, WHMIS AND ETHICS

Introduction to sociological and historical perspective on health and safety issues in industrial environments, ethics implementation to modern technology. Laser and electrical safety. Health and safety related to ergonomics. Workplace Hazardous Materials Information System (WHMIS), Material Safety Data Sheets (MSDS).
Prerequisite: restricted to students in the B.I.T. degree program.
Lectures one hour a week, tutorial/laboratory two hours a week

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Describe the legal requirements concerning workplace health and safety in Canada.
2. Identify the hazards related to different chemical substances.
3. Examine the differences between various hazard classification systems used at home, in the workplace and on the roads
4. Select and use fire extinguishers
5. Identify and explain work-related factors that present the greatest risk for injuries to the muscles and joints.
6. Develop an understanding of the basic elements of office ergonomics
7. Measure workplace noise
8. Identify and describe hazards related to the operation of machinery.
9. Examine control methods to prevent personal injury.

PLT1002 TRENDS IN PHOTONICS

Survey of the history and future of photonics. Photonics benefits and impact on technology and society. Emerging applications of photonics in industry and commercial products. The forces (business, social, political, economic, technical, and educational) that influence the development, adoption and success or failure of technologies.
Prerequisite: restricted to students in the B.I.T. degree program.
Lectures one hour a week, tutorial/laboratory two hours a week

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Discuss the impact of photonics technology on everyday life.
2. Describe photonics technologies in the workplace and home.
3. Summarize the history and application of various photonics technologies.
4. Describe the evolution of photonics technologies and recognize important milestones in the evolution of the industry.
5. Describe the wide variety of photonics technologies that are being utilized today.

6. Explain the application of photonics in: Telecommunications, Data storage, Medicine & biotechnology, Manufacturing, Imaging & surveillance, Energy distribution, Military applications, Education and R&D
7. Summarize the industry trends and potential future applications of photonics technology.

8. Discuss the potential for photonics enabling technologies and the forces which lead to the realization of these new systems.

LEVEL 02 (YEAR 1 – Winter)

BIT1201 MATHEMATICS II FOR PHOTONICS

Tailored for students in the Photonics program, this course covers systems of linear equations, vector space of n-tuples, subspaces and bases, matrix transformations, kernel, range, matrix algebra and determinants, inner products and orthogonality, eigenvalues, diagonalization and applications.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Define the definite integral and relate it to the area problem.
2. Determine the indefinite and definite integral of a function constant of integration.
3. Calculate areas and volumes using the definite integral
4. Calculate an integral using a variety of integration techniques.
5. Represent functions as Taylor and Maclaurin series
6. Calculate partial derivatives
7. Calculate multiple integrals and apply them to the calculation of volumes.

PLT1204 PHYSICS II FOR PHOTONICS

This calculus-based course introduces electricity, magnetism, oscillations, waves and optics. The laboratory is an essential and autonomous part of the course.
Precludes additional credit for PHYS **1004, PHYS** 1002 and PHYS 1008.
Prerequisites: BIT 1203, restricted to students in the B.I.T. degree program.
Lectures three hours a week, laboratory or tutorial three hours a week.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to (to be filled out by Carleton)**:**

1. Explain
2. Describe

PLT1003 OPTICS/OPTICAL FIBERS I (PRINCIPLES)

Principles of optics, optical fibers and waveguiding and hands-on experience with optical components. Optical fibers manufacturing and variety of industrial applications including telecommunications, and bio/medicine. Optical sources, detectors, fiber splicing, fiber testing in lab environment.
Prerequisites: restricted to students in the B.I.T. degree program.
Lectures two hours a week, laboratory two hours a week

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Employ the principles of light in relation to lenses, mirrors, prisms, and gratings.
2. Mount, focus, clean, test, and specify optical systems involving lenses, mirrors, and gratings
3. Employ the principles of light propagation in optical fibers.
4. Handle safely, splice, mount, clean, test, and specify components in a optical fiber system.
5. Work with optical fiber connection systems.
6. Give examples of types of light emitters and detectors for optical fiber systems and describe their operation.
7. Perform standard optical tests and measurements.

PLT1004 MANUFACTURING PHOTONICS COMPONENTS

Manufacturing techniques and methods used to produce photonics components and devices/systems. Micro assembly, adhesives, optical tests and measurement, lean manufacturing and quality control standards (Telcordia). Laboratory exposure to optical component production processes: grinding, polishing, coating, mounting, tolerance and accuracy.
Prerequisites: PLT1001, restricted to students in the B.I.T. degree program.
Lectures two hours, laboratory two hours a week
Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Explain the principles behind the use of the components being manufactured and the reasons why particular manufacturing methods are chosen for each component.
2. Polish safely, clean, coat, and mount various optical components in various optical devices.
3. Identify the strengths and weaknesses of various manufacturing techniques.
4. Use clean assembly procedures to construct devices free from dust and defects.
5. Test completed components for tolerances and determine appropriate solutions to manufacturing problems.
6. Employ the appropriate quality control standards for the devices being manufactured.
7. Clean safely, handle and connect optical fiber components and systems, as well as test their operation and characteristics.
8. Apply optical coatings, and use design tools to specify such coatings for optical systems.

PLT1005 INTRODUCTION TO OPTICS

Physics of waves, optics and light propagation through lectures and lab experiments. Geometrical optics, refraction and reflection, interference, diffraction and polarization, thin lens equation, laser beams, Michelson interferometer, birefringence, and Abbe theory of imaging. Electromagnetic spectrum, quantum nature of light, photons, and photoelectric effect.
Prerequisites: BIT 1203, restricted to students in the B.I.T. degree program.
Lectures two hours, laboratory three hours a week.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Explain the concept of simple harmonic motion, damped motion and resonance.
2. Explain superposition & interference, and reflection & refraction of waves
3. Describe the production of electromagnetic waves, the electromagnetic spectrum and modulation of waves as well as the speed of light and solve problems in those areas.
4. Describe the reflection of image formation in plane and spherical mirrors
5. Distinguish between converging and diverging lenses, describe images and their characteristics, and find image locations and characteristics using ray diagrams and the thin-lens equation.
6. Explain the Wave nature of light, and the phenomena of coherence, and interference and to decide how best to treat light in different situations.
7. Explain Huygen's principle and diffraction and describe the Huygen's principle and the law of reflection
8. Explain the phenomena of diffraction and polarization and calculate different order angles of light from a diffraction grating quantization of energy.
9. Perform simple calculations based on photon theory, and calculate spectral lines of simple atoms.

LEVEL 03 (YEAR 2 – Fall)

BIT 2004 DIFFERENTIAL EQUATIONS FOR PHOTONICS

First-order differential equations. Second-order linear equations with constant coefficients, undetermined coefficients, variation of parameters. Systems of equations. Sequences and series, convergence tests, estimation of sums. Power series, Taylor series, remainders. Fourier series.
Restricted to students in the Faculty of Engineering, or in B.Sc. programs of the Department of Physics (except Double Honours Mathematics and Physics).
Precludes additional credit for MATH 1005, MATH 1002, MATH 2007, and MATH 2404.
Prerequisites: BIT1201.
Lectures three hours a week, laboratory three hours a week.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to (to be filled out by Carleton)**:**

BIT2300 INTRO TO STATISTICS FOR PLT

Tailored for students in the Photonics program, this course covers data analysis, introduction to probability theory, some standard discrete and continuous distributions and their application to interval estimation and significance testing, computational
aspects of statistics.
Precludes additional credit for STAT 2507.
Prerequisite: restricted to students in the BIT degree program.
Lectures three hours a week, tutorial/laboratory one hour a week.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Apply basic statistical skills required in their technology program.
2. Solve problems accurately using statistical strategies and necessary tools.
3. Explain how statistics are used in hypothesis testing and how confidence in results is measured and communicated.

PLT2000 OPTICS/OPTICAL FIBERS II (DEVICES)

Optical and fiber optical devices used in metrology, sensing, telecommunications, oil/gas civil and biomedical engineering applications. Lectures and lab experiments on fiber modes and mode-coupling, transmitters, couplers, splitters, receivers, wavelength division multiplexers, optical amplifiers, physical layer of optical networks, dispersion, and nonlinear effects management.
Prerequisites: PLT1003, BIT1201
Lectures two hours a week, laboratory three hours a week

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Use, maintain, and analyze devices used in the transmission, manipulation, and detection of light.
2. Decide on the appropriate device the application desired and explain the strengths and weaknesses of each device for particular applications.
3. Safely handle, clean, and connect optical fiber devices.
4. Test and characterize optical fiber devices with the appropriate measurement tools.
5. Make optical measurements and tests of the devices being considered for various applications.

PLT2001 FUNDAMENTALS OF LIGHT SOURCES

Introduction to incoherent light sources and lasers. Lasers operation, energy levels, quantum mechanics basics. Pumping/excitation, population inversion, laser cavity design, gain and loss, and characteristics of laser emission. An extensive lab manual of relevant experiments, variety of lasers, spectrometers, and detection equipment will be used.
Prerequisites: BIT1201, restricted to students in the BIT degree program.
Lectures two hours a week, laboratory two hours a week.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Describe the different characteristics of various coherent and incoherent light sources and analyze their uses in various applications.
2. Explain the workings of different incoherent light sources including incandescent, fluorescent, arc and discharge lamps, LEDs, and solar.
3. Explain the workings of different coherent and laser light sources and their strengths and weaknesses.
4. Compare the characteristics of different light sources to decide their strengths and weaknesses for various applications.

PLT2005 CIRCUITS AND SIGNALS

Properties of signals. Basic circuit elements: voltage and current sources. Kirchhoff's laws, linearity, superposition. Thevenin and Norton's theorems. Circuit simplification. AC steady-state analysis: impedance, admittance, phasors, frequency response. Transient response of RL and RC circuits: form of response, initial and final conditions. RLC circuits: resonance.
Prerequisites: BIT 1200 and BIT 1203.
Lectures three hours a week, laboratory and problem analysis three hours a week.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Analyze how current flows through simple circuits, and be able to calculate expected circuit behaviour.
2. Use Ohm's law, Kirchhoff's laws, and Thevenin's theorem to solve electric problems.
3. Explain how diodes and rectifiers work and are used in electric circuits.
4. Design and build basic electronic circuits.
5. Use electronic measurement equipment such as multimeters and oscilloscopes to analyze electronic circuits.

LEVEL 04 (YEAR 2 – Winter)

BIT2005 MULTIVARIATE CALCULUS FOR PHOTONICS

Fourier series; expansions for even and odd functions; half-range expansions. Surfaces in R3. Differential calculus of functions of several variables. Extrema and Lagrange multipliers. Exact differentials. Line integrals. Double integrals; polar coordinates; applications. Triple integrals; cylindrical and spherical coordinates; applications.
Precludes additional credit for: MATH 2001, MATH 2002, MATH 2008, MATH 2009 and MATH 2000.
Prerequisites: BIT1200, BIT1201 Restricted to students in the BIT.
Lectures three hours a week, tutorial one hour a week.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Apply basic differential equation manipulation skills required in their degree program.
2. Use differential equations to specify the characteristics of systems being studied.
3. Apply knowledge of differential equations and their associated tools to solve problems as related to their program of study.
4. Apply their knowledge of calculus and linear algebra to manipulate systems of differential equations related to their program of study.
5. Apply advanced calculus skills required in their applied degree program courses.
6. Use vector calculus equations to specify the characteristics of systems being studied.
7. Apply knowledge of vector calculus and associated tools to solve problems as related to their program of study.

PLT2002 FIBER OPTICS COMMUNICATIONS I

Fiber-laser implementation and optical networks, topologies, OSI, SONET/SDH, synchronous payload envelope, virtual tributaries, optimized mapping techniques, and optical carriers (OC-n/STM-m). Extensive lab manual and hands-on experience using state-of-the-art Optophotonics Lab to work on OAM&P, facility/equipment, synchronization, bandwidth management, and performance monitoring and other functionalities.
Prerequisites: PLT2000
Lectures two hours a week, laboratory three hours a week

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Describe a variety of network configurations, network terminology, and calculate attenuation and performance of optical fiber networks.
2. Describe optical network hierarchies and network protocols in Synchronous Optical NETworks/Synchronous Digital Hierarchy (SONET/SDH) used in North America and the rest of the world.
3. Describe the operation administration maintenance and provisioning. (OAM&P) of various optical network configurations (SONET/SDH: Linear, UPSR, BLSR).
4. Describe the types of SONET/SDH optical carriers and define Metro and Long-Haul Communications Networks.
5. Operation of metro optical network element and use the lab systems to implement various network configurations.

6. Describe optical interface specifications for long-haul optical network element and use the lab systems to implement various networks.
7. Explain terminal and add drop multiplexing (ADM) and illustrate signal flow (Tx, Rx) in OC-3 in linear and ring networks.
8. Monitor the performance of optical network elements and equipments using the lab systems
9. Synchronize optical network elements using the lab systems.
10. Build bandwidth management in optical networks using the lab systems.

PLT2003 LASER SYSTEMS

Laser theory, devices and systems. Safety procedures, laser power supplies, and laser system applications. Solid state, gas, and other types of lasers. Basic material processing, micro machining, bio/medical, and military applications will be covered. Hands-on experience with advanced laser equipment in lab.
Prerequisites: PLT2001
Lectures two hours a week, laboratory two hours a week

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Identify and describe the different strengths and weaknesses of various laser systems for various applications, and be able to describe appropriate choices for them.
2. Clean, align, and operate different gas, diode, and solid state lasers.
3. Describe the use of electro-optic devices as modulators, deflectors, and Q-switches.
4. Employ acousto-optic devices as well as mechanical devices such as prisms and piezoelectric devices in various applications.

PLT2004 INTERMEDIATE PROGRAMMING

A study of object-oriented programming with emphasis on techniques used in multimedia applications. Topics include basic and user defined data structures, classes, memory management, basic image processing, and plugin development.
Prerequisite(s): PLT1000

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Use a microcomputer to control external devices.
2. Write computer programs to control speakers, DC and stepper motors, and other equipment.
3. Build and use analog to digital converters.
4. Write computer programs to display and/or respond to measured data from temperature, position, and/or opto-electronic sensors.
5. Troubleshoot both hardware and software problems in various situations.
6. Work with various standard tools for system interfacing.

PLT2006 SEMICONDUCTORS

Qualitative semiconductor physics, leading to the diode equation. Diode applications. Operational amplifiers and their application in feedback configurations including active filters. Introduction to bipolar transistors and MOSFETs, analysis of biasing circuits. Transistor applications including small signal amplifiers.
Prerequisite: PLT2005.
Lectures three hours a week, laboratory and problem analysis three hours a week

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Explain how semiconductor devices are constructed and operate.
2. Design, build, and analyze simple electronic circuits using semiconductor devices.
3. Use electronic measurement equipment such as multimeters and oscilloscopes to analyze electronic circuits.
4. Apply the tools of basic logic functions and Boolean algebra to solve circuit problems.

COOP1000 WORK TERM PREPARATION

This short course prepare students for the cooperative work term with employer.
Prerequisites: None.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Analyze a work situation to identify the contribution made by the various departmental personnel.
2. Use employability skills (such as time management, personal responsibility, team work, problem-solving, etc.) in an industry context.
3. Apply core concepts and skills related to Photonics in a real work context.
4. Adapt technical skills to requirements in the specific workplace.
5. Identify, document and validate learning that resulted from their work experience.
6. Transfer knowledge and skills to new situations with increased confidence.
7. Adapt learning and working style to the context of the situation.
8. Use critical thinking skills to support decision-making and solve problems in an increasingly wide range of industry applications and contexts.
9. Use an understanding of the current literature in the field as well as tools of reflective practice to contribute both to organizational learning in the workplace and to their own personal learning plans.

COOP1001 WORK TERM I

During the first work experience students familiarize themselves with the work setting and its specific culture and practices. As a contributing member of a work team they learn to apply core concepts and skills in Photonics and related disciplines, practice more generic employability skills, and see a concrete example of how various technical units and staff work together to enable the organization to fulfill its mission.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Communicate effectively in a work environment.
2. Create and implement a learning plan that reflects a realistic assessment of learning needs and builds related skills.
3. Work within a team environment to accomplish work related tasks and meet organizational goals.
4. Work responsively, respecting industry and organizational guidelines and standards.

LEVEL 05 (YEAR 3 – Fall)

PLT3000 FIBER OPTICS COMMUNICATIONS II

Operation, management and maintenance of metro/long haul optical network elements and systems. Hands-on skills using GUI, Transaction Language One (TL1), optical network management to perform line and path protection, alarm provisioning, security and data communications, optical network backup and restore, load upgrade and installation management.
Prerequisites: PLT2002
Lectures two hours a week, laboratory three hours a week

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Explain SONET/SDH-based network elements, configurations, OAM&P, and user interfaces.
2. Provision and manage protection switching of optical, digital and electrical equipment in metro and long haul optical communication networks.
3. Define the concept of critical redundancy against unforeseen equipment failures in synchronous networks.
4. Define and monitor alarms in optical networks for equipment, facility, path, line, protection and system alarms, external controls and environmental alarms.
5. Define security user levels for optical networks administration.
6. Manage and define data communications in optical networks using various communication methods for accessing and controlling local as well as remote network elements creating channels to pass data between network elements.
7. Describe Backup and Restore the operation of optical networks.
8. Describe upgrade the operation of optical networks.
9. Use Transaction Language One (TL1) for managing optical networks.

PLT3001 PHOTONICS MANUFACTURING SYSTEMS

Laser based manufacturing, measurement and control systems, further applications of laser machining, welding, emphasizing industrial real world systems. Extensive hands on laser lab experiments, measurement jigs, scanners, swept wave systems (SWS), motion stages, optics, wavelength measuring, pulse detection, oscilloscopes, digital spectrometers.
Prerequisites: PLT2003.
Lectures two hours a week, laboratory two hours a week*3*

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Safely use and be familiar with the capabilities of standard prototype development equipment.
2. Test, maintain, analyze, and use laser based manufacturing equipment.
3. Identify the strengths and weaknesses of various manufacturing techniques, and the material characteristics and properties that would influence the choice of manufacturing method to be employed.

4. Test, maintain, analyze, and use alignment and measurement control systems for photonic manufacturing equipment.

PLT3002 REAL-TIME SYSTEMS

Principles of event-driven systems, review of computer organization; parallel and serial interfaces; programmable timer; I/O methods; polling and interrupts. Real-time kernels. Critical design consideration: concurrency, dead lock, synchronization. Maintaining and improving system performance. Programming exercises in low and high level languages.
Prerequisite: PLT2004.
Lectures three hours a week, tutorial/Laboratory two hours a week

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Describe the use of open and closed loop control systems in a variety of applications.
2. Use PLC/CNC to direct the operation of automated systems.
3. Analyze open and closed loop control systems with a variety of methods.

PLT3003 ELECTRO MAGNETICS I

Electrostatics and magnetostatics. Solution of Poisson's and Laplace's equations. The Lorenz equation and force. Time varying fields. Magnetic circuits and transformers.
DC and AC motors.
Prerequisites: BIT2005.
Lectures three hours a week, laboratory and problem analysis three hours alternate weeks.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Calculate the effect and behaviour of charges in a variety of static and dynamic electromagnetic fields.
2. Use the tools of integral calculus and the theories of Maxwell to describe the behaviour of electromagnetic waves.
3. Explain how different media effect the propagation of EM waves and how this influences technological device design.

PLT3008 COMMUNICATION SKILLS FOR PLT

Development of competence in written and oral communication in relation to network design, development, and management. Focus on technical reports, proposals, and other related project documents; formal and informal oral presentations.
Prerequisite: restricted to students in the B.I.T. degree program.
Lecture and tutorial three hours a week.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Effectively communicate in both written and spoken English, particularly in workplace communications.
2. Research and write reports as required by the student's discipline.
3. Present reports, particularly of a technical nature, in a variety of situations.
4. Plan, write, revise and edit short documents and messages that are organized, complete and tailored to specific audiences.
5. Plan and deliver short, organized spoken messages and oral reports tailored to specific audiences and purposes.
6. Interpret and reframe information gained from spoken messages in ways that show accurate analysis and comprehension
7. Use effective reading strategies to collect and reframe information from a variety of written materials accurately.
8. Locate, select and organize relevant and accurate information drawn from a variety of sources appropriate to the task.
9. Integrate and document information using commonly accepted citation guidelines.
10. Select and use common, basic, information technology tools to support communication.

LEVEL 06 (YEAR 3 – Winter)

BIT2001 INTRODUCTION TO BUSINESS

The management of people, human resources, marketing, accounting and finances, business law and operations.
Prerequisite: restricted to students in the B.I.T. degree program.
Lectures: three hours a week.

Upon successful completion students will have demonstrated ability to:

Course Learning Requirements

1. Describe how a typical business is financed.
2. Describe how businesses are regulated in the areas of finance, labour, safety, etc.
3. Describe how the broader economic factors influence various sectors and businesses within those sectors.
4. Show how projects and products are affected by business considerations independent of technical strengths or weaknesses.
5. Show how marketing considerations influence business decisions.

PLT3004 DESIGN OF OPTICAL COMPONENTS AND SYSTEMS

Optical ray-tracing for analysing systems of sources, lenses, mirrors, prisms, fibers, diffractive elements, MEMS. Zemax® fundamentals, pupils, aspherics, non-sequential tracing, aberrations, image metrics, optimization/merit functions. Applications: imaging, illumination, lasers. Trade-offs, mechanical constraints, tolerances and cost. Physical optics modeling of beam propagation, near-field diffraction and waveguides.
Prerequisites: PLT2000
Lectures two hours a week, laboratory three hours a week

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Describe the main steps involved in modern optical systems design and he key terms: aperture stop, pupils, field of view, chief and marginal rays, point spread- and modulation transfer functions
2. Use Zemax' lens data editor to define singlets, mirrors and diffractive surfaces
3. Understand the way that conic and higher order aspheric surfaces are specified in Zemax
4. Use of spot diagrams, ray-fan and optical path difference plots to evaluate performance
5. Know how the five main Seidel aberrations depend on field angle or pupil zone
6. Be able to define a merit function and progressively optimize a lens system. Know how to achromatize a doublet and a Cassegrain reflecting telescope to specified parameters
7. Explain why manufacturing errors require tolerance and Sensitivity Analysis on a new design
8. Define the use of non-sequential ray-tracing to model illumination and scattering
9. Apply the capabilities of Zemax to model physical optics wave propagation

PLT3005 INTRODUCTION TO SOLID STATE PHYSICS

This course provides the students with the study of materials via the techniques of solid state physics. Topics include bonding and structure of crystals, energy band in insulators, semiconductors, and metals. Also included are electrical conductivity, optical properties, lattice vibration, elasticity, point defects and dislocations.
Prerequisites: third-year standing in the photonics and laser program.
Lectures: three hours a week.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Describe how the molecular structure of a material affects its properties.
2. Describe how energy bands in different materials affect electrical conductivity and other properties.
3. Explain how different semiconductor devices operate.
4. Describe the theoretical foundations for the optical properties of various materials.

PLT3006 PHYSICAL ELECTRONICS

Fundamentals of device physics and operation of the pn junction, bipolar transistor and MOSFET. Basic integrated circuit processing and application to diodes, BJTs and MOSFETs. Correlation between processing, structure, operation and modeling. Consideration of parasitic and small-geometry effects, reliability and process variation.
Precludes additional credit for PHYS 3608.
Prerequisite: PLT3003 or permission of the Department.
Lectures three hours a week, problem analysis three hours alternate weeks.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Examine and describe the structure, fabrication, physical operation and modeling of semiconductor diodes, bipolar transistors and MOSFETs.
2. Apply reliability and process variation methodologies to semiconductor devices
3. Model and analyze systems for semiconductor structure and operation.

PLT3007 ELECTRO MAGNETICS II

Maxwell's equations and EM wave solutions. Polarization. Poynting vector. EM waves in dielectrics and conductors; skin depth. Reflection and refraction. Standing waves. Fresnel relations, Brewster angle. Transmission lines. Line termination, basic impedance matching and transformation. Smith charts. Introduction to guided waves; slab waveguide.
Precludes additional credit for PHYS 3308.
Prerequisites: PLT3003.
Lectures three hours a week, problem analysis two hours a week.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Calculate the effect and behaviour of charges in a variety of static and dynamic electromagnetic fields.
2. Use the tools of integral calculus and the theories of Maxwell to describe the behaviour of electromagnetic waves.
3. Explain how different media effect the propagation of EM waves and how this influences technological device design.

COOP1002 WORK TERM II

During the second work experience students gain confidence in their ability to apply and adapt their learning to new situations. They are expected to apply concepts, principles and skills to make decisions and solve problems in more complex situations. They are also expected to use a variety of resources to develop new knowledge and skills required to fulfill its mission.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

5. Communicate effectively in a work environment:
   Use terminology and language appropriate to their work
   Use active listening skills
   Read, comprehend and develop written materials
6. Create and implement a learning plan that reflects a realistic assessment of learning needs and builds related skills:
   Gain self-esteem, confidence
   Match strengths to job requirements
   Be responsible for your actions
7. Work within a team environment to accomplish work related tasks and meet organizational goals:
   Contribute to organizational goals and objectives
   Plan and make decisions as a team and support the outcome
   Respect the opinions of other team members
   Identify opportunities for networking
8. Work responsively, respecting industry and organizational guidelines and standards:
   Work with honesty, integrity and ethics, initiative, energy and persistence to accomplish a job.

LEVEL 07(YEAR 4 – Fall)

BIT 2002 MARKETING IN THE IT SECTOR

Basic problems and practices in marketing. Marketing strategies, planning, packaging, branding and promotion at the level of the individual firm; distribution channels.
Prerequisite: restricted to students in the B.I.T. degree program.
Lectures three hours a week.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Explain basic marketing concepts, methods and terminology
2. Describe role of marketing in modern organizations.
3. Describe basic analytical and communication skills necessary to marketing decision-making.
4. Present a comprehensive overview of the entire marketing process.
5. Develop and present a marketing plan for a product or service in the photonics industry.

PLT4000 APPLICATIONS OF QUANTUM PHYSICS

Fabrication, operation and modeling of advanced devices for information technology. Topics: physics of materials, quantum mechanics of solids, optical transitions, physical analysis and models for state-of-the-art electronic/optical technologies and materials.
Technologies: MOS and III-V based transistors, solidstate optical devices, MEMS and nano-technology based devices.
Prerequisite: PLT 3006.
Lectures three hours a week, problem analysis two hours alternate weeks.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Describe how quantum theory was developed and how it describes particle behaviour and atomic structure.
2. Calculate various solutions to the Schrodinger equation and explain their physical interpretation.
3. Describe how molecular structure and chemical reactions arise from quantum theory.
4. Describe the structure of the nucleus and how that affects the properties of various nuclei.

PLT4001 OPTO-ELECTRONIC DEVICES

Review of semiconductors, semiconductor lasers, detectors, photovoltaics. Electro, magneto and acousto-optic modulation devices. Transmitters, receivers, photo diodes, fiber sensors, and amplifiers, Mach–Zehnder interferometers. Polarization-mode dispersion. Experiments on non-linear optical elements, Sagnac and ring resonator, optical modulation.
Prerequisites: PLT3005.
Lectures two hours /laboratory two hours a week

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Describe and use electro-optic devices such as modulators, deflectors, and Q-switches.
2. Use acousto-optic devices as well as mechanical devices such as prisms and piezoelectric devices.
3. Clean, test, and use different optical sensors and receivers for optical fiber applications.
4. Describe and use spatial light modulators such as liquid crystal and magneto optic light valve arrays, and acousto optic devices.

PLT4002 APPLIED ADVANCED OPTICS

Wave optics: scalar Kirchhoff's diffraction, Fraunhofer/Fresnel cases, Fourier optics crystal optics. Devices and applications: multilayer coatings, fiber gratings, diffractive optics, spatial-light modulators. Novel microscopies, super-resolution, sub/superluminal light and metamaterials. Labs on diffractionless beams, vectorial focusing, computer generated beams/holograms, nonlinear optics and modeling in Zemax®.
Prerequisites: PLT3004
Lectures two hours a week, laboratory three hours a week

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Describe the effect of diffraction on light propagation in the near- and far-field regions as a resolution limiting factor in microscopy and lithography.
2. Apply Fourier optics to predict and analyze diffraction.
3. Align optical multilayer filters/mirrors, fiber gratings, diffractive elements, LED arrays; control and program spatial-light modulators.
4. Design various optical multilayer filters and diffractive elements; generate dynamic holograms and vortex beams with spatial-light modulators.
5. Align optical crystals, generate and optimize second harmonic by nonlinear frequency doubling of Nd-YAG lasers.

PLT4900 PHOTONICS RESEARCH PROJECT

Research project develops students' ability to direct own learning and pursue advanced study in variety of subjects. Select topic, perform literature search, theoretical background, preliminary measurements, calculations, and design. Present findings in a preliminary thesis. Encourage writing technical papers. Research opportunities with industry and academia.
Prerequisites: 4th year Standing
Tutorial hours arranged

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Identify and examine research topic in Photonics areas (Communications, Surgical and Medical Technology, Biotechnology, Manufacturing, Laser Machining and Material Processing, Laser Diagnostics and Repair, Space Technology, Military Technology, Microelectronics and Optoelectronics, Optical Computers, Imaging, Illumination and Visual Arts, Metrology, Spectroscopy, Holography, etc.)
2. Define the research project objectives, develop project specifications, adopt a design solution and perform the necessary analysis.
3. Deal, engage and work with professionals from industry, research institutes, and academia.
4. Gain new research performance and enhance communications and networking skills.
5. Search and gather information from references, books, journals, literature, and on-line resources related to the research project.
6. Write and provide project progress reports and document the project using technical writing skills.
7. Perform theoretical background study and summarize it in a preliminary thesis report.
8. Apply a wide variety of mathematical techniques with the degree of accuracy required to solve problems and make decisions. Use a variety of computer hardware and software and other technological tools appropriate and necessary to the performance of tasks.
9. Carry out preliminary experimental measurement, analysis and calculation.
10. Use equipment and lab facilities in a safe manner
11. Give oral presentations on the research project measurements and findings.

LEVEL 08 (YEAR 4 – Winter)

PLT4003 MATERIALS SCIENCE WITH LASER

Properties and behavior of materials. Chemistry of materials, interactions between materials and laser energy, including organic and biological substances. Energetics, phases, equilibrium, kinetics in solids, crystals and polymers. Applications of high power laser systems, safety, materials in manufacturing and design. Nanomaterials and nanophotonics.
Prerequisites: PLT3001, PLT4001
Lectures two hours a week, laboratory two hours a week.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Describe the role that chemical energies and equilibrium play in the properties and behaviours of various materials.
2. Describe how the chemical and material properties of different materials influence their application in various fields.
3. Explain how the interactions of light and materials affects the behaviour of those materials.
4. Explain how various solids and crystals differ in terms of their underlying structure.
5. Use the properties of polymer systems in a variety of applications.
6. Explain the shaping of materials by the absorption of light.
7. Evaluate the safety issues associated with high-power systems and various materials uses.
8. Use high-power lasers in a variety of different applications.

PLT4004 BIOMEDICAL PHOTONICS

Biological and medical photonics. Effect of light on biological systems, medical imaging, medical treatments, biological research and bio/medical applications. Laser manipulation of cells, laser surgery, and photo-therapy. Biophotonic lab experiments with scanning confocal microscopes, endoscopes , DNA scanners.
Prerequisites: PLT3007
Lectures/ tutorial five hours a week

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Explain the interaction of light with biological systems all the way from the molecular level to the full biological system/sub system level
2. Work with a variety of biophotonic related equipment and be able to produce viable measurements
3. Describe a variety of bio photonic and medical methods and equipment
4. Describe the use of photonic techniques and tools in the biological and medical science fields.

5. Apply knowledge of basic photonics principles and techniques to provide solutions for bio/medical applications.

PLT4005 FIBER OPTIC THEORY

Fundamentals of optoelectronics with application to fiber optic communications. Optical fibre: modes, losses, dispersion, splices and coupling to sources. Optical sources: LEDs and laser diodes. Optical detectors: photoconductor, pin and avalanche photodiodes. Optical receiver design. Fiber optic communications systems: intensity modulation/direct detection; coherent homodyne or heterodyne detection.
Prerequisites: PLT 4002.
Lectures three hours a week, laboratory three hours alternate weeks

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Describe and use optoelectronics devices in fiber optic communications systems.
2. Calculate losses and dispersion in optical fiber system.
3. Specify devices for building optical communication systems using optical sources, optical fiber, amplifier, and photo-detectors.
4. Understand and implement the concept of intensity modulation, direct detection, coherent homodyne or heterodyne detection.

PLT 4900 PHOTONICS RESEARCH PROJECT

Research project develops students' ability to direct own learning and pursue advanced study in variety of subjects. Select topic, perform literature search, theoretical background, preliminary measurements, calculations, and design. Present findings in a preliminary thesis. Encourage writing technical papers. Research opportunities with industry and academia.
Prerequisites: 4th year Standing
Tutorial hours arranged.

Course Learning Requirements

Upon successful completion students will have demonstrated ability to:

1. Develop and enhance a research topic to reach the goal and objective of the research project.
2. Define the millstone and deliverables to carry out the research and complete thesis.
3. Conduct research, investigate and solve problems creatively as they arise.
4. Analyze, present and evaluate information and data collected.
5. Draw conclusions based on the information gathered in an investigation
6. Demonstrate findings using scientific and engineering principles.
7. Deal, engage and work with professionals from industry, research institutes, and academia.
8. Write and provide project progress reports on what has been achieved.
9. Write thesis, clearly, orderly and technical sound, and conclusive thesis presenting your research and conclusions.
10. Modify research data and thesis based on feedback and comments of reviewers.
11. Publish the thesis according to specifications and publication standards.
12. Present and defend thesis at a judging panel of advisors, and industry professionals.

Arts and Humanities Elective

Students must choose from among an approved list of Arts & Humanities Electives provided by Carleton University.

Elective Options:

- **CDNS** - Any appropriate course from Canadian Studies
- **ENST** - Any appropriate course from Environmental Studies
- **CHIN** - Any appropriate course from Chinese
- **ECON** - Any appropriate course from Economics
- **CRCJ** - Any appropriate course from Criminology and Criminal Justice
- **CLCV** - Any appropriate course from Classical Civilisation
- **CLST** - Any appropriate course from Comparative Literary Studies
- **CHST** - Any appropriate course from Child Studies
- **ENGL** - Any appropriate course from English
- **CGSC** - Any appropriate course from Cognitive Science
- **CCDP** - Any appropriate course from Comm. Courses for Disciplines & Professions
- **ENSC** - Any appropriate course from Environmental Science
- **FREN** - Any appropriate course from French
- **BUSI** - Any appropriate course from Business
- **ARTH** - Any appropriate course from Art History
- **ASLA** - Any appropriate course from American Sign Language
- **HUMS** - Any appropriate course from Humanities
- **ACUL** - Any appropriate course from Art and Culture
- **LALS** - Any appropriate course from Linguistics
- **JOUR** - Any appropriate course from Journalism & Communication
- **JAPA** - Any appropriate course from Japanese
- **ITAL** - Any appropriate course from Italian
- **INAF** - Any appropriate course from International Affairs
- **ISSC** - Any appropriate course from Interdisciplinary Studies
- **FILM** - Any appropriate course from Film Studies
- **HUMR** - Any appropriate course from Human Rights
- **ERTH** - Any appropriate course from Earth Sciences
- **HIST** - Any appropriate course from History
- **GREK** - Any appropriate course from Greek
- **GERM** - Any appropriate course from German
- **GEOM** - Any appropriate course from Geometrics
- **GEOG** - Any appropriate course from Geography
- **ALSS** - Any appropriate course from Applied Language Studies
- **FINS** - Any appropriate course from French Interdisciplinary Studies
- **ANTH** - Any appropriate course from Anthropology
- **EURR** - Any appropriate course from European & Russian Studies
- **LATN** - Any appropriate course from Latin
- **LAWS** - Any appropriate course from Law Studies
- **MCOM** - Any appropriate course from Mass Communication
- **MUSI** - Any appropriate course from Music
- **PADM** - Any appropriate course from Public Policy & Administration
- **PAPM** - Any appropriate course from Public Affairs & Policy Management
- **PHIL** - Any appropriate course from Philosophy

- **PSCI** - Any appropriate course from Political Science
- **PSYC** - Any appropriate course from Psychology
- **RELI** - Any appropriate course from Religion
- **RUSS** - Any appropriate course from Russian
- **SOCI** - Any appropriate course from Sociology
- **SOWK** - Any appropriate course from Social Work
- **SPAN** - Any appropriate course from Spanish
- **TSES** - Any appropriate course from Tech., Society, Environmental Studies
- **WOMN** - Any appropriate course from Women's Studies

APPENDIX II

Evidence of need for program.

MARKET DEMAND FOR GRADUATES

PREAMBLE/OVERVIEW

Historically the market demand in Photonics has gone up and down in various segments of the business and the telecom area has been a very big player. However, that is not the only business area served by graduates of our programs. Areas such as optical components, thin film coatings, bio-photonics & medical, machine vision, solar cells, electronics, laser machining, laser radar, laser and fiber optic sensing exist, some of which are, of course, cross linked to telecom but also clearly address other market segments. Employment opportunities are not limited to the Ottawa area and some of our students have been employed as far afield as Florida.
A result of the initial Strategic Programs and Services Planning (*SPSP*) analysis conducted by the college in 2009/2010, noted a low contribution from the college Photonics training sector & an initial assessment that the training should cease. We then polled **over a dozen** companies & agencies in the Spring of 2010 to gauge the level of support locally, and further afield, for Photonics training in Ottawa. The result was overwhelmingly positive, with considerable distress noted by a number of the companies that there would be no future graduates to help grow their business.
This information was then submitted to the Board of Governors, and also discussed in the final SPSP BOG meeting. The BOG recommendation, based on this show of support, was that the college transition, instead, to a new educational opportunity in the Photonics area rather than continue unsuccessfully in the present educational format. Hence the current discussion of a joint degree with Carleton University and a parallel granting of an Photonics Engineering Technology Ontario Advanced Diploma by Algonquin College, which had already been in the works for a year or so prior to the BOG 2010 recommendation.

HIGHLIGHTS of Market and market demand

The lack of a flagship local company such as Nortel is clearly a challenge for the local high tech economy, which now, as a result, has elements of a branch plant economy, but the dissolution of the Nortel assets has resulted in a number of smaller and hopefully more agile players in the marketplace.

Some notes on an initial sampling of local Photonics related companies and their growth /hiring prospects follow :--

Ciena--- (Optical telecom) Jan 18th 2011 Citizen—900 million investment in Ottawa in Optical telecom area of Photonics (old Nortel Optical switching area) —aim to hire **125 university graduates over the next five year period.** Our grads would be particularly ideal for many of the Ciena hires, if they were available, according to head of research of Ciena in a recent e mail.

Huawei . In April 2010, Huawei recognizing the highly educated base of employees in Ottawa in the Photonics area, opened its first Canadian R&D center in Ottawa, Ontario. The R&D Center currently has more than 70 employees, and is concentrated on several strategic product initiatives, with a number in the Photonics area, specifically in Wireline, Wireless, Optical, and IP networking sectors. Huawei also recently received a $6.5 million grant from the Ontario government to invest in the Huawei Ottawa R&D center, and will invest $67 million in R&D in Canada over the next five years. Huawei has also initiated a large R &D centre in Markham Ontario.

Sanmina, previously Brecon Ridge, linked to Ciena (*building multi GHz circuit packs to 100GHz*) reported high student demand in mid 2010, but is currently in the process of regrouping, in sync with Ciena, after being purchased .

Optelian which is in some similar market segments to Sanmina, has seen strong growth in recent

quarters & has hired some of our recent Algonquin Photonics grads.

Enablence is seeing a sharp increase in business over the last 12 months, with record quarters. The company is driven by fiber to the home, plus test/measurement needs. It is keen on Algonquin Photonics students, and would like more coop students. Enablence is going to three shifts in the near future.

Iridian based in Ottawa which is a premier maker of thin film optical components and has a large part of the world market share for the 3D glasses used in films such as Avatar (*amongst other product lines*) has grown to approx 130 people. It has hired over ten of our Photonics graduates and is keen on seeing the supply of locally qualified students in Photonics continue in the future.

B Con Engineering, a local company making advanced optical elements for the Automotive, Military and entertainment segments of the industry (*and already a hirer of some of our Photonics graduates)* noted that it had increased employment by 20% in 2010 and was expecting further growth in employment in coming years. In addition an increase in the number of shifts worked was noted. It was stated that the graduates of the new joint degree would be suitable candidates for hire, as well as the hiring of coop students during term time. B- Con has developed a strong relationship with the college Applied research group, with the signing of an agreement to use the college owned patented technology of Axicon optics.

In Ontario alone two companies **ELCAN** (*with 900 employees at the Midland Ont facility*) and **DALSA**, recently bought by Teledyne for its expertise in imaging, dominate the scene with 66% of the Revenues and 59% of the employees. In general, however, the remainder of the business scene in Canada is made up largely of SME's.

Related to these specific company notes, indicating a broad based increase in the Photonics business area, the Canadian Photonics Fabrication centre (**CPFC**) has noted that it is increasing its throughput, based on strong industry demand for its services, to three shifts a day.

More generally, an **OCE study** by Don Wilford (2008/2009) noted Canada had about 7% of the world wide revenue in photonics which is approximately 700 billion plus but expected to grow to 1.2 trillion within a decade. In Ontario alone there are 10,0000 high paying jobs and a revenue of approx $3 Billion (*Canada wide there are about 20,000 jobs and approx $4.5 Billion revenues, 85% of this is exports*) , this can be expected to grow to around $5 Billion by the year 2018. It is worth noting that this number could be multiplied by a factor, if you include users of the technology *(according to Dr Sylvain Charbonneau of CPFC in a late 2009 Globe and Mail special section on Photonics)*.

Also, according to the 2009 **Mike Scott** in depth study of the industry there are 370 Photonic related companies in Canada (*with 117 of those in Ontario*). One of the key points made by the Scott report was the lack of trained people knowledgeable in the Photonics area, which, inevitably, will put the brakes on expansion of the industry in Canada. In Ottawa alone the local Photonics network and OCRI estimate around 70 companies active in Photonics. A newer **NRC cluster** based study on the Photonics marketplace is being analyzed, at present, to add to this stock of information but it is believed to be in general support of the findings of these slightly earlier reports.

APPENDIX IV

Advisory Committee membership and minutes showing support for the program modifications.

ALGONQUIN COLLEGE **PHOTONICS ADVISORY COMMITTEE MEETING**
January 20th, 2011

18:00-20:00
Room T106

Minutes

Present: Shawn McCormick, Sylvain Charbonneau, John Fielding, Brian Creber, Matt Pearson, Marc Nantel, Vince Guthro, Maike Luiken, Ravi Bhardwaj, Misheck Mwaba, Wahab Almuhtadi, Robert Weeks, Abdul Al-Azzawi

Guest: Anthony Whitehead

Regrets: Ray Novokowsky, Robert Keys, Greg Kricorissian

Item		Action
1.	Welcome by Chair of Advisory Committee Shawn McCormick Introduction around table Welcome Matt Pearson (VP Technology, Enablence) as a new member of the Advisory Committee.	
2.	Update and discussion on the recommendations of the Strategic Programs and Services Planning (SPSP)/Board of Governors (Misheck Mwaba)	
3.	Discussion of various Photonics Market Studies and Discussion on Photonics industry and growth prospects (Robert Weeks) R Weeks handed out and discussed the draft of market demand and marketing related material. The intent was to give a brief overview of market demand based on various published reports (*e.g Mike Scott, Don Wolford, etc…*) and to discuss the perceived issues with the program. It was hoped that we would get some extra input on market demand from the Advisory group & some consensus on whether the name Photonics was really an issue. Comment and input: Sylvain Charbonneau, NRC : Mentioned the new developments at NRC Canadian Photonics Fabrication Centre – CPFC. He noted DALSA was bought by Teledyne as of Feb, their expertise in imaging was a driver of the purchase, and they would still be an active player in Canada. A NRC cluster initiative report had been produced chaired by Terry Matthews with Doyle Tech involvement. Data could be very useful to us and some	Sylvain Charbonneau: - To send pdf of selected data to Advisory Committee - To mention Photonics Program (Algonquin/Carleton Degree Program). At the Photonics North and Information Photonics conferences (over an 8 day period in May, 2011). Some exposure on CBC/CTV John Fielding: - Matt Pearson, Brian Creber, Shawn McCormick to make noise– see John Fielding for contact info. Marc Nantel: - Marc Nantel — attempt to provide

	sections will be circulated by Sylvain. Also noted that the Group 4 company, no longer exists. Also he recommended that the Mike Scott data set could be replaced with data from the Canadian Photonics report. Matt Pearson, Enablence: He is seeing a sharp increase in business over the last 12 months, with record quarters. Driven by fiber to the home plus test/measurement needs. Keen on Algonquin student at present but would like more time, more of a coop need. Current student is a final year research project student at 2 days per week. Enablence going to three shifts. SC interjected that CPFC has seen an increase in clients and was thinking of a third shift as a result. John Fielding, OCE: Said were a huge number of companies could add to the list. Avaya, Huawei etc. Noted that OCE no longer had dedicated Photonics personnel but those personnel are still there and available to help. JF is the executive coordinator of the Photonics Industry network and noted that there was a need to re engage. Noted some possible ministerial interest if was re generated. However the impetus needs to come from industry, not OCE, so the manufacturers around the table were encouraged to make some noise.. Shawn McCormick, Nakina: Comments on Venture Capital discussion point. 14% of VC money into telecom in 2000 and only 4% in 2008. Slump from 1.3 Billion to 100 million. Money going elsewhere. Green tech etc. However can possibly reposition as are chunks of money there (4 million water, 15 million Smart grid and loads of actual Photonics apps there anyway) SC further noted that double digit growth in Photonics is real (in US) and he was getting CPFC personnel poached by US companies. Maike Luiken, Lambton College: Electronics started like this—Photonics is just hitting it—positioning is difficult in terms of name of the program. University name program on subject area rather than what gets employed, no one ready for the market. To reiterate is a mainstream enabling technology. Marc Nantel, OCE: Concurs with the name being a problem. He sits on a SITE planning committee, some push to revamp of "harnessing light" — asking for an update on this. Discuss resetting in USA of what Photonics does for Society (*however noted this is a bit long term)*. Noted words Optics and Laser in title in new program sounds preferable to Photonics. A brief discussion of nanotechnology and some note of caution was sounded about getting in to this area. Market strategy an issue here. Sylvain Charbonneau noted "Be careful what you wish for". Is more an advanced research area and maybe not a job market for some time.	Algonquin Photonics with kits from CIPI also kits from OSA.

	Marc Nantel —Noted studies of light—and related try to get it in to high schools, in to the curriculum. (*various agreed is a long term item and lot of work needed*). Discussion of dual credit courses part High school part college — Mishek Mwaba mentioned college was doing this in toolmaking. (Opportunities *here?)* Marc Nantel —noted free kits from CIPI also kits from OSA can be used for helping teach students at high school. Bob Weeks has one of the CIPI kits en route; also developed a Photonics related teaching kit of equipment over the last two years of high school visits. <u>Brian Creber, B Con Engineering:</u> His market mainly export, has also seen an increase in business especially in military area (going to a second shift also) had added 20% more staff recently and expected more. Also other programs increasing spherical display technologies now a few hundred might increase to 250K units (Chinese elementary school market). Also Automotive interested — non planar optic elements. Sylvain Charbonneau noted Iridian — have a good portion of world market in 3D goggles. Do not need PhD's –Have grown to 130 people at present. (We *noted that they have hired about 10 of our Photonics grads*). Sylvain Charbonneau also noted that One Chip Photonics had doubled in size. <u>Ravi Bhardwaj, U of Ottawa:</u> Mentioned Robert Boyd and the $50 million investment at U of Ottawa in Photonics plus other significant monies ($15 million) in addition. Working on extreme photonics nano to xrays etc Lithography applications etc. During this discussion comments were made by several in the group about the wisdom of changing curriculum to address perceived needs (e.g nano) were "suicidal". The training basics for Photonics remain the same but branding (name) is still an issue. <u>Vince Guthro, Sanmina:</u> Is involved in Assembly and Test. Happy to hear about the growth. Was seeing a green energy shift in business areas and seeing a lot of Photonic build gong "offshore". Agrees the branding is an issue however. <u>Anthony Whitehead, Carleton U, BIT program:</u> (invited to join discussion of group). Discussed involvement in joint degree. MM noted degree not an engineering degree , not a P Eng qualification, Further discussion on this comment around the group and the main industry partners did not think it was a big concern, however needs to be made clear to potential students at the outset. Some further discussion on this aspect may be needed. BC noted he hire P Eng personnel but would still hire students with this qualification in any case.	
4..	<u>Overview of the progress, and content, of the joint BIT-PHO (Photonics) degree program with Carleton University (Advanced Diploma by Algonquin College and Bachelor degree by Carleton). Curriculum Development Review and</u>	<u>Shawn McCormick, Wahab Almuhtadi:</u> - Letter to be drafted in support of joint degree signed by Shawn

	College Timelines (Wahab Almuhtadi) a) Input from the Advisory Committee on the program content. b) Discussion of required support letters etc from the Advisory Committee and other interested parties. e.g.: i. Overall group support with letter from Chair of Advisory Committee for the program modification to support BIT-PHO (Photonics) joint venture program ii. Individual letter of support from advisory members for the concept of the joint degree (as mentioned in (a) and the desirability of the trained students to the company. *iii.* Letter of support describing willingness to take on coop students from the program (*no actual commitment needed but some approx number can hire would be good)*. Can be part of the letter of support. *iv.* Other companies that group members can contact, or suggest we contact, that would be willing to support the new initiative Further discussion by Wahab Almuhtadi centered on the overall plan for the joint degree, course map and descriptions (*previously given to all participants*) . Discussion was also on the Advanced diploma portion that will be awarded by Algonquin and with documentation required to achieve this. **Motion:** **"Moved by Shawn McCormick and seconded by John Fielding that the Advisory Committee support the new BIT-PHO Photonics joint degree program (Carleton University-Algonquin College) to start Fall 2012"** **Vote:** Vote was unanimous in favour of the motion A Draft support letter was requested and was tasked to Anthony Whitehead and Bob Weeks. The letter will be noting support for the joint degree, desirability of such students as future employees and general willingness to employ the coop students	McCormick. Based on requirements of Advanced diploma discussed by Wahab Almuhtadi Whitehead and Bob Weeks: - Whitehead and Bob Weeks to draft support letter and send to Advisory Committee for further action /distribution. Wahab Almuhtadi: - To complete the documentation requirements for the CRC-Algonquin and send a copy to the Advisory Committee.
5.	Comments from Carleton representative, School Director of the BIT program (Anthony Whitehead) Anthony Whitehead noted that he has to work through steps required by Carleton in line with what was done for BAT degree. Noted that there might be an opportunity to change the name. Discussion of Senate process at Carleton. Although name on the books can we advertise under a different name (*comments by Maike Luiken*).	Wahab Almuhtadi and Anthony Whitehead : - To look in to the name of the BIT-PHO Photonics to sound more acceptable to the marketplace to increase the number of students enrolled.

6.	Other Photonics related training option s that could, or should be developed (or redeveloped) for BIT-PHO Program Further discussion by John Fielding on the desirability of getting marketing elements (and positioning) Brian Creber noted University of Arizona has similar program of study Discussion item 6 on Agenda possible Graduate Certificate in Photonics noted by Maike Luiken (Note Already in rough draft by BW). Discussion of Brock-Niagara certificate in Advanced lasers --- Misheck enquired how healthy was it as a study area if Brock was not involved. Marc Nantel also noted we need to be in better & more regular contact with Niagara. Need to keep an eye on transferability. Some note made of not forgetting the bridging of technology stream students to joint degree (Note-*had already been achieved in Algonquin from technology stream to BAT degree)*	Bob Weeks: - to review photonics program at University of Arizona. Algonquin Photonics team - to re engage with Niagara counterparts.
7.	Election of new chair: Item 7 –. Some discussion. It was agreed that an industry member of the Advisory group would be preferable. Shawn McCormick to be still in place until new chair was chosen (*there were expression of gratitude from several of the group for Shawn McCormick continuing in place as acting chair until that occurs*) . Further discussion to be off line.	
8.	Any Other Business: John Fielding & Sylvain Charbonneau noted there needed to be much work on marketing aspects. Need engagement plan especially further in the schools. Team to form based on this Shawn McCormick and BW volunteered to contribute. Newsletter?	John Fielding - to form Marketing team from the Advisory Committee and have separate meetings.
9.	Next Meeting: TBA	

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