



**Application for Changes to  
Ministerial Consent**

**BACHELOR OF APPLIED TECHNOLOGY (PHOTONICS)**

**Submitted by Algonquin College**

**October 25, 2007**

# 1. Organization and Program Information

## 1.1 Submission Title Page

Full Legal Name of Organization: <b>Algonquin College of Applied Arts and Technology</b>
Operating Name of Organization: <b>Algonquin College</b>
Common Acronym of Organization (if applicable): N/A
URL for Organization Homepage (if applicable): <a href="http://www.algonquincollege.com">www.algonquincollege.com</a>
Degree program for which consent renewal is being sought: <b>Bachelor of Applied Technology (Photonics)</b>
Location (specific address) where program is delivered: <b>Woodroffe Campus 1385 Woodroffe Avenue Ottawa, Ontario K2G 1V8</b>
Date on which the program commenced: <b>07 September 2004</b> Date when the initial class of students will complete the program: <b>26 April 2008</b>
Contact Information: Person Responsible for this Submission: <b>*Marguerite Donohue</b> Name/Title: <b>Executive Dean, Academic Development</b> Full Mailing Address: <b>1385 Woodroffe Avenue , Ottawa, Ontario K2G 1V8</b> <b>Telephone: 613 727 4723 ext. 2486</b> <b>Fax: 613 727 7633</b> <b>Email: <a href="mailto:donohum@algonquincollege.com">donohum@algonquincollege.com</a></b>
Site Visit Coordinator (if site visit is required and if different from above):** Name/Title: Full Mailing Address: Telephone: Fax: Email:
* The person who is the primary contact for the submission on matters pertaining to proposal content and communications from the Postsecondary Education Quality Assessment Board. ** This person will be the college's liaison for coordinating the site visit, if required.

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## **Appendix 2.1: Executive Summary**

### **Application for Changes to Ministerial Consent**

The Bachelor of Applied Technology (Photonics) program fills a clear 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 advanced degrees in engineering, science, or business fields. This unique program was originally offered by Niagara and Algonquin Colleges, the colleges that have pioneered undergraduate photonics programs at the diploma and advanced diploma levels in Ontario, with strong support from industry and government. Algonquin College has applied for renewal of its Ministerial Consent to deliver the BAT (Photonics) program while Niagara has elected to teach out its current degree students.

After successful completion of three years of delivery of the Bachelor of Applied Technology (BAT) – Photonics program, Algonquin identified that some changes are necessary to ensure student success in the program. The proposed changes do not affect the Program Level Learning Outcomes outlined in the original proposal nor will these changes compromise the standards specified by PEQAB for honours bachelor's degrees and more specifically for bachelor's degrees in applied areas of study.

These proposed changes are fully supported by the Photonics Program Advisory Committee.

#### **The Nature of the Requested Changes**

We are requesting changes to the following sections of the Ministerial Consent for the Bachelor of Applied Technology (Photonics) program:

- 5.2 Advanced Standing
  - 5.2.1 Credit Transfer/Recognition Policies & Procedures
  - 5.2.2 Advanced Placement Policies
  - 5.2.3 Bridging Program From Photonics Engineering Technology to BAT (Photonics)
  - 5.2.4 Gap Analysis
  - 5.2.5 Bridging Courses

The addition of a Bridging Program will provide an opportunity for the eligible students in the Photonics Technology programs at both Algonquin and Niagara to pursue degree level education in their field. Advanced Standing policies provide this same opportunity for eligible students with other related education.

#### **5.3 Promotion and Graduation Requirements**

Changes to promotion and graduation requirements are being recommended to bring this program's requirements in line with other programs of this nature offered in higher education in Ontario.

- 6.5 Work Experience Required for Degree Completion
  - 6.5.1 Program Structure Requirement
  - 6.5.2 Support for Work Experience
  - 6.5.3 Work Experience Outcomes and Evaluation

Changes to the number of work terms in the program from three to two were made based on the advice and capacity of the photonics industry and with the full support of the Photonics Program Advisory Committee. On one occasion it was necessary to provide an unpaid work experience for a student. We are seeking approval to continue to do this in circumstances when a paid work experience cannot be secured.

The supporting documentation for each of these change requests is included in the appropriate appendices in this submission

### **Conclusion**

These changes are not requested lightly. Our Program Advisory Committee has reviewed and fully supports these requests, which will ultimately provide the following benefits:

- ◆ Improved student success in the program
- ◆ Ability to capitalize on current trends in industry
- ◆ Improved student retention
- ◆ Improved job placement for graduates
- ◆ Meeting the needs of employers for students/graduates according to their business timelines
- ◆ Providing degree completion opportunities for Photonics Engineering Technology Advanced Diploma graduates

## **Appendix 3.1: Program Abstract**

### **Abstract of Proposed Program**

The Bachelor of Applied Technology in Photonics 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 advanced degrees in engineering, the sciences, or business fields. Graduates of the program have demonstrated the ability to:

- Design, prototype, analyze, troubleshoot, as well as commission, install and repair a variety of photonics equipment and systems.
- Create, run and monitor quality control and assurance programs.
- Apply communication, documentation, computer applications, information technology, and teamwork skills to support the technology activities of an organization.
- 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.
- Monitor and evaluate effectiveness of safety, supply chain and project management systems in relation to photonics systems and processes.
- Create innovative strategies and/or products that meet identified needs.
- Form, determine goals for, manage and work within a team to design and meet target goals.
- Evaluate the student's own thinking throughout the steps and processes used in problem solving and decision making.
- Adapt to new situations and demands by applying and/or updating the student's knowledge and skills.
- Demonstrate proven capacity for on-the-job effectiveness as a value-added member of a production or research team.

## **Appendix 4.1: Program Degree Level Summary**

### **Background**

The process leading up to the proposed joint applied degree programs in Photonics began in late summer of 1999, when the lead scientist from Photonics Research Ontario approached Niagara College and Algonquin College to enter into an alliance for the development of education and training programs in photonics to meet the needs of provincial and regional industries. The three partners proposed a \$7.6 million Photonics Education and Training project to the Ministry of Economic Development and Trade; photonics industry leaders brought over half of the funding to the project. The project was approved for a four-year period, and the initial programs developed and offered jointly at the two Colleges were a two-year Photonics Engineering Technician and a three-year Photonics Engineering Technology Program. The partners and the project's industry-led Steering Committee clearly identified a need for degree level photonics programming with an applied focus to compliment the diploma programming. The joint degree program, Bachelor of Applied Technology (Photonics) received Ministerial Consent in August 2003. Algonquin recently submitted its application to renew its consent while Niagara has decided to teach out its current students.

### **Curriculum Framework and Graduate Abilities**

The Bachelor of Applied Technology (Photonics) clearly fits into a niche area of specialized programming serving the broad-based photonics industry. The program curriculum fully meets the Degree Level Standard as outlined in the Handbook for CAAT Applied Degrees. Holders of the qualification will have demonstrated their ability as:

- Highly competent technological workers with a sound understanding of the principles of the photonics field and underlying foundational concepts in math, physics, and chemistry, and their application to tasks involving the wide variety of photonics industry production and research needs.
- Effective communicators and team managers able to fulfill leadership roles on an interdisciplinary technical team.
- Critical and creative thinkers able to analyze, problem-solve and develop innovation solutions across the spectrum of photonics applications.
- Informed citizens able to contribute to the world in which they live and work.
- Continuous learners able to update their knowledge and skills and to apply their learning with confidence in changing situations.

Students learn and practise the concepts, principles and skills related to the diverse and complex photonics industry. In many courses, active learning approaches such as case study and project-based learning will help learners develop analytical and problem-solving skills, as well as the ability to critically examine information available to create solutions to technology problems,

understand the limitations of the available data and source new information as needed. Skills laboratories, projects, industry-led applied research, and co-op work experience will help learners apply their learning to practical situations and employment situations. The culminating project work in the final year of study is an important example of the integration of theory into practice.

### **Highly Competent Technology Workers**

The degree program contains courses specifically related to the fundamentals of photonics and their use in a broad array of photonics applications in industry. Year one subjects introduce students to the fundamentals of the photonics discipline, and foundational theory in math, chemistry, and physics. Students are presented with a range of problem-solving approaches and techniques and apply their knowledge in hands-on practical labs with leading-edge optics equipment and appropriate computer software and networking applications.

As students progress, more in-depth theory and a wider variety of practical applications expand their knowledge of the industry, and build more advanced levels of math and physics knowledge. By the end of the second year, learners will have acquired a strong foundation and core competencies in photonics technology and applications, as well as analytical skills and problem solving methodologies. Students will learn to question the limitations of information for problem-solving and seek out new information as required to develop, analyze, and present solutions.

In senior years students apply photonics theory and principles in a wider variety of applications in manufacturing and packaging, imaging and communications, medical and biophotonics.

After the fourth academic semester, two paid co-op semesters are interspersed with academic semesters. Through their work experience, students consolidate and apply knowledge and skills in actual work settings with increasing levels of competency and independence. The program culminates with two academic semesters. Students are guided through increasingly complex industry-based problems, and conclude with a major degree level project that involves industry collaboration.

### **Communicators and Team Managers**

Several courses in the program (Occupational Health and Safety and Ethics, Technical Communications, Business Principles, and Operations Management) are specifically designed to help students hone their communications and business management skills to work effectively in peer teams, and manage an industry-based project with specific specifications and timelines. Graduates, while not business operations managers as such, will be able to competently manage work teams in a technology environment, and be able to scope out and solve technical problems through effective team management.

Collaborative learning strategies are used throughout the program, including lab assignments, and discussion and/or group work, culminating in two major project courses using industry-based problems, linking students at each college campus through distance technologies.

## **Critical and Creative Thinkers**

Thinking skills are an integral part of all courses. Students learn to identify their own thinking and information processing patterns and how they relate to those of others. They identify information needs for problems and learn how to evaluate information, determine its validity and sufficiency, and source new information. Students also learn a variety of technological tools to collect, organize, and present information.

Some courses teach students how to use specific strategies to interpret information. For example, the Statistics course in year two introduces quantitative analysis methods, and teaches skills that can be applied, adapted and extended in subsequent courses.

Lab exercises, group work, problem-solving project work, and industry work experience all provide learners with the opportunity to demonstrate their thinking skills. The final project courses challenge them to integrate their learning from academic and real world experience and apply both analytical and creative thinking skills.

## **Informed Citizens**

Courses such as Law and the electives help learners to understand and critically examine the world in which they live and work. Work placements extend this learning by helping them understand the relationship between the world of industry, and the national and global contexts in which industry functions. Collaborative work and on-line discussions during work placements help learners to understand the structure of the workplace and the legislative context and professional standards guiding operations in the industry. Students will be encouraged in the context of advanced technology.

## **Continuous Learners**

Photonics is a rapidly advancing field and graduates of this bachelor's degree in applied studies will be challenged to keep abreast of changes in the field and how they impact on community or global environments. A major goal of the photonics bachelor's degree in applied studies curriculum is not only highly qualified technical personnel with current knowledge and skill in the photonics discipline, but also learners who are cognizant of their own knowledge and the opportunities before them, and are anxious to develop themselves professionally. One key strategy is the two semesters of co-op placements, in which students will be able to develop industry mentors and a network of contacts.

The experiential learning provided by these co-op semesters also requires students as part of their competitive application process to assess, summarize, and be able to articulate their skills and knowledge, as well as future professional development strategies and goals.

Helping students to become active, enthusiastic continuous learners and reflective, responsible photonics practitioners is a core theme that crosses the entire curriculum. Throughout the program, active learning approaches in labs, groups, team-based projects, and work placements assist students in identifying personal thinking and work styles and information needs, analyzing and enhancing decision-making information, and linking academic work to the broader world of collaborative work and responsible citizenship.

## **Appendix 5.2 Advanced Standing**

We are requesting a change to Appendix 5.2 Advanced Standing in our current Ministerial Consent for the Bachelor of Applied Technology (Photonics) program. We propose adding a bridging program to enable graduates of the Photonics Engineering Technology Ontario College Advanced Diploma program to transfer into the Bachelor of Applied Technology (Photonics) program delivered by Algonquin College. We also propose being able to evaluate individual applicants for advanced standing to the program based on previous related education at other institutions of higher education.

### **Individual Requests for Advanced Standing**

With respect to the requests received from individuals for advanced standing in Bachelor of Applied Technology (Photonics) program the College will follow the guidelines set out by the Postsecondary Education Quality Assessment Board. These guidelines have been incorporated into College policies. In support of this request Algonquin College's Directives E6 – Advanced Standing, E9 – Transfer of Academic Credit (Internal), and E10 – Transfer of Academic Credit (External) are attached as **Appendix 5.2.1**. These Directives will be used when assessing individual candidates requesting advanced standing. Note: These Directives were submitted to PEQAB for review in the Bachelor of Applied Arts (Interior Design) Ministerial Consent renewal submission in August 2007.

### **Bridging Program**

The Advanced Diploma in Photonics Engineering Technology and the Bachelor of Applied Technology (Photonics) are in the same field and share a close affinity. At both Algonquin and Niagara Colleges these programs share human resources, labs and equipment.

In order to develop a curriculum for a bridging program for the graduates from the Photonics Engineering Technology Advanced Diploma program to complete the Bachelor of Applied Technology (Photonics) degree a detailed two stage gap analysis was performed. This enabled us to determine the appropriate point of entry for Photonics Advanced Diploma graduates entering the BAT (Photonics) and to identify the learning outcomes required in a bridging program for these diploma graduates.

In the first stage of the gap analysis the learning outcomes in the corresponding courses in the advanced diploma and the degree programs were compared. This comparison identified the courses in the degree for which no exemption could be granted because the content simply was not covered. For the courses where the learning outcomes had been covered a second review was conducted to assess the difference in theoretical approach and focus with a particular emphasis on the type of mathematical focus used. In order to be successful in the degree program the gap identified needed to be filled effectively.

The second stage analysis was conducted by expert professors in the field. They compared the courses in the two programs. They examined in more detail the theoretical focus of the courses

and the depth of theoretical learning. Based on this in depth review, a recommendation was made for each course to grant an exemption, deny the exemption or grant an exemption with remediation to cover material that was identified as missing.

This gap analysis, included as **Appendix 5.2.4**, was approved by the Curriculum Review Committee at Algonquin College. Based on the learning outcomes that were identified as missing, two bridging courses and the program of studies for the BAT (Photonics) bridging program were developed.

Attached as **Appendix 5.2.3** is the program of study for the bridging program for the Bachelor of Applied Technology (Photonics). The bridging program consists of four academic semesters and two work terms. During the first academic semester students will take the courses identified as required from levels 01 to 05 and the two bridging courses. The remaining academic semesters are concurrent with the regular program. The percentage of the credits awarded to graduates of the Photonics Engineering Technology Advanced Diploma program is 59% and thus does not exceed the 67% limit identified for graduates of three-year diploma programs in the PEQAB guidelines.

A cumulative GPA of B (75%) will be required for graduates of the Photonics Advanced Diploma program to be accepted into the BAT (Photonics) bridging program.

It is recognized that should the program of study for the BAT (Photonics) program or the Advanced Diploma in Photonics Engineering Technology be revised, the gap analysis will need to be reviewed, and the content of the bridging courses modified accordingly.

### **Application Process**

Students will apply to the BAT (Photonics) program through OCAS and request advanced standing. They will then submit transcripts and course outlines to the Registrar's Office at Algonquin College as required.

## **Appendix 5.2.1: Credit Transfer/Recognition Policies and Procedures**

When requests received from individuals for advanced standing in Bachelor of Applied Technology (Photonics) program are received, the College will follow the guidelines set out by the Postsecondary Education Quality Assessment Board. These guidelines have been incorporated into College policies. In support of this request Algonquin College's Directives E6 – Advanced Standing, E9 – Transfer of Academic Credit (Internal), and E10 – Transfer of Academic Credit (External). These Directives will be used when assessing individual candidates requesting advanced standing.

NOTE: These Directives were submitted to PEQAB for review in the Bachelor of Applied Arts (Interior Design) Ministerial Consent renewal submission in August 2007.

## **Appendix 5.2.2: Advanced Placement Policies**

In conjunction with the Directives identified in Appendix 5.2.1 related to credit transfer and recognition, the College has policies in place for Prior Learning Assessment and Recognition and Advanced Standing: Directive E6 – Advanced Standing; and Directive E35 – Prior Learning Assessment and Recognition.

NOTE: These Directives were submitted to PEQAB for review in the Bachelor of Applied Business (e-Business Supply Chain Management) program request for renewal of Ministerial Consent Submission in December 2006.

### Appendix 5.2.3: Degree Completion Arrangements: Bridging Program for Photonics Engineering Technology Advanced Diploma Graduates

This program of study was developed based on the gap analysis detailed in Appendix 5.2.3.

Year and Semester	Course Title	Course Hours
Summer after Graduation	Co-operative Education Work Term Preparation	15
Summer *	Co-op 1: Work Term I	
Semester 01*	Advanced Physics (Bridging Course 1)	75
	Advanced Optical Engineering (Bridging Course 2)	75
	General Chemistry	45
	Linear Algebra	45
	Differential Equations	45
Semester 02**	Advanced Calculus	45
	Electromagnetic Theory	45
	Opto-electronic Devices	75
	Business Principles	60
	Imaging Image/Signal Processing	60
Summer**	Co-op 2: Work Term II	45
Semester 03**	Materials Science	60
	Thermodynamics and Heat Transfer	45
	Advanced Optical Theory	45
	Quantum Physics	45
	Photonics Research Project	60
	Elective	45
Semester 04**	Solid State Physics	45
	Bio-Medical Photonics	60
	Advanced Research Project	60
	Operations Management	60
	Elective	45

\* Includes courses from semesters 01 to 05 of the regular program and the bridging courses.

\*\* These semesters are concurrent with semesters 6, 7 and 8 the regular program.

## Appendix 5.2.4: Gap Analysis

The work documented in this gap analysis identifies how the contents of the bridging program for the graduates of the Photonics Engineering Technology program entering the Bachelor of Applied Technology (Photonics) program were developed.

In this document, the Photonics Engineering Technology program will be referred to as Diploma and the Bachelor of Applied Technology (Photonics) will be referred to as BAT.

In the first iteration of the gap analysis the learning outcomes of the BAT courses are compared to those of the corresponding courses in the Diploma program. This will demonstrate the learning outcomes covered and those not covered. In the second iteration of the gap analysis, a comparison of the theoretical coverage and the mathematical focus used in both programs is undertaken. The worksheets completed for this comparison are included in this appendix. The content of the bridging courses to be developed is identified.

### Iteration 1: Comparison of learning outcomes between Diplomas and BAT courses:

#### Level 01:

<b>BAT</b>	<b>Diploma</b>
<b>Calculus 1 – MAT6443</b>	<b>Differential Calculus – MAT8731</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Apply basic mathematical skills required in their technology program.	1. Apply basic mathematical skills required in their technology program.
2. Differentiate algebraic and transcendental functions.	2. The students will be able to differentiate algebraic and transcendental functions.
3. Apply differentiation to problems involving tangents, rates, minima, and curve sketching.	3. The students will be able to apply differentiation to problems involving tangents, rates, minima and maxima, and curve sketching.
4. Calculate and use numerical methods to arrive at solutions to derivative problems.	4. Use numerical solutions to derivative and integration problems at the basic level.

#### Discussion:

The learning outcomes of MAT6443 are covered in MAT8731. It should also be mentioned that MAT8731 is the second math course taken in the diploma program, the first being MAT8730 (Technical Mathematics).

#### Recommendation:

Exemption granted based on MAT8731.

<b>BAT</b>	<b>Diploma</b>
<b>General Chemistry – CHE8287</b>	<b>No Chemistry courses.</b>

**Discussion:**

No chemistry course is offered in the Diploma program.

**Recommendation:**

No exemption granted.

<b>BAT</b>	<b>Diploma</b>
<b>Programming 1 – CST8810</b>	<b>Computer Applications – CST8710 and other courses</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Use a personal computer for Internet access such as email and the World Wide Web.	1. Covered during the three years. Use of Internet, email and the World Wide Web is an integral part of the study.
2. Use a personal computer and basic productivity software such as word processors, graphics programs, and spreadsheets.	2. Covered in many courses including but not limited to PHY2020, ENL2020, PHY2021 and ENL2021.
3. Manage file storage and transport both locally and on networks.	3. Covered in many courses including but not limited to PHY2020, ENL2020, PHY2021 and ENL2021.
4. Operate the basic features of technical software such as CAD, engineering, and design software.	4. Covered in many courses including but not limited to PHY2020, PHY2021 and PHY8751.
5. Program simple automation and computing tasks to accomplish a variety of tasks.	5. Covered in many courses including but not limited to CST8711 and CST8720.

**Discussion:**

The learning outcomes of CST 8810 are covered in the program of study of the Diploma students.

**Recommendation:**

Exemption granted based on exposure from a variety of courses in the Diploma program.

<b>BAT</b>	<b>Diploma</b>
<b>Optics and Waves - PHY2110</b>	<b>Optics and Waves – PHY8730</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Explain the concept of waves, and give examples of wave ideas both inside and outside of the lab or classroom.	1. Explain the concept of waves, and give examples of wave ideas both inside and outside of the lab or classroom.
2. Apply the tools of energy and waves to	2. Apply the tools of energy and waves to

<b>BAT</b>	<b>Diploma</b>
<b>Optics and Waves - PHY2110</b>	<b>Optics and Waves – PHY8730</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
calculating and solving problems in those areas.	calculating and solving problems in photonics.
3. Explain the ideas of interference and diffraction and solve problems in those areas.	3. Explain the ideas of interference and diffraction and solve problems in those areas.
4. Explain how wave modulation, AM and FM, come about through superposition, and explain their uses in communications.	4. Explain how wave modulation, AM and FM, come about through superposition, and their uses in communications.
5. Solve basic problems in geometric optics using both lenses and mirrors.	5. Explain the diffraction of light through different media.
6. Explain the refraction of light through different media.	6. Solve basic problems in geometric optics using both lenses and mirrors.
7. Explain the dual nature of light and to be able to decide how best to treat light in different situations.	7. Explain the dual nature of light and to be able to decide how to treat light in different situations.

**Discussion:**

The learning outcomes of both courses correspond one-on-one, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

<b>BAT</b>	<b>Diploma</b>
<b>Trends in Photonics Technology - PHY2111</b>	<b>Trends in Photonics Technology – PHY8711</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Describe the history of photonics, particularly as it relates to the fields of telescoping telecommunications, medicine, manufacturing, and computing.	1. Describe the history of photonics, particularly as it relates to the fields of telecommunications, medicine, manufacturing, and computing.
2. Illustrate the influence that photonics technology has had on today’s society.	2. Describe the influence that photonics technology has had on today’s society.
3. Give examples of the current problems that photonics technology is likely to address in the near future, and how those solutions will fit into society.	3. Describe the current problems that photonics technology is likely to address in the near future, and how those solutions will fit into current society.
4. Summarize the current limitations faced by today’s photonics technology, and	4. Describe the current limitations faced by today’s photonics technology, and the

<b>BAT</b>	<b>Diploma</b>
<b>Trends in Photonics Technology - PHY2111</b>	<b>Trends in Photonics Technology – PHY8711</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
the likely direction of future developments to address these limitations.	likely direction of the future developments to address these limitations.
5. Evaluate the impact future developments, both technical and societal, will likely have on the field of photonics.	5. Evaluate the impact future developments will likely have on the field of photonics.

**Discussion:**

The learning outcomes of both courses correspond one on one.

**Recommendation:**

Exemption granted for course PHY2111 based on PHY8711.

<b>BAT</b>	<b>Diploma</b>
<b>Occupational Health &amp; Safety and Ethics – SAF8208</b>	<b>Ethics in the Workplace –GEN0013</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Describe the evolution of worker safety in industrial and office settings through the years.	1. Describe the evolution of worker safety in industrial settings through the years.
2. Describe the evolution of ethics awareness in industrial and business settings through the years.	2. Describe the philosophical background to current thinking on safety regulations, safety management and lifestyle management and how that affects safety standards in industry.
3. Describe the philosophical background to current thinking on safety regulations, safety management, lifestyle management, and ethical regulations and how that affects standards in industry.	3. Describe laboratory and workshop safety procedures and general safety rules, particularly as they apply to the photonics work environment.
4. Demonstrate a good understanding of laboratory and workshop safety procedures and general safety rules, particularly as they apply to the photonics work environment.	4. Safely work with chemical systems and in environments using chemistry procedures.
5. Identify graphic symbols of common mechanical, chemical, electric, electronic and photonic components, and interpret data sheets for	5. Demonstrate the basic concepts of laboratory and workshop hand and bench tool safety.

<b>BAT</b>	<b>Diploma</b>
<b>Occupational Health &amp; Safety and Ethics – SAF8208</b>	<b>Ethics in the Workplace –GEN0013</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
components and hardware to identify their optical, physical and electrical characteristics.	
	6. Identify graphic symbols of common mechanical, chemical, electric, electronic, and photonic components.
	7. Interpret data sheets for components and hardware and to identify their optical, physical and electrical characteristics.

**Discussion:**

The learning outcomes of SAF8202 are covered in GEN0013.

**Recommendation:**

Exemption granted for course SAF8202 based on GEN0013.

**Level 02:**

<b>BAT</b>	<b>Diploma</b>
<b>Calculus 2 - MAT8202</b>	<b>Integral Calculus - MAT8741</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Apply calculus skills required in their degree program.	1. Apply basic calculus skills required in their technology program.
2. Integrate a variety of functional forms by a variety of methods.	2. Integrate a variety of functional forms by a variety of methods.
3. Apply integration tools to solve problems as related to their program of study.	3. Apply integration tools to solve problems as related to their program of study.
4. Use integral methods, including the use of multiple integration, to solve area, volume, and other types of problems.	4. Use integral methods, including the use of multiple integration, to solve area, volume and other types of problems.
5. Calculate and use numerical methods to arrive at solutions to derivative and integration problems.	5. Use of numerical solutions to derivative and integration problems, at the basic level.

**Discussion:**

The learning outcomes of MAT8202 are covered in MAT8741.

**Recommendation:**

Exemption granted based on MAT8731 and MAT8741.

<b>BAT</b>	<b>Diploma</b>
<b>Kinematics and Dynamics – PHY2210</b>	<b>Kinematics/Dynamics for Technology – PHY8732</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Describe the measurements used to characterize motion.	1. Describe the measurements used to characterize motion.
2. Solve problems related to the motion of objects using the tools of kinematics, dynamics, and energy.	2. Solve problems related to the motion of objects using the tools of kinematics, dynamics, and energy.
3. Explain the concepts of energy and power and how they are related to the motion of objects.	3. Explain the concepts of energy and power and how they are related to the motion of objects.
4. Relate the motion of objects to the motion of waves in terms of the ideas of energy and power.	4. Relate the motion of objects to the motion of waves in terms of the ideas of energy and power.

**Discussion:**

The learning outcomes of both courses correspond one-on-one, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

<b>BAT</b>	<b>Diploma</b>
<b>Programming 2 – CST8811</b>	<b>Computer Programming – CST8711</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Understand the major system components and be able to explain how programs are executed in a typical computer system.	1. Understand the major system component and be able to explain how programs are executed in a typical computer system.
2. Describe and specify using standard format (flowcharts, block diagrams, pseudo code, etc.) implementation of various algorithms.	2. Write algorithms for solving engineering problems using flowcharts, block diagrams and pseudo code.
3. Produce structured computer programs involving the use of decision logic, loops, basic inputs and outputs, functions and data structures.	3. Produce structured computer programs involving the use of decision logic, loops, basic input and output, functions and data structures.

**Discussion:**

The learning outcomes of CST881 correspond to learning outcomes of CST8711. Learning

**Recommendation:**

Grant exemption for CST8811 based on CST8711.

<b>BAT</b>	<b>Diploma</b>
<b>Electrotechnology – ELN2210</b>	<b>Electronic Fundamental for Technology - ELN8730</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Analyze how current flows through simple circuits, and be able to calculate expected circuit behaviors.	1. Explain how current flows through simple circuits, and be able to calculate expected circuits behavior.
2. Use Ohm’s law, Kirchhoff’s law, and Thevenin’s theorem to solve electric problems.	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.	3. Explain how diodes and rectifiers work and are used in electric circuits.
4. Design and build basic electronic circuits.	4. Use electronic measurement equipment such as multimeters and oscilloscope to analyze electronic circuits.
5. Use electronic measurement equipment such as multimeters and oscilloscope to analyze electronic circuits.	

**Discussion:**

The learning outcomes of both courses correspond one on one, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

<b>BAT</b>	<b>Diploma</b>
<b>Optics/Optical Fiber Principles – PHY2211</b>	<b>Optical Fiber Principle for Technology – PHY8731</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Employ the principles of light in relation to lenses, mirrors, prisms, and gratings.	1. Describe the principles of light in relation to lenses, mirrors, and gratings.
2. Mount, focus, clean, test, and specify optical systems involving lenses, mirrors, and gratings.	2. Mount, focus, clean, and test, and specify optical systems involving lenses, mirrors, and gratings.
3. Employ the principle of light propagation in optical fibers.	3. Describe the principles of light propagation in optical fibers.
4. Safely handle, splice, mount, clean, test, and specify components in an optical fiber system. Be familiar with optical fiber connection systems.	4. Safely handle, splice, mount, clean, test, and specify components in an optical fiber system. Use optical fiber connection systems.
5. Give examples of types of light emitters and detectors for optical fiber systems and describe their operation.	5. Describe the operation of light emitters and detectors for optical fiber systems.

<b>BAT</b>	<b>Diploma</b>
<b>Optics/Optical Fiber Principles – PHY2211</b>	<b>Optical Fiber Principle for Technology – PHY8731</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
6. Perform standard optical tests and measurements.	6. Perform standard optical tests and measurement.

**Discussion:**

The learning outcomes of both courses correspond one on one, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

**Level 03:**

<b>BAT</b>	<b>Diploma</b>
<b>Linear Algebra – MAT8203</b>	<b>No Linear Algebra courses.</b>

**Discussion:**

No Linear Algebra course is offered in the Diploma program.

**Recommendation:**

No exemption granted for this course.

<b>BAT</b>	<b>Diploma</b>
<b>Interfacing – ELN2310</b>	<b>Microcomputer Interfacing – CST8720</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Use a microcomputer to control external devices.	1. Use a microcomputer to control external devices.
2. Write computer programs to control speakers, DC and stepper motors, and other equipment.	2. Write computer programs to control speakers, DC and stepper motors, and other equipment.
3. Build and use analog to digital converters.	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.	4. Write computer programs to display and/or respond to measured data from temperature, position, and/or opto-electronic sensors.
5. Trouble shoot both hardware and software problems in various situations.	5. Trouble shoot both hardware and software problems in various situations.
6. Use various standard tools for system interfacing.	6. Use various standard tools for system interfacing.

**Discussion:**

The learning outcomes of both courses correspond.

**Recommendation:**

Exemption granted for course ELN2310 based on CST8720.

<b>BAT</b>	<b>Diploma</b>
<b>Semiconductors and Logic – PHY2310</b>	<b>Semiconductors and Logic for Technology – ELN8740</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Explain how semiconductor devices are constructed and operate.	1. Explain how semiconductor devices are constructed and operate.
2. Design, build, and analyze simple electronic circuits using semiconductor devices.	2. Design, build, and analyze simple electronic circuits using semiconductors devices.
3. Use electronic measurement equipment such as multimeters and oscilloscope to analyze electronic circuit.	3. Use electronic measurement equipment such as multimeters and oscilloscope to analyze electronic circuits.
4. Apply the tools of basic logic functions and Boolean algebra to solve circuit problems.	4. Apply the tools of basic logic functions and Boolean algebra to circuit problems.
5. Design, build, and analyze basic logic circuits.	5. Design, analyze, build, and analyze basic logic circuits.

**Discussion:**

The learning outcomes of both courses correspond one-on-one, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

<b>BAT</b>	<b>Diploma</b>
<b>Fundamentals of Light Sources – PHY2311</b>	<b>Fundamentals of Light Emission – PHY8740</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Describe the different characteristics of various coherent and incoherent light sources and analyze there uses in various applications.	1. Describe the different characteristics of various coherent and incoherent light sources and their uses in various applications.
2. Describe the workings of different incoherent light sources including incandescent, fluorescent, arc and discharge lamps, LEDs, and solar.	2. Describe the workings of different incoherent light sources included incandescent, fluorescent, arc and discharge lamps, LEDs, and solar.

<b>BAT</b>	<b>Diploma</b>
<b>Fundamentals of Light Sources – PHY2311</b>	<b>Fundamentals of Light Emission – PHY8740</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
3. Explain the workings of different coherent and laser light sources and their strengths and weaknesses.	3. Describe 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.	4. Compare the characteristics of different light sources to decide their strengths and weaknesses for various applications.

**Discussion:**

The learning outcomes of both courses correspond, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

<b>Optics/Optical Fiber Devices – PHY2312</b>	<b>Optic and Optical Fiber Devices – PHY8742</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Use, maintain, and analyze devices used in the transmission, manipulation, and the detection of lights.	1. Describe how to use, maintain, and analyze devices used in the transmission, manipulation, and detection of light.
2. Decide on the appropriate device the application desired. Explain the strengths and weaknesses of each device for particular applications.	2. Decide on the appropriate device the application desired. Explain the strengths and weaknesses of each device for particular applications.
3. Safely handle, clean, and connect optical fiber devices.	3. Safely handle, clean, and connect optical fiber devices.
4. Test and characterize optical fiber devices with the appropriate measurement tools.	4. Test and characterize optical fiber devices with the appropriate measurement tools.
5. Make optical measurements and testes of the devices being considered for various applications.	5. Make optical measurements and tests of the devices being considered for various applications.

**Discussion:**

The learning outcomes of both courses correspond, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

**Level 04:**

<b>BAT</b>	<b>Diploma</b>
<b>Differential Equations – MAT8204</b>	<b>Differential Equations – MAT8742</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Apply basic differential equation manipulation skills required in their degree program.	1. Apply basic differential equation manipulation skills required in their technology program.
2. Use differential equation to specify the characteristics of systems being studied.	2. Use the 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.	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 study.	

**Discussion:**

It is expected that the MAT8204 is a more advanced course in differential equations than MAT8742.

**Recommendation:**

No exemption is granted for this course.

<b>BAT</b>	<b>Diploma</b>
<b>Laser Systems – PHY2410</b>	<b>Laser Systems for Technology – PHY8743</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Identify the different strengths and weaknesses of various laser systems for various applications, and be able to describe appropriate choices for them.	1. Identify the different strengths and weaknesses of various laser systems to various applications, and describe appropriate choices for them.
2. Clean, align, and operate different gas, diode, and solid state lasers.	2. Clean, align, and operate different gas, diode, and solid state lasers.
3. Describe the use of electro-devices as modulators, deflectors, and Q-switches.	3. Describe the use of electro-optic devices as modulators, deflectors, and Q-switches.

<b>BAT</b>	<b>Diploma</b>
<b>Laser Systems – PHY2410</b>	<b>Laser Systems for Technology – PHY8743</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
4. Employ acousto-optic devices as well as mechanical devices such as prisms and piezoelectric devices in various applications.	4. Describe the use of acousto-optic devices as well as mechanical devices such as prisms and piezoelectric devices.

**Discussion:**

The learning outcomes of both courses correspond, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

<b>BAT</b>	<b>Diploma</b>
<b>Telecommunications – ELN2410</b>	<b>Fiber communications I-PHY 8761</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Describe the basic elements of a communication system.	1. Describe the basic element of a communication system.
2. Explain the different methods used in wired, wireless, digital, analog, electrical, and optical communications systems.	2. Describe the different methods used in wired, wireless, digital, analog, electrical, and optical communications systems.
3. Describe the different forms of a signal modulation, and evaluate their strengths and weaknesses in various applications.	3. Describe the different forms of signal modulation, and be able to evaluate their strengths and weaknesses in various applications.
4. Describe the communications techniques used in the telephone systems.	4. Describe the communications techniques used in the telephone systems.
5. Describe the different systems and protocols used for digital communications, such as UART, DDCMP, TCP/IP, SONNET, etc.	5. Describe the different systems and protocols used for digital communications, such as UART, DDCMP, TCP/IP, SONNET, etc.
6. Explain the use of error detection and correction in various systems.	6. Describe the use of error detection and correction in various systems.

**Discussion:**

The learning outcomes of both courses correspond, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

<b>BAT</b>	<b>Diploma</b>
<b>Manufacturing Photonics Components – PHY2411</b>	<b>Manufacturing Photonics Devices – PHY8741</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Identify the principles behind the use of the components being manufactured and the reason why particular manufacturing methods are chosen for each component.	1. Identify the principles behind the use of the components being manufactured and the reasons why particular manufacturing methods are chosen for each component.
2. Safely polish, clean, coat, and mount various optical components in various optical devices.	2. Safely polish, clean, coat, and mount various optical components and various optical devices.
3. Identify the strengths and weaknesses of various manufacturing techniques.	3. Identify the strengths and weaknesses of various manufacturing techniques.
4. Use clean assembly procedures to construct devices free from dust and defects.	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.	5. Test completed components for tolerances and will be able to determine appropriate solutions to manufacturing problems.
6. Employ the appropriate quality control standard for the devices being manufactured.	6. Use the appropriate quality control standards for the devices being manufactured.
7. Safely clean, handle and connect optical fiber components and systems, as well as test their operation and characteristics.	7. Safely clean, handle and connect optical fiber systems as well as be able to test their operation and characteristics.
8. Apply optical coatings, and use design tools to specify such coatings for optical systems.	8. Apply optical coatings, and to use design tools to specify such coatings for optical systems.

**Discussion:**

The learning outcomes of both courses correspond, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

<b>BAT</b>	<b>Diploma</b>
<b>Statistics - MAT8205</b>	<b>Statistics for Technology – MAT 8740</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Apply basic statistical skills required in their technology program.	1. Apply basic statistical skills required in their technology program.
2. Solve problems accurately using statistical strategies and necessary tools.	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.	3. Apply statistical tools in hypothesis testing and performing regression analysis.

**Discussion:**

The learning outcomes of both courses correspond one on one.

**Recommendation:**

Exemption granted for course MAT8205 based on MAT8740.

<b>BAT</b>	<b>Diploma</b>
<b>Technical Communications – ENL8810</b>	<b>Photonics Report I (ENL2020) Photonics Report II (ENL2021)</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Effectively communicate in both written and spoken English, particularly in the workplace communications.	1. Produce oral and written material that demonstrates evidence of idea development, progress and planning related to their individual or group project. (ENL2020)
2. Research and write reports as required by the student’s discipline.	2. Plan and research a topic suitable for final year project. (ENL2020)
3. Present reports, particularly of a technical nature, in a variety of situations.	3. Prepare and present a formal oral and written technical report that documents their final year project. (ENL2021)

**Discussion:**

The learning outcomes of ENL8810 are covered in ENL2020 and ENL2021.

**Recommendation:**

Exemption granted based on ENL2020 and ENL2021.

<b>BAT</b>	<b>Diploma</b>
<b>CO-OPERATIVE EDUCATION WORK TERM PREPARATION WKT8000</b>	<b>No equivalent in Diploma.</b>

**Discussion:**

No equivalent in Diploma program.

**Recommendation:**

No exemption granted for this course.

<b>BAT</b>	<b>Diploma</b>
<b>WORK TERM I - PHY2901</b>	<b>No equivalent in Diploma.</b>

**Discussion:**

No equivalent in Diploma program.

**Recommendation:**

No exemption granted.

**Level 05:**

<b>BAT</b>	<b>Diploma</b>
<b>Control Systems – ELN2510</b>	<b>Control Systems – ELN8750</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Describe the use of open and closed loop control systems in a variety of applications.	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.	2. Use PLC/CNC to direct the operation of automated systems.
3. Analyze open and closed loop control systems with a variety of methods.	3. Use laboratory, computer-based and traditional methods to model and analyze closed-loop control systems.

**Discussion:**

The learning outcomes of both courses correspond one on one, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

<b>BAT</b>	<b>Diploma</b>
<b>Photonics Manufacturing Systems – PHY2510</b>	<b>Photonics and Biophotonics Systems – PHY8750 Laser Matter Interaction – PHY8753</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Safely use and be familiar with the capabilities of standard prototype development equipment.	1. Describe the safe use and capabilities of standard prototype development equipment. (PHY8750 and PHY8753)
2. Test, maintain, analyze, and use laser based manufacturing equipment.	2. Test, maintain, analyze, and use laser based manufacturing based equipment. (PHY8753)
3. Identify the strengths and weaknesses and various manufacturing techniques, and the material characteristics and properties that would influence the choice of manufacturing method to be employed.	3. Identify the strengths and weaknesses of various manufacturing techniques, and the material characteristics and properties that would influence the choice of manufacturing techniques to be employed. (PHY8753)
4. Test, maintain, analyze, and use alignment and measurement control systems for photonics manufacturing equipment.	4. Test, maintain, analyze, and use alignment and measurement control systems for photonics manufacturing equipment. (PHY8750)

**Discussion:**

The learning outcomes of PHY2510 are covered in PHY8750 and PHY8753, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

<b>BAT</b>	<b>Diploma</b>
<b>Advanced Optical Systems – PHY2511</b>	<b>Advanced Optical Systems – PHY8751</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Demonstrate a broad knowledge of equipment, methods, and processes employed in the development of photonic systems.	1. Develop a broad knowledge of equipment, methods, and processes employed in the development of photonics systems.
2. Use hardware and software tools to model and analyze systems.	2. Use the hardware and software tools used to analyze systems.
3. Work in a team to research and present information about particular optical systems.	3. Work in a team to research and present information about particular optical systems.

<b>BAT</b>	<b>Diploma</b>
<b>Advanced Optical Systems – PHY2511</b>	<b>Advanced Optical Systems – PHY8751</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
4. Analyze and evaluate the characteristics of various optical systems and create procedures for their use, maintenance, and troubleshooting.	4. Analyze and evaluate the characteristics of various optical systems and create procedures for their use, and maintenance, and troubleshooting.

**Discussion:**

The learning outcomes of both courses correspond, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

<b>BAT</b>	<b>Diploma</b>
<b>Thin Film and Vacuum Systems – PHY2512</b>	<b>Fluid and Vacuum Systems – PHY8755</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Operate vacuum systems, particularly as related to sputtering and other deposition systems.	1. Operate vacuum systems, particularly as related to sputtering and other depositions systems.
2. Use various coating processes and identify the strengths and weaknesses of different techniques under various conditions.	2. Use various coating processes and identify the strengths and weaknesses of different techniques under various conditions.
3. Solve problems in fluid flow, as related to hydraulic and power transmission.	3. Solve problems in fluid flow, as related to hydraulics and power transmission.
4. Solve hydraulic circuit and pneumatic control problems.	4. Operate hydraulic systems, and solve hydraulic circuit and pneumatic control problems.

**Discussion:**

The learning outcomes of both courses correspond one on one, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

**Level: 06**

<b>BAT</b>	<b>Diploma</b>
<b>ADVANCED CALCULUS - MAT8206</b>	<b>No equivalent in Diploma.</b>

**Discussion:**

No equivalent in Diploma program.

**Recommendation:**

No exemption granted for this course.

<b>BAT</b>	<b>Diploma</b>
<b>ELECTROMAGNETIC THEORY - PHY2610</b>	<b>No equivalent in Diploma.</b>

**Discussion:**

No equivalent in Diploma program.

**Recommendation:**

No exemption granted for this course.

<b>BAT</b>	<b>Diploma</b>
<b>Opto-Electronic Devices – PHY2611</b>	<b>Opto-Electronic Devices – PHY8752</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Describe and use electro-optic devices such as modulators, deflectors, and Q-switches.	1. Describe the use of electro-optic devices as modulators, deflectors, and Q-switches.
2. Describe the use of acousto-optic devices as well as mechanical devices such as prisms and piezoelectric devices.	2. Describe the use of 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.	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.	4. Describe and use spatial light modulator such as liquid crystal and magneto optic light valve arrays, and acousto-optic devices.

**Discussion:**

The learning outcomes of both courses correspond, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

<b>BAT</b>	<b>Diploma</b>
<b>Imaging, Image/Signal Processing – PHY2612</b>	<b>Computer Vision &amp; Image Processing – PHY8757</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Describe the strengths and weaknesses of analog vs. digital signal processing, in various different situations.	1. Describe the trances and weaknesses of analog vs. digital signal processing, in various different situations.
2. Describe the uses of display devices including LCD, LED, electroluminescent, plasma, and CRT displays, and determine the relative strengths and weaknesses of different display systems in various applications.	2. Describe the uses of display devices including LCD, LED, electroluminescent, plasma, and CRT displays, and determine the relative strengths and weaknesses of different display systems in various applications.
3. Explain different methods of generating optical images and storing those images for later use, both digital and analog.	3. Describe different methods of generating optical images and storing those images for later use.
4. Employ CCD camera, and video capture hardware to record digital audio and video signals.	4. Use CCD cameras, and video capture hardware to record digital audio and video signals.
5. Use data acquisition software and image processing software, and describe the benefits and weaknesses of different software packages and algorithms.	5. Use data acquisition software and image processing software, and describe the benefits and weaknesses of different software packages.
6. Describe and employ various different printing technologies to produce printed images, including impact, electrostatic, laser, ink jet and thermal printing, as well as photographic and film basic devices.	6. Use various different printing technology to produce printed images, including impact electrostatic, laser, inkjet and thermal printing, as well as photographic and film based devices.

**Discussion:**

The learning outcomes of both courses correspond, however the in depth coverage of the different topics and the use of mathematical skills might differ.

**Recommendation:**

Undertake a more extensive comparison of mathematical skills and theoretical foundations of both courses.

<b>BAT</b>	<b>Diploma</b>
<b>BUSINESS PRINCIPLES - MGT8500</b>	<b>No equivalent in Diploma.</b>

**Discussion:**

No equivalent in Diploma program.

**Recommendation:**

No exemption granted for this course.

<b>BAT</b>	<b>Diploma</b>
<b>WORK TERM II - PHY2902</b>	<b>No equivalent in Diploma.</b>

**Discussion:**

No equivalent in Diploma program.

**Recommendation:**

No exemption granted for this course.

**Level: 07**

<b>BAT</b>	<b>Diploma</b>
<b>Material Science - PHY2714</b>	<b>No equivalent in Diploma.</b>

**Discussion:**

No equivalent in Diploma program.

**Recommendation:**

No exemption granted for this course.

<b>BAT</b>	<b>Diploma</b>
<b>Thermodynamics and Heat Transfer - PHY2710</b>	<b>Heat Transfer – PHY8756</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Apply the theories of thermodynamics to study problems in heat flow.	
2. Identify the modes of heat transfer and apply concepts of heat transfer and diffusion to the problems in science and technology.	1. Identify the modes of heat transfer and apply the concepts of heat transfer and diffusion to the problems in engineering.
3. Perform conduction analysis using analytic and computer tools such as finite element analysis.	2. Perform conduction analysis using analytic and computer tools such as finite element analysis.
4. Calculate the results of heat flow and diffusion in various processes.	3. Calculate the results of heat flow and diffusion in various processes.
5. Predict the results of applications of various energy sources on various materials.	4. Predict the results of applications of various energy sources on various materials.

**Discussion:**

No thermodynamics is covered in the Diploma course. A more advanced coverage of heat transfer concepts is also expected.

**Recommendation:**

No exemption granted for this course.

<b>BAT</b>	<b>Diploma</b>
<b>Advanced Optical Theory - PHY2711</b>	<b>Advanced Optical Systems – PHY8751</b>
Learning Outcomes: Students will demonstrate the ability to:	Learning Outcomes: Students will demonstrate the ability to:
1. Measure and calculate the optical properties of a variety of optical systems.	
2. Describe the theoretical background for different optical systems.	
	1. Describe equipment, methods and processes employed in the development of photonics systems.
	2. Use hardware and software tools used to analyze systems.
	3. Work in a team to research and present information about particular optical systems.
	4. Analyze and evaluate the characteristics of various optical systems and create procedures for their use, maintenance and troubleshooting.

**Discussion:**

The focus of these courses is different. PHY2711 involves more advanced concepts in optical theories.

**Recommendation:**

No exemption granted for this course.

<b>BAT</b>	<b>Diploma</b>
<b>QUANTUM PHYSICS - PHY2712</b>	<b>No equivalent in Diploma.</b>

**Discussion:**

No equivalent in Diploma program.

**Recommendation:**

No exemption granted for this course.

<b>BAT</b>	<b>Diploma</b>
<b>PHOTONICS RESEARCH PROJECT - PHY2713</b>	

**Discussion:**

The research project is necessary for students of the BAT program.

**Recommendation:**

No exemption granted for this course.

**Level: 08**

<b>BAT</b>	<b>Diploma</b>
<b>SOLID STATE PHYSICS - PHY2810</b>	<b>No equivalent in Diploma.</b>

**Discussion:**

No equivalent in Diploma program.

**Recommendation:**

No exemption granted for this course.

<b>BAT</b>	<b>Diploma</b>
<b>BIO/MEDICAL PHOTONICS - PHY2811</b>	<b>No equivalent in Diploma.</b>

**Discussion:**

No equivalent in Diploma program.

**Recommendation:**

No exemption granted for this course.

<b>BAT</b>	<b>Diploma</b>
<b>ADVANCED RESEARCH PROJECT - PHY2812</b>	

**Discussion:**

The research project is necessary for students of the BAT program.

**Recommendation:**

No exemption granted for this course.

<b>BAT</b>	<b>Diploma</b>
<b>OPERATIONS MANAGEMENT - MGT8501</b>	<b>No equivalent in Diploma.</b>

**Discussion:**

No equivalent in Diploma program.

**Recommendation:**

No exemption granted for this course.

**Electives:**

The students enrolled in the BAT program have to take 5 elective courses, during their program of study. These courses help the students acquire a breadth of knowledge outside their discipline. The students enrolled in the Diploma program have to take 3 general education courses for the same objective. Based on this, the students who go through bridging will be required to take only the electives from the levels where their program of study coincides with those in the regular program namely during levels 06, 07 and 08.

## Results of Gap Analysis Iteration 1:

### Level: 01

MAT6443 CALCULUS 1	Credit granted
CHE8287 GENERAL CHEMISTRY	Required
CST8810 PROGRAMMING 1	Credit granted
PHY2110 OPTICS AND WAVES	Detailed comparison
PHY2111 TRENDS IN PHOTONICS TECHNOLOGY	Credit granted
SAF8208 OCCUPATIONAL HEALTH AND SAFETY, AND ETHICS	Credit granted

### Level: 02

MAT8202 CALCULUS 2	Credit granted
PHY2210 KINEMATICS AND DYNAMICS	Detailed comparison
CST8811 PROGRAMMING 2	Credit granted
ELN2210 ELECTROTECHNOLOGY	Detailed comparison
PHY2211 OPTICS/OPTICAL FIBRE PRINCIPLES	Detailed comparison

### Level: 03

MAT8203 LINEAR ALGEBRA	Required
ELN2310 INTERFACING	Credit granted
PHY2310 SEMICONDUCTORS AND LOGIC	Detailed comparison
PHY2311 FUNDAMENTALS OF LIGHT SOURCES	Detailed comparison
PHY2312 OPTICS/OPTICAL FIBRE DEVICES	Detailed comparison
PHY2313 ELECTIVE	Credit granted

### Level: 04

MAT8204 DIFFERENTIAL EQUATIONS	Required
PHY2410 LASER SYSTEMS	Detailed comparison
ELN2410 TELECOMMUNICATIONS	Detailed comparison
PHY2411 MANUFACTURING PHOTONICS COMPONENTS	Detailed comparison
MAT8205 STATISTICS	Credit granted
ENL8810 TECHNICAL COMMUNICATIONS	Credit granted
WKT8000 CO-OPERATIVE EDUCATION WORK TERM PREPARATION	Required

### Co-op 1

PHY2901 WORK TERM I	Required
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### Level: 05

ELN2510 CONTROL SYSTEMS	Detailed comparison
PHY2510 PHOTONICS MANUFACTURING SYSTEMS	Detailed comparison
PHY2511 ADVANCED OPTICAL SYSTEMS	Detailed comparison
PHY2512 THIN FILM AND VACUUM SYSTEMS	Detailed comparison
PHY2513 ELECTIVE	Credit granted

**Level: 06**

MAT8206 ADVANCED CALCULUS	Required
PHY2610 ELECTROMAGNETIC THEORY	Required
PHY2611 OPTO-ELECTRONIC DEVICES	Detailed comparison
PHY2612 IMAGING, IMAGE/SIGNAL PROCESSING	Detailed comparison
MGT8500 BUSINESS PRINCIPLES	Required
PHY2613 ELECTIVE	Required

**Co-op 2**

PHY2902 WORK TERM II	Required
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**Level: 07**

PHY2714 MATERIALS SCIENCE	Required
PHY2710 THERMODYNAMICS AND HEAT TRANSFER	Required
PHY2711 ADVANCED OPTICAL THEORY	Required
PHY2712 QUANTUM PHYSICS	Required
PHY2713 PHOTONICS RESEARCH PROJECT	Required
PHY2715 ELECTIVE	Required

**Level: 08**

PHY2810 SOLID STATE PHYSICS	Required
PHY2811 BIO/MEDICAL PHOTONICS	Required
PHY2812 ADVANCED RESEARCH PROJECT	Required
MGT8501 OPERATIONS MANAGEMENT	Required
PHY2818 ELECTIVE	Required

## **Gap Analysis Iteration 2: Detailed comparison of theoretical focus and mathematical skills required**

A framework containing a set a mathematical topics was used to measure and compare the extent of theoretical content between the courses in the BAT program and the corresponding one in the Diploma program.

The following documentation summarizes the review by expert professors in the subject area.

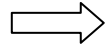
<b>PSY 2110 OPTICS AND WAVES (BAT)</b> <b>Evaluator: Dr. Mohammed Mostefa</b>				<b>PHY 8730 OPTICS AND WAVES (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)		Moderately			Limited	
Trigonometric functions		Extensively			Extensively	
Geometry Coordinate systems, vectors in space, planes, angles		Extensively			Moderately	
Exponential and logarithmic functions		Extensively		X		
Derivatives		Extensively		X		
Integrals		Moderately		X		
Linear algebra: Systems of equations, matrices, determinants.		Extensively			Limited	
Complex numbers	X			X		

<b>PSY 2110 OPTICS AND WAVES (BAT)</b> <b>Evaluator: Dr. Mohammed Mostefa</b>				<b>PHY 8730 OPTICS AND WAVES (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Differential questions: - Ordinary - Partial	X			X		
Laplace transforms	X			X		
Infinite series (power series, Taylor and Maclaurin series, Binomial series)	X			X		
Fourier series	X			X		
Statistics: Sample mean, Sample variance, Standard deviation		Extensively			Extensively	
Statistics: Normal distribution		Extensively			Extensively	
Other: N/A						

**Bridging Requirements (BAT) for OPTICS AND WAVES**

A) A graduate from the Photonics Technology program should take this course (no exemption granted).

B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s):

 C) **A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course *PHY 8730 Optics and Waves for Technology* only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses:  
*Calculus approach to mathematical derivations of theory.***

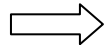
<b>PSY 2210 KINEMATICS AND DYNAMICS (BAT)</b> <b>Evaluator: Dr. Mohammed Mostefa</b>				<b>PHY 8732 KINEMATICS AND DYNAMICS</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)		Moderately			Limited	
Trigonometric functions		Extensively			Extensively	
Geometry Coordinate systems, vectors in space, planes, angles		Extensively			Moderately	
Exponential and logarithmic functions		Extensively		X		
Derivatives		Extensively		X		
Integrals		Moderately		X		
Linear algebra: Systems of equations, matrices, determinants.		Extensively			Limited	

PHY 2210 KINEMATICS AND DYNAMICS (BAT)				PHY 8732 KINEMATICS AND DYNAMICS (DIPLOMA)		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Complex numbers	X			X		
Differential equations: - Ordinary - Partial	X			X		
Laplace transforms	X			X		
Infinite series (power series, Taylor and Maclaurin series, Binomial series)	X			X		
Fourier Series	X			X		
Statistics: Sample mean, Sample variance, Standard deviation		Limited			Moderately	
Statistics: Normal distribution		Limited			Moderately	
Other: In this course the student will have to derive the equations to be used.	X					

**Bridging Requirements (BAT) for KINEMATICS AND DYNAMICS**

A) A graduate from the Photonics Technology program should take this course (no exemption granted).

B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s):



**C) A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course *PHY8732 Kinematics and Dynamics* only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses:**

***Calculus approach to mathematical derivations of theory.***

<b>ELN 2210 ELECTRO TECHNOLOGY (BAT)</b> <b>Evaluator: Dr. Mohammed Mostefa</b>				<b>ELN 8730 ELECTRONIC FUNDAMENTALS (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)		Moderately			Limited	Power (electric)
Trigonometric functions		Extensively	AC, Circuits RLC, Circuits	X		
Geometry Coordinate systems, vectors in space, planes, angles		Moderately	Vectors in RLC Phase shifters	X		
Exponential and logarithmic functions		Extensively	Capacitors Inductors		Moderately	Capacitors
Derivatives		Extensively	Capacitors Inductors	X		
Integrals		Extensively	Capacitors Inductors	X		
Linear algebra: Systems of equations, matrices, determinants		Extensively	Meshes/Nodes		Moderately	

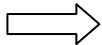
<b>ELN 2210 ELECTRO TECHNOLOGY (BAT)</b>				<b>ELN 8730 ELECTRONIC FUNDAMENTALS (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Complex numbers		Moderately	Capacitor	X		
Differential equations: - Ordinary - Partial	X			X		
Laplace transforms	X			X		
Infinite series (power series, Taylor and Maclaurin series, Binomial series)	X			X		
Fourier Series	X			X		
Statistics: Sample mean, Sample variance, Standard deviation	X			X		
Statistics: Normal distribution	X			X		
Other: In this course the students have to derive the equations to be used		Moderately		X		

**Bridging Requirements (BAT) for ELECTRO TECHNOLOGY**

A) A graduate from the Photonics Technology program should take this course (no exemption granted).

B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s):

**C) A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course *ELN 8730 Electronic Fundamentals for Technology* only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses:  
*Calculus approach to mathematical derivations of theory.***

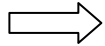


PHY 2211 OPTICS/OPTICAL FIBRE PRINCIPLES (BAT) Evaluator : Dr. Abdul Al-Azzawi				PHY 8731 OPTICS/OPTICAL FIBRE PRINCIPLES (DIPLOMA)			
Mathematical Tool	Not Used	Used	Examples		Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)	X				X		
Trigonometric functions		Moderately				Moderately	
Geometry Coordinate systems, vectors in space, planes, angles		Limited				Limited	
Exponential and logarithmic functions		Moderately				Moderately	
Derivatives	X				X		
Integrals		Limited				Limited	
Linear algebra: Systems of equations, matrices, determinants	X				X		

PHY 2211 OPTICS/OPTICAL FIBRE PRINCIPLES (BAT)				PHY 8731 OPTICAL FIBRE PRINCIPLES FOR TECHNOLOGY (DIPLOMA)		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Complex numbers	X			X		
Differential equations: - Ordinary - Partial	X			X		
Laplace transforms	X			X		
Infinite series (power series, Taylor and Maclaurin series, Binomial series)	X			X		
Fourier Series	X			X		
Statistics: Sample mean, Sample variance, Standard deviation	X			X		
Statistics: Normal distribution	X			X		
Other: Algebra						

**Bridging Requirements (BAT) for OPTICS/OPTICAL FIBRE PRINCIPLES**

A) A graduate from the Photonics Technology program should take this course (no exemption granted).



**B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s): *PHY 8731 (80.0 hrs) Optical Fibre Principles for Technology.***

C) A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course ..... only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses:

<b>PHY 2310 SEMICONDUCTORS AND LOGIC (BAT)</b> Evaluator: Dr. Mohammed Mostefa				<b>ELN 8740 SEMICONDUCTORS AND LOGIC FOR TECHNOLOGY(DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)		Extensively			Moderately	
Trigonometric functions		Moderately		X		
Geometry Coordinate systems, vectors in space, planes, angles		Moderately		X		
Exponential and logarithmic functions		Moderately			Moderately	
Derivatives		Moderately			Moderately	
Integrals		Moderately		X		
Linear algebra: Systems of equations, matrices, determinants.		Moderately			Moderately	

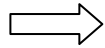
PHY 2310 SEMICONDUCTORS AND LOGIC (BAT)				ENL 8740 SEMICONDUCTORS AND LOGIC FOR TECHNOLOGY(DIPLOMA)		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Complex numbers		Limited		X		
Differential equations: - Ordinary - Partial		Moderately		X		
Laplace transforms	X			X		
Infinite series (power series, Taylor and Maclaurin series, Binomial series)	X			X		
Fourier Series	X			X		
Statistics: Sample mean, Sample variance, Standard deviation	X			X		
Statistics: Normal distribution	X			X		
Other: In this course the students have to derive the equations to be used.		Moderately			limited	

**Bridging Requirements (BAT) for PSY2310 SEMICONDUCTORS AND LOGIC**

A) A graduate from the Photonics Technology program should take this course (no exemption granted).

B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s):

**C) A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course *ELN 8740 Semiconductors and Logic for Tech* only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses:**




***Math Skills***

<b>PHY 2311 FUNDAMENTALS OF LIGHT SOURCES (BAT)</b> Evaluator : Dr. Abdul Al-Azzawi				<b>PHY 8740 FUNDAMENTALS OF LIGHT EMISSION (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)	X			X		
Trigonometric functions		Limited			Limited	
Geometry Coordinate systems, vectors in space, planes, angles	X			X		
Exponential and logarithmic functions		Moderately			Limited	
Derivatives	X			X		
Integrals		Moderately			Limited	
Linear algebra: Systems of equations, matrices, determinants.	X			X		

PHY 2311 FUNDAMENTALS OF LIGHT SOURCES (BAT)				PHY 8740 FUNDAMENTALS OF LIGHT EMISSION (DIPLOMA)		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Complex numbers	X		Absolutely	X		
Differential equations: - Ordinary - Partial	X			X		
Laplace transforms	X			X		
Infinite series (power series, Taylor and Maclaurin series, Binomial series)	X			X		
Fourier Series	X			X		
Statistics: Sample mean, Sample variance, Standard deviation	X			X		
Statistics: Normal distribution	X			X		
Other: Simple Algebra						

**Bridging Requirements (BAT) for PSY231 FUNDAMENTALS OF LIGHT SOURCES.**

A) A graduate from the Photonics Technology program should take this course (no exemption granted).

 **B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s):**  
***PHY 8740 Fundamental of Light Emission.***

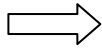
C) A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course ..... only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses.

<b>PHY 2312 OPTICS/OPTICAL FIBRE DEVICES (BAT)</b> <b>Evaluator: Dr. Abdul Al-Azzawi</b>				<b>PHY 8742 OPTIC/OPTICAL FIBRE DEVICES (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)	X			X		
Trigonometric functions		Moderately			Moderately	
Geometry Coordinate systems, vectors in space, planes, angles		Moderately			Moderately	
Exponential and logarithmic functions		Moderately			Moderately	
Derivatives	X			X		
Integrals		Limited			Limited	
Linear algebra: Systems of equations, matrices, determinants.	X			X		

PHY 2312 OPTICS/OPTICAL FIBRE DEVICES (BAT)				PHY 8742 OPTIC/OPTICAL FIBRE DEVICES (DIPLOMA)		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Complex numbers	X			X		
Differential equations: - Ordinary - Partial	X			X		
Laplace transforms	X			X		
Infinite series (power series, Taylor and Maclaurin series, Binomial series)	X			X		
Fourier Series	X			X		
Statistics: Sample mean, Sample variance, Standard deviation	X			X		
Statistics: Normal distribution	X			X		
Other: Simple Algebra	X			X		

**Bridging Requirements (BAT) for PSY2312 OPTICS/OPTICAL FIBRE DEVICES**

A) A graduate from the Photonics Technology program should take this course (no exemption granted).



**B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s):  
*PHY 8742 OPTICS/OPTICAL FIBRE DEVICES.***

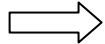
C) A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course ..... only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses.

<b>PHY 2410 LASER SYSTEMS (BAT)</b> Evaluator: Dr. Robert Weeks				<b>PHY 8743 LASER SYSTEMS FOR TECHNOLOGY (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)		Moderately	Various functions are discussed.		Limited	Some discussion of various functions and optic discussions.
Trigonometric functions		Limited	Some Schrodinger Equations and Basic Optics.		Limited	Some use of sine, cosine, etc. optics related discussions.
Geometry Coordinate systems, vectors in space, planes, angles		Limited	Discussion of Laser System Layouts.		Limited	Discussion of construction of laser systems.
Exponential and logarithmic functions		Moderately	Exponentials in various equations.		Moderately	Exponential equations used in a variety of experiments. (Black Body)
Derivatives		Limited	Einstein's Coefficients		Moderately	Einstein's Coefficients
Integrals		Limited			Limited	
Linear algebra: Systems of equations, matrices, determinants.		Limited	Some discussion on Optics.	X		

PHY 2410 LASER SYSTEMS (BAT)				PHY 8743 LASER SYSTEMS FOR TECHNOLOGY (PHY 8743) (DIPLOMA)		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Complex numbers		Limited	Phase Discussion		Limited	
Differential equations: - Ordinary - Partial		Limited	Quantum Mechanics Basics		Moderately	Discussion of phase.
Laplace transforms	X			X		
Infinite series (power series, Taylor and Maclaurin series, Binomial series)	X			X		
Fourier Series	X			X		
Statistics: Sample mean, Sample variance, Standard deviation		Limited	Discussion of lab methods		Limited	Some use in lab discussions and experiments.
Statistics: Normal distribution		Limited	Gaussian Distribution		Moderately	Gaussian Distribution and discussion of Broadening.
Other: Software		Moderately	Zemax Software used for Basic Optic Design	X		
In this course the student have to derive the equations to be used.		Limited			Limited	

**Bridging Requirements (BAT) for PSY2410 LASER SYSTEMS**

A) A graduate from the Photonics Technology program should take this course (no exemption granted).



**B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s):**

***PHY 8743 + PHY 8752 + PHY 8751***

C) A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course ..... only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses.

<b>ELN 2410 TELECOMMUNICATIONS (BAT)</b> <b>Evaluator: Dr. Wahab Almuhtadi</b>				<b>PHY 8761 FIBER COMMUNICATIONS I (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)		Limited			Limited	
Trigonometric functions		Extensively	The nature of light optical fibers, structure wave guiding and fabrication.		Moderately	The nature of light optical fibers, structure wave guiding and fabrication
Geometry Coordinate systems, vectors in space, planes, angles		Moderately	Light propagation, geometrical optics.		Limited	Light propagation, geometrical optics.
Exponential and logarithmic functions		Moderately	Wave equation for step index fiber, wave guide equation.		Limited	Wave equation for step index fiber, wave guide equation.
Derivatives		Limited	Material dispersion, wave guide dispersion, signal degradation.			Material dispersion, wave guide dispersion, signal degradation.
Integrals		Limited	Digital receiver performance, Intermodel Dispersion, shot noise, sensitivity.		Limited	Digital receiver performance, Intermodel Dispersion, shot noise, sensitivity.
Linear algebra: Systems of equations, matrices, determinants.		Limited			Limited	

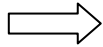
<b>ELN 2410 TELECOMMUNICATIONS (BAT)</b>				<b>PHY 8761 FIBER COMMUNICATIONS I (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Complex numbers		Limited	In various chapters of the course.		Limited	
Differential equations: - Ordinary - Partial		Limited	Soliton, pulses and parameters.		Limited	Soliton, pulses and parameters.
Laplace transforms	X			X		
Infinite series (power series, Taylor and Maclaurin series, Binomial series)	X			X		
Fourier Series	X		Optical receiver operation, fundamental receiver operation, Fourier Transform Representation.		Limited	Optical receiver operation, fundamental receiver operation, Fourier Transform Representation.
Statistics: Sample mean, Sample variance, Standard deviation		Limited			Limited	
Statistics: Normal distribution		Limited		X		
Other: Maxwell's Equations		Moderately	Mode theory for circular waveguide.		Limited	Mode theory for circular waveguide.
In this course the student have to derive the equations to be used.	X			X		

**Bridging Requirements (BAT) for ELN 2410 TELECOMMUNICATIONS**

A) A graduate from the Photonics Technology program should take this course (no exemption granted).

B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s):

**C) A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course *PHY 8761 FIBER COMMUNICATIONS I (Diploma)* only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses: *Fourier Series, Derivations, Integral, geometry, Differential equations, Maxwell's equations.***

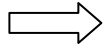


<b>PHY 2411 MANUFACTURING PHOTONICS COMPONENTS (BAT)</b> <b>Evaluator: Dr. Abdul Al-Azzawi</b>				<b>PHY 8741 MANUFACTURING PHOTONICS DEVICES (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)	X			X		
Trigonometric functions	X			X		
Geometry Coordinate systems, vectors in space, planes, angles.	X			X		
Exponential and logarithmic functions		Limited			Moderately	
Derivatives	X			X		
Integrals	X			X		
Linear algebra: Systems of equations, matrices, determinants.	X			X		

PHY 2411 MANUFACTURING PHOTONICS COMPONENTS (BAT)				PHY 8741 MANUFACTURING PHOTONICS DEVICES (DIPLOMA)		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Complex numbers	X			X		
Differential equations: - Ordinary - Partial	X			X		
Laplace transforms	X			X		
Infinite series (power series, Taylor and Maclaurin series, Binomial series)	X			X		
Fourier Series	X			X		
Statistics: Sample mean, Sample variance, Standard deviation		Moderately			Limited	
Statistics: Normal distribution		Moderately			Moderately	
Other: Simple Algebra						

**Bridging Requirements (BAT) for PHY2411 MANUFACTURING PHOTONICS COMPONENTS.**

A) A graduate from the Photonics Technology program should take this course (no exemption granted).



**B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s):**  
***PHY 8741 MANUFACTURING PHOTONICS COMPONENTS***

C) A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course ..... only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses.

<b>ELN 2510 CONTROL SYSTEMS (BAT)</b>				<b>ELN 8750 CONTROL SYSTEMS (DIPLOMA)</b>		
<b>Evaluator: Dr. Brahim Chebbi</b>						
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)		Extensively			Extensively	
Trigonometric functions		Extensively			Extensively	
Geometry Coordinate systems, vectors in space, planes, angles		Moderately			Moderately	
Exponential and logarithmic functions		Extensively			Limited	
Derivatives		Extensively			Moderately	
Integrals		Moderately			Moderately	
Linear algebra: Systems of equations, matrices, determinants.		Moderately			Moderately	

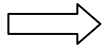
ELN 2510 CONTROL SYSTEMS (BAT)				ELN 8750 CONTROL SYSTEMS (DIPLOMA)		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Complex numbers		Extensively			Moderately	
Differential equations: - Ordinary - Partial		Extensively			Moderately	
Laplace transforms		Extensively			Moderately	
Infinite series (power series, Taylor and Maclaurin series, Binomial series)	X			X		
Fourier Series	X			X		
Statistics: Sample mean, Sample variance, Standard deviation	X			X		
Statistics: Normal distribution	X			X		
Other:						

**Bridging Requirements (BAT) for ENL2510 CONTROL SYSTEMS**

A) A graduate from the Photonics Technology program should take this course (no exemption granted).

B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s):

**C) A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course *ELN 8750 CONTROL SYSTEMS* only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses: *More involved Math theory in system modeling and stability analysis.***



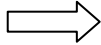
<b>PHY 2510 PHOTONICS MANUFACTURING SYSTEMS (BAT)</b> Evaluator: Dr. Robert Weeks				<b>PHY 8750 PHOTONICS AND BIOPHOTONICS SYSTEMS</b> Also material from PHY8753 LASER MATTER INTERACTION (DIPLOMA)		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)		Limited			Moderately	Refresher material
Trigonometric functions		Moderately			Limited	Optic basics
Geometry Coordinate systems, vectors in space, planes, angles		Moderately			Limited	System design and set up.
Exponential and logarithmic functions		Moderately			Moderately	Various equations used have exponentials (black body, radiation, absorption, etc.)
Derivatives		Moderately			Limited	Semiconductor basics
Integrals		Moderately			Limited	
Linear algebra: Systems of equations, matrices, determinants.		Moderately		X		

<b>PHY 2510 PHOTONICS MANUFACTURING SYSTEMS (BAT)</b> <b>Evaluator: Dr. Robert Weeks</b>				<b>PHY 8750 PHOTONICS AND BIOPHOTONICS SYSTEMS</b> <b>PHY8753 LASER MATTER INTERACTION (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Complex numbers		Moderately			Limited	Phase and holography discussions.
Differential equations: - Ordinary - Partial		Moderately			Limited	Schrodinger equations Quantum wells.
Laplace transforms		Moderately		X		
Infinite series (power series, Taylor and Maclaurin series, Binomial series)		Moderately		X		
Fourier Series		Moderately		X		
Statistics: Sample mean, Sample variance, Standard deviation		Extensively			Moderately	Experimental discussions
Statistics: Normal distribution		Moderately			Moderately	Gaussian Beam discussions.
Other: Lab view		Moderately	Student to learn use of lab view. Control/Measure Experiments	X		
In this course the student will have to derive the equations to be used		Moderately		X		

**Bridging Requirements (BAT) for PHY2510 PHOTONICS MANUFACTURING SYSTEMS**

A) A graduate from the Photonics Technology program should take this course (no exemption granted).

B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s):

 C) **A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course PHY 8750 and PHY8753 only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses:**

*Add labview training, Cross Reference to PHY 2511 to ensure expertise.*

*Possibly Mathematical Training in making/ designing beam deliveries using Zemax or other software.*

<b>PHY 2511 ADVANCED OPTICAL SYSTEMS (BAT)</b> <b>Evaluator: Dr. Robert Weeks</b>				<b>PHY 8751 ADVANCED OPTICAL SYSTEMS (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)		Moderately			Moderately	Bessel Functions
Trigonometric functions		Extensively			Moderately	Basic Optics Refraction (etc.)
Geometry Coordinate systems, vectors in space, planes, angles		Moderately			Moderately	Commonly used throughout (evectors)
Exponential and logarithmic functions		Moderately			Moderately	Exponential Decrease of Evanescent Waves.
Derivatives		Moderately			Moderately	Maxwell Equations
Integrals		Moderately			Moderately	Fourier Optics
Linear algebra: Systems of equations, matrices, determinants.		Extensively			Moderately	Jones Matrices Optic Matrices

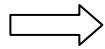
<b>PHY 2511 ADVANCED OPTICAL SYSTEMS (BAT)</b> <b>Evaluator: Dr. Robert Weeks</b>				<b>PHY 8751 ADVANCED OPTICAL SYSTEMS (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Complex numbers		Extensively			Moderately	Phase Discussion
Differential equations: - Ordinary - Partial		Moderately	Maxwell Equation EM Theory (Curl, Div., etc.)		Moderately	Various equations
Laplace transforms		Moderately		X		
Infinite series (power series, Taylor and Maclaurin series, Binomial series)		Moderately			Limited	
Fourier Series		Extensively			Moderately	Fourier optics
Statistics: Sample mean, Sample variance, Standard deviation		Moderately			Limited	Some discussion in labs.
Statistics: Normal distribution		Moderately			Moderately	Gaussian, Bessel Beams
Other: Optical Design Software		Moderately	Need to expand student exposure.	X		
In this course the student will have to derive the equations to be used.		Moderately		X		

**Bridging Requirements (BAT) for PHY2511 ADVANCED OPTICAL SYSTEMS**

A) A graduate from the Photonics Technology program should take this course (no exemption granted).

B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s):

**C) A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course *PHY 8751 ADVANCED OPTICAL SYSTEMS* only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses:**



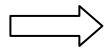
***Software Design Tools, Jones Matrices, Fourier Optics , Electro Magnetic Theory and Applications , Matrix Optics, Holographic Theory, more math.***

<b>PHY 2512 THIN FILM AND VACUUM SYSTEMS (BAT)</b> <b>Evaluator: Dr. Brahim Chebbi</b>				<b>PHY 8755 FLUID AND VACUUM SYSTEMS (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)		Moderately			Moderately	
Trigonometric functions	X			X	Moderately	
Geometry Coordinate systems, vectors in space, planes, angles		Moderately			Moderately	
Exponential and logarithmic functions		Moderately			Moderately	
Derivatives		Moderately			Moderately	
Integrals		Moderately			Moderately	
Linear algebra: Systems of equations, matrices, determinants.		Moderately			Moderately	

<b>PHY 2512 THIN FILM AND VACUUM SYSTEMS (BAT)</b>				<b>PHY 8755 FLUID AND VACUUM SYSTEMS (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Complex numbers	X			X		
Differential equations: - Ordinary - Partial		Moderately			Moderately	
Laplace transforms	X			X		
Infinite series (power series, Taylor and Maclaurin series, Binomial series)	X			X		
Fourier Series	X			X		
Statistics: Sample mean, Sample variance, Standard deviation	X			X		
Statistics: Normal distribution	X			X		
Other: Finite Element Method Software						

**Bridging Requirements (BAT) for PHY2512 THIN FILM AND VACUUM SYSTEMS**

A) A graduate from the Photonics Technology program should take this course (no exemption granted).



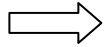
**B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s):**

C) A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course ..... only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses:

PHY 2611 OPTO-ELECTRONIC DEVICES (BAT) Evaluator: Dr. Robert Weeks				PHY 8752 OPTO-ELECTRONICS DEVICES (DIPLOMA)		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)		Moderately			Moderately	Bessel Functions
Trigonometric functions		Extensively			Moderately	Basic Optics Refraction (etc.)
Geometry Coordinate systems, vectors in space, planes, angles		Moderately			Moderately	Commonly used throughout (evectors)
Exponential and logarithmic functions		Moderately			Moderately	Exponential Decrease of Evanescent Waves.
Derivatives		Moderately			Moderately	Maxwell Equations
Integrals		Moderately			Moderately	Fourier Optics
Linear algebra: Systems of equations, matrices, determinants.		Extensively			Moderately	Jones Matrices Optic Matrices

PHY 2611 OPTO-ELECTRONICS DEVICES (BAT)				PHY 8752 OPTO-ELECTRONICS DEVICES (DIPLOMA)		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Complex numbers		Extensively			Moderately	Phase Discussion
Differential equations: - Ordinary - Partial		Moderately	Maxwell Equation EM Theory (Curl, Div., etc.)		Moderately	Various equations
Laplace transforms		Moderately		X		
Infinite series (power series, Taylor and Maclaurin series, Binomial series)		Moderately			Limited	
Fourier Series		Extensively			Moderately	Fourier optics
Statistics: Sample mean, Sample variance, Standard deviation		Moderately			Limited	Some discussion in labs.
Statistics: Normal distribution		Moderately			Moderately	Gaussian, Bessel Beams
Other: Optical Design Software		Moderately	Need to expand student exposure	X		
In this course the student will have to derive the equations to be used.		Moderately		X		

**Bridging Requirements (BAT) for PHY2611 OPTO-ELECTRONIC DEVICES**



**A) A graduate from the Photonics Technology program should take this course (no exemption granted).**

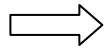
B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s):

C) A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course ..... only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses:

<b>PHY 2612 IMAGING, IMAGE/SIGNAL PROCESSING (BAT)</b> <b>Evaluator: Mrs. Sofia Matoug</b>				<b>PHY 8757 COMPUTER VISION AND IMAGE PROCESSING (DIPLOMA)</b>		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Polynomials Functions Roots of Polynomials (e.g. quadratic equations)		Moderately			Moderately	
Trigonometric functions		Extensively			Moderately	
Geometry Coordinate systems, vectors in space, planes, angles		Moderately			Moderately	
Exponential and logarithmic functions		Limited			Limited	
Derivatives		Moderately			Moderately	
Integrals		Moderately			Moderately	
Linear algebra: Systems of equations, matrices, determinants.		Extensively			Extensively	

PHY 2612 IMAGING, IMAGE/SIGNAL PROCESSING (BAT)				PHY 8757 COMPUTER VISION AND IMAGE PROCESSING (DIPLOMA)		
Mathematical Tool	Not Used	Used	Examples	Not Used	Used	Examples
Complex numbers	X			X		
Differential equations: - Ordinary - Partial		Limited			Limited	
Laplace transforms	X			X		
Infinite series (power series, Taylor and Maclaurin series, Binomial series)		Moderately			Moderately	
Fourier Series		Moderately			Moderately	
Statistics: Sample mean, Sample variance, Standard deviation		Moderately			Moderately	
Statistics: Normal distribution	X			X		
Other:						

**Bridging Requirements (BAT) for PHY2612 IMAGING, IMAGE/SIGNAL PROCESSING**



**A) A graduate from the Photonics Technology program should take this course (no exemption granted).**

B) A graduate from the Photonics technology program should be exempted from this course. The learning outcomes of this course are equivalent to the learning outcomes of the following course(s):

C) A graduate from the Photonics technology program should be exempted from this course, with some remediation. The learning outcomes from the following course ..... only partially fulfill the learning outcomes of the present course. The following outcomes will have to be addressed in other courses:

## Results of iteration 2:

### Level: 01

MAT8201 CALCULUS 1	Credit granted
CHE8287 GENERAL CHEMISTRY	Required
CST8810 PROGRAMMING 1	Credit granted
PHY2110 OPTICS AND WAVES	Exemption with remediation
PHY2111 TRENDS IN PHOTONICS TECHNOLOGY	Credit granted
SAF8208 OCCUPATIONAL HEALTH AND SAFETY, AND ETHICS	Credit granted

### Level: 02

MAT8202 CALCULUS 2	Credit granted
PHY2210 KINEMATICS AND DYNAMICS	Exemption with remediation
CST8811 PROGRAMMING 2	Credit granted
ELN2210 ELECTROTECHNOLOGY	Exemption with remediation
PHY2211 OPTICS/OPTICAL FIBRE PRINCIPLES	Credit granted

### Level: 03

MAT8203 LINEAR ALGEBRA	Required
ELN2310 INTERFACING	Credit granted
PHY2310 SEMICONDUCTORS AND LOGIC	Exemption with remediation
PHY2311 FUNDAMENTALS OF LIGHT SOURCES	Credit granted
PHY2312 OPTICS/OPTICAL FIBRE DEVICES	Credit granted
PHY2313 ELECTIVE	Credit granted

### Level: 04

MAT8204 DIFFERENTIAL EQUATIONS	Required
PHY2410 LASER SYSTEMS	Credit granted
ELN2410 TELECOMMUNICATIONS	Exemption with remediation
PHY2411 MANUFACTURING PHOTONICS COMPONENTS	Credit granted
MAT8205 STATISTICS	Credit granted
ENL8810 TECHNICAL COMMUNICATIONS	Credit granted
WKT8000 CO-OPERATIVE EDUCATION WORK TERM PREPARATION	Required

### Co-op 1

PHY2901 WORK TERM I	Required; may challenge through PLAR process
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### Level: 05

ELN2510 CONTROL SYSTEMS	Exemption with remediation
PHY2510 PHOTONICS MANUFACTURING SYSTEMS	Exemption with remediation
PHY2511 ADVANCED OPTICAL SYSTEMS	Exemption with remediation

PHY2512 THIN FILM AND VACUUM SYSTEMS	Credit granted
PHY2513 ELECTIVE	Credit granted

**Level: 06**

MAT8206 ADVANCED CALCULUS	Required
PHY2610 ELECTROMAGNETIC THEORY	Required
PHY2611 OPTO-ELECTRONIC DEVICES	Required
PHY2612 IMAGING, IMAGE/SIGNAL PROCESSING	Required
MGT8500 BUSINESS PRINCIPLES	Required
PHY2613 ELECTIVE	Required

**Co-op 2**

PHY2902 WORK TERM II	Required
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**Level: 07**

PHY2714 MATERIALS SCIENCE	Required
PHY2710 THERMODYNAMICS AND HEAT TRANSFER	Required
PHY2711 ADVANCED OPTICAL THEORY	Required
PHY2712 QUANTUM PHYSICS	Required
PHY2713 PHOTONICS RESEARCH PROJECT	Required
PHY2715 ELECTIVE	Required

Level: 08

PHY2810 SOLID STATE PHYSICS	Required
PHY2811 BIO/MEDICAL PHOTONICS	Required
PHY2812 ADVANCED RESEARCH PROJECT	Required
MGT8501 OPERATIONS MANAGEMENT	Required
PHY2818 ELECTIVE	Required

**Bridging courses:**

From the difference in the theoretical coverage in the Diploma courses and the BAT courses, it was felt that the mathematical background can be covered in two bridging courses.

Bridging course I: ADVANCED PHYSICS

Bridging course II: ADVANCED OPTICAL ENGINEERING

These courses will cover the curriculum gaps identified in the second iteration of the gap analysis. The course outlines for these two bridging courses are included in Appendix 5.2.5.

## Appendix 5.2.5: Bridging Courses

<b>Course Title: Advanced Physics</b>
<b>Year and Semester: Year One (Semester 01) (Bridging Program) concurrent with Year 03 (Semester 05) (Regular Program)</b>
<p><b>Course/subject description:</b>            This course builds on the student's understanding of mechanics, electricity, optics and electronics. It reviews the basic principles of the physical concepts and covers in detail the mathematical foundations of these principles. The mathematical derivations of pertinent equations are developed. In mechanics, the course covers the concepts of motion, inertia, momentum, oscillations, waves and energy. It emphasizes the different laws of mechanics; and the laws of conservation of energy and momentum.            Prerequisites: Advanced Diploma in Photonics Engineering Technology.            Corequisites: None.</p>
<p><b>Method(s) of Instruction:</b>            Lectures and/or directed studies.</p>
<p><b>Content outline by topic:</b></p> <ol style="list-style-type: none"> <li>1. Selected topics in mechanics such as:           <ul style="list-style-type: none"> <li>- Analytical solutions of linear, curvilinear and simple harmonic motions.</li> <li>- Newton's Laws of motion.</li> <li>- Rotational motion: vector cross product, kinematics, dynamics, angular momentum, rotational work and energy.</li> </ul> </li> <li>2. Selected topics in electricity such as:           <ul style="list-style-type: none"> <li>- Kirchhoff's voltage law, Kirchhoff's current law</li> <li>- Parallel circuit, equivalent resistance, Series-parallel circuit, circuit analysis by simplification, ladder network.</li> <li>- Loop analysis, concept.</li> <li>- Current source, conversions, superposition theorem.</li> <li>- Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.</li> </ul> </li> <li>3. Selected topics in semiconductors and logic such as:           <ul style="list-style-type: none"> <li>- Voltage and current equations for PN junction diodes, Bipolar junction transistor (BJT), Field effect transistor (FET, MESFET, JFET) and metal-oxide semiconductor (MOS, MOSFET).</li> <li>- Number systems &amp; Boolean algebra</li> <li>- Combinational logic</li> </ul> </li> <li>4. Selected topics in optics and waves such as:           <ul style="list-style-type: none"> <li>- Maxwell's equations and electromagnetic waves.</li> <li>- Wave nature of light; interference.</li> <li>- Diffraction and polarization.</li> <li>- Early quantum theory and models of the atom.</li> </ul> </li> </ol>
<b>Length in Hours: 75 hours</b>
<p><b>Methods and Frequency of evaluation of student performance:</b>            Assignments, quizzes and exams.</p>
<b>Resources to be purchased by students: None.</b>
<p><b>Textbook requirements:</b>            Giancoli, D.C. (2000). <i>Physics for scientists and engineers with modern physics</i>. Upper Saddle River, NJ: Prentice-Hall.</p>
<p><b>Learning Outcomes:</b>            The student will be able to demonstrate the following skills:</p> <ol style="list-style-type: none"> <li>1. Identify and explain the physical concepts of different laws in mechanics, electricity, optics and semiconductor theories.</li> <li>2. Analyze the mathematical formulation of the above laws.</li> </ol>

<p>3. Derive the equations describing the application of the physical laws to specific cases using realistic assumptions and simplifications.</p> <p>4. Formulate problems in mechanics, electricity and optics from the physical model to the mathematical model.</p>
<p><b>Information About Course Designer/Developer:</b>  Course designed by faculty eligible to teach this course:  Dr. Brahim Chebbi, Ph.D. Mech. Eng; Dr. Mohammed Mostefa, Ph.D. Physics.</p>
<p><b>List faculty qualified to teach the course and/or statement “faculty to be hired”:</b>  Dr. Brahim Chebbi, Ph.D. Mech. Eng; Dr. Mohammed Mostefa, Ph.D. Physics.</p>
<p><b>If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line?</b> up to 100%</p>
<p><b>Faculty qualifications required to teach/supervise the course:</b>  Ph.D. or Master’s degree in the subject area and related experience in subject area.</p>
<p><b>Classroom requirements:</b> e-Classroom.</p>
<p><b>Equipment requirements:</b> None.</p>

<b>Course Title: Advanced Optical Engineering</b>
<b>Year and Semester: Year One (Semester 01) (Bridging Program) concurrent with Year 03 (Semester 05) (Regular Program)</b>
<p><b>Course/subject description:</b>  This course builds on the student's understanding of photonics and optical engineering systems in telecommunications, laser technology, manufacturing and other applications. Emphasis will be placed on the design of procedures, performance assessment and estimation of losses. The students will study the theories on which these systems are based and use them throughout this course.  Prerequisites: Advanced Diploma in Photonics Engineering Technology.  Corequisites: None.</p>
<p><b>Method(s) of Instruction:</b>  Lectures and/or directed studies.</p>
<p><b>Content outline by topic:</b></p> <ol style="list-style-type: none"> <li>1. Selected topics in optical communications such as: <ul style="list-style-type: none"> <li>- Wave guides, dispersion, sensitivity, signal degradation, Fourier transform representation,</li> <li>- Attenuation and performance of optical fibres</li> <li>- Optical interface specifications of optical network elements</li> <li>- Performance monitoring of optical network element</li> </ul> </li> <li>2. Selected topics in laser technology such as: <ul style="list-style-type: none"> <li>- Light spectrum, light loss measurements and calculations</li> <li>- Waves and wave generation</li> <li>- Introduction to visible light wavelengths and spectrums, and blackbody radiation including Planck formula &amp; quantum concepts</li> <li>- Basic quantum theory, Bohr theory, Schrodinger theory (particle in a box) and energy levels</li> <li>- Quantum energy level designations including spin and s,p,d, f, designations</li> <li>- Gain and loss in a lasers</li> </ul> </li> <li>3. Selected topics in photonics manufacturing systems such as: <ul style="list-style-type: none"> <li>- Advanced engineering calculations and design of laser manufacturing applications (drilling, cutting and welding)</li> <li>- Chemistry, physics and biophysics of various laser based measurement, material modification (including biological materials) and test systems</li> </ul> </li> </ol>
<b>Length in Hours:</b> 75 hours
<p><b>Methods and Frequency of evaluation of student performance:</b>  Assignments, quizzes and exams.</p>
<b>Resources to be purchased by students:</b> None.
<p><b>Textbook requirements:</b>  Silfvast, W. (2004). <i>Laser fundamentals</i>. (2<sup>nd</sup> ed.). Cambridge, UK: Cambridge University Press.  Keiser, G. (1999). <i>Optical fibre communications</i>. McGraw-Hill Higher Education, ISBN : 0072360763.  Ready, J. (1997). <i>Industrial applications of lasers</i>. (2<sup>nd</sup> ed.). San Diego, CA: Academic Press.</p>
<p><b>Learning Outcomes:</b>  The student will be able to demonstrate the following skills:</p> <ol style="list-style-type: none"> <li>1. Describe the operation of different telecommunication, laser technology, manufacturing and other advanced optical systems and their components.</li> <li>2. Assess the performance, the efficiency and the losses of different systems by using the appropriate theories.</li> <li>3. Use computer aided design software to design systems and perform relevant analysis.</li> </ol>
<p><b>Information About Course Designer/Developer:</b>  Course designed by faculty eligible to teach this course:  Dr. Robert Weeks, Ph.D. Physics; Dr. Wahab Al-Muhtadi, Ph.D. Elec. Eng.</p>

<p><b>List faculty qualified to teach the course and/or statement “faculty to be hired”:</b>  Dr. Robert Weeks, Ph.D. Physics; Dr. Wahab Al-Muhtadi, Ph.D. Elec. Eng.</p>
<p><b>If the method of instruction includes on-line delivery (technology-based, computer-based and web-based), what percentage of the course content will be offered on-line?</b> up to 100%</p>
<p><b>Faculty qualifications required to teach/supervise the course:</b>  Ph.D. or Master’s degree in the subject area and related experience in subject area.</p>
<p><b>Classroom requirements:</b> e-Classroom.</p>
<p><b>Equipment requirements:</b> None.</p>

### Appendix 5.3: Promotion and Graduation Requirements

We are requesting that the grade required for promotion in all courses and for graduation be changed from the current B- (70% – 72%) to C- (60% – 62%). The academic difficulty and standards in this program are quite high. A promotion and graduation level of C- (60% – 62%) will still demand high performance from the students in the program. It will put the levels at a comparable level to the technology and engineering programs at other institutions of higher learning. A survey of engineering programs in Ontario universities revealed that, in general, the promotion requirements, including those for individual courses and those for overall achievement, range between D- and C-. Please refer to table on next page.

The proposed change will preserve the high standards of the program and will be more fair to the students. This proposed promotion and graduation level is within the guidelines set by PEQAB.

Program Requirement	Level of Achievement	
	Promotion	Graduation
Courses in disciplines outside the main field(s) of study	60% – 62% C-	
Courses in disciplines within the main field(s) of study	60% – 62% C-	
Other: Co-op Work Term	Pass/Fail	
Other: Research Project	60% – 62% C-	
Overall achievement		60% – 62% C-

Directive E11 (attached) explains how the GPA is calculated.

## Ontario Universities' Passing and Graduation Grade Requirements in Engineering Programs\*

University	Passing Grade	Graduation Grade
Carleton	D- 50%	C- 60-62%
Lakehead	60% (3rd & 4 <sup>th</sup> year)	
McMaster	D-	
Ottawa	D+	
Queen's	50%	Cumulative Average of 55%
Ryerson		Minimum GPA 2.0
Toronto	50%	Average $\geq 60\%$
Waterloo	50%	Term Average $\geq 60\%$ required for promotion & graduation
Western	50%	Term Average $\geq 60\%$ required for promotion & graduation
Windsor	50%	
York		Cumulative average of C+

\* This information was obtained from each university's web site. Full details were not available in all cases.

<b>ALGONQUIN COLLEGE DIRECTIVE</b>	<b>NO. OF PAGES</b> 6	<b>DIRECTIVE NO.</b> E11
	<b>ORIGINATOR</b> Registrar	
	<b>APPROVED BY</b> ASMC	
<b>TITLE</b> GRADING SYSTEM	<b>EFFECTIVE DATE</b> 2005.06.01	<b>REPLACES</b> 2001.10.05

### **PREAMBLE**

The College is accountable for evaluating student achievement based on established standards and for communicating the results of evaluation in a clear, consistent and equitable manner. The assigning of College-defined grades formalizes a student's status within a course and/or program and provides a basis for decisions regarding recognition of excellence, promotion, academic probation and withdrawal.

### **POLICY**

1. Evaluation of student performance is an academic activity, which culminates in the assigning of grades. Grades are earned by students and represent a measure of achievement in reference to the standards established for programs and courses.
2. The College-wide grading system, which is described in this policy, is to be applied in all courses. All sections of a given course are to use the same grading designation.
3. Students' final grades are not official until recorded and released by the Registrar's Office via ACSIS or via hard copy.

### **PROCEDURES, ROLES AND RESPONSIBILITIES**

1. Grade Designations with Numeric Value
  - 1.1 Letter grades are used to describe the achievement level attained within a particular course. Variance within a grade range is indicated by the use of a plus or a minus.
  - 1.2 If percentages are used for a course, they are to be converted to a letter grade.

## Range

- A:    Excellent            Course learning requirements are met in a consistently outstanding manner.
- B:    Superior              Course learning requirements are met and exceed the requirements.
- C:    Satisfactory          Course learning requirements are met satisfactorily.
- D:    Marginal                Course learning requirements are met, but achieved at a marginal level. Consistent, ongoing effort is required for continuing success in the program.
- F:    Unsatisfactory Course learning requirements are not met. No credit is  
      (Failure)            awarded.
- FSP: Failure with Supplemental Privilege - An "FSP" is a grade designation assigned to a student whose achievement in a course is at a failing level but warrants the opportunity to upgrade. The "FSP" is treated as an "F" until such time as it is replaced with a grade achieved through the supplemental process. Any FSP not upgraded within 4 months will revert to an "F" in the term record. Exceptions due to unusual circumstances will be handled on an individual basis by arrangement with the Registrar's Office prior to the conversion date.

The supplemental process: A student is assigned an FSP grade. The student pays the Supplemental Evaluation Fee at the Registrar's Office and completes the Application for Supplemental Evaluation form. The student takes the completed form to the department where the supplemental process is arranged. Upon completion of the requirements of the supplemental process, the department assigns the student's grade and submits the grade on the Application for Supplemental Evaluation form to the Registrar's Office. The Registrar's Office actions the grade on the system accordingly and sends a revised transcript to the student, if applicable.

During the supplemental process, the student is normally granted permission to continue into the next course, pending the outcome of the supplemental.

- 1.3 A pass in each course is (50) percent. In some courses students may be required to achieve more than a minimal level of achievement in order to proceed in their program. For those courses, the course outline will stipulate the progression requirements, as will the supplementary program regulations.

Apprenticeship: Effective September 1999, an apprentice is deemed to have successfully completed a level of training if the grade point average for the session of in-school training is 1.7 or above, with no F's. This represents a satisfactory level of performance. A grade point average of less than 1.7 indicates that the apprentice has not been successful in the level of in-school training and has not satisfactorily demonstrated achievement of the learning outcomes of that level.

- 1.4 The grades described above carry numeric value for the purpose of averaging. These values are described in the table below:

<u>Percent Grade</u>	<u>Letter Grade</u>	<u>Numeric Grade</u>
90 - 100	A+	4.0
85 - 89	A	3.8
80 - 84	A-	3.6
77 - 79	B+	3.3
73 - 76	B	3.0
70 - 72	B-	2.7
67 - 69	C+	2.3
63 - 66	C	2.0
60 - 62	C-	1.7
57 - 59	D+	1.4
53 - 56	D	1.2
50 - 52	D-	1.0
	F	0
	FSP	0

- 1.5 The grade point average is a weighted average. It is calculated as follows:

- Each course is designated as having normative total instructional hours, that is the designated number of hours within which the course objectives may be achieved, regardless of variations in delivery. The number of grade points per course is determined by multiplying the normative total instructional hours of the course by the numeric value of the grade earned in that course. The resultant figure is called the grade point total.
- The grade point total is divided by the total number of normative instructional hours attempted for courses with grades having numeric value. Please note in such a computation '0' (F) is a numeric value. The resultant quotient is the grade point average.

$$\frac{\text{Grade Point Total}}{\text{Total Normative Hours}} = \text{Grade Point Average (G.P.A.)}$$

## 2. Grade Designations without Numeric Value

2.1 The following grade designations form part of the overall College grading system but do not carry numeric value.

**AG:** Aegrotat - Aegrotat standing "AG" applies to those students whose performance over a significant proportion of the course has been more than satisfactory but where, because of compelling personal reasons such as illness, the student is unable to complete the course, and where the student is unable to make up the deficiency.

Aegrotat standing does not carry a grade point value and is not included in the calculation of the GPA but is credited toward program requirements. In the case of illness, the student is required to present a medical certificate to the Program Chair. Aegrotat standing is recommended by the Academic Chair and approved by the Dean and submitted for consideration to the Registrar's Office with supporting medical documentation. It is only awarded in exceptional circumstances.

**AU:** Audit - An "AU" designates a course registration with audit status. A student who decides formally to waive receiving a credit for a particular course, by opting out of evaluation and grading, is described as having audit status in that course. This status is requested at the time of registration in the course.

**CR:** Credit - Indicates that the course learning requirements have been achieved by Prior Learning Assessment (PLA) process.

**EX:** Exemption - An "EX" is awarded to a student in recognition of a transfer of academic credit from other recognized institution(s).

Exemptions awarded for courses required for a program contribute to the requirements for graduation from the program, but have no value for the GPA.

**I:** Incomplete - The "Incomplete" is used when a student has not completed the course requirements within the time allotted but who is progressing satisfactorily. Normally the reason for Incomplete status is due to illness or bereavement or other personal reasons.

An Incomplete is not intended to give an extension to a student who has completed all elements of a course with failing status.

The Chair or designate will determine a realistic completion date to a maximum of four months, and must specify the grade to which the

"Incomplete" will default if the completion date is not met. The student will be informed in writing by the Chair or designate of the condition(s) for removal of the Incomplete and the deadline date for completion. Unless a new grade is submitted to the Registrar's Office, the default grade will be entered into the student's term record.

Exceptions to the four-month period due to unusual circumstances will be handled on an individual basis through the Registrar's Office.

A student who has an "Incomplete" in a course which is prerequisite to a course in the succeeding term may be permitted to register in that course only with the permission of the Chair responsible for the course.

**MB:** Modular-based. This is used by the Career and College Preparation department only and designates modular delivery.

**N:** Not Available - An "N" is an interim designation assigned when the course is still in progress at the time of reporting. "N" is also used to indicate that the professor was unable to provide the grades at the end of the course. Within four weeks of the end of the term, an "N" must be replaced with the grade earned. Exceptions to the deadline requirement due to curriculum constraints are to be arranged with the Registrar's Office.

**P:** Pass - A "P" is designated for a course which is not graded on the A-F scale but does carry credit value in a student's program. A "P" represents successful completion of the course learning requirements.

**SC:** Satisfactorily Completed

**NSC:** Not Satisfactorily Completed

"SC" and "NSC" are grades used only for continuing education non-credit courses and cannot be used to obtain transfers of credit.

**W:** Withdrawn - A "W" is assigned to a student who withdraws formally from a course within the prescribed deadline (the two-thirds point of the course section duration). A course dropped after the deadline, or *de facto* by ceasing to attend, is assigned an "F" grade.

**Note:** No Grades Required: A course, normally less than ten hours in duration, assigned this grading category requires no evaluation. It is assigned only to non-credit, general interest courses. The course will not appear on the transcript and cannot be used to obtain transfers of credit.

### 3. Academic Achievement

- 3.1 Unless the program has stipulated more specific program promotion criteria, a student who achieves a term grade point average at or above 1.7, as well as any minimum grade requirements in particular course(s) within a program, may progress in his/her program.
- 3.2 When all courses in a given level are graded Pass/Fail, a term GPA is not calculated. A student who achieves a "P" in all courses may progress in his/her program.

### 4. Academic Probation

- 4.1 A student is considered to be on academic probation whose term/cumulative grade point average falls below 1.7, or who carries 2 or more F grades. Continuation in the program is subject to conditions established by the Chair. In some cases, there may be program specific progression requirements which supersede the foregoing.

The transcript message reads:

Academic Probation - Please see your Program Coordinator

- 4.2 A student on probation may be required to reduce his/her course load, to withdraw from full-time status within the program, or, to withdraw completely from the program. A student permitted to continue in the program is subject to conditions established by the Chair.

A student required to withdraw completely from level 01 must reapply through the Ontario College Application Services. A student required to withdraw from an advanced level of the program must have the approval of the Chair prior to resuming his/her studies.

### 5. Repeated Courses

- 5.1 All grades are recorded on the student's transcript. If a course is repeated to replace a failed or lower grade, the higher grade will always be used to compute averages or to determine standing.

If the prerequisite(s) to a previously failed course changes prior to the student's repeating the course, the new prerequisite(s) is binding on the student.

- 5.2 Where the failed course is prerequisite to a course in the next level, the Chair may allow the student to re-register in the failed course and in the course to which it is prerequisite concurrently.

6. Repeated Level

In certain programs, students may be required to repeat a level. This could include the repetition of courses previously passed. In such cases, students must achieve satisfactory grades in all repeated courses.

7. Grade Changes

Any change in grades must be approved by the appropriate Chair, and submitted on the Grade Change Form to the Registrar's Office no later than four weeks after the end of the term (Incompletes and FSPs excepted). A failed prerequisite will not be upgraded to a passing grade on the basis of successful completion of a senior level course. The student must re-register in and successfully complete the failed course.

8. Review of Final Grades

If a student wishes a formal reassessment of a final grade, he/she must make the request in writing to the Registrar's Office within ten (10) working days of the issuance date of the transcript or the release of grades via ACSIS. This request must be accompanied by the fee levied for formal review of grades.

For more information, please see College Directive E24, Review of Final Grades.

**RELATED DIRECTIVES**

Course Outlines - E33

Academic Appeal - E15

Evaluation of Student Learning - E1

Progression and Graduation Requirements - E29

Review of Final Grades - E24

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Vice President, Academic

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Registrar

## APPENDIX A

### APPRENTICE

The following grading system was in effect from 1967 to 1999:

- (1) The summary of achievement is processed at the college for your information. The result is a grade rather than a percentage mark. Each course is assigned a credit value, therefore, the grade assigned for courses is converted into numerical values as follows:

Grade 4	=	Excellent
Grade 3	=	Good or Above Average
Grade 2	=	Satisfactory or Average
Grade 1	=	Below Average or Poor
Grade 0	=	Unsatisfactory or Failure
Grade SP	=	Failed with Supplemental Privileges

- (2) In the case of failure, you must contact your sponsoring agency.

### COLLEGE GRADING SYSTEM

The following grading system was in effect from 1967 to 1987:

Letter grades will be used for student assessment as described below:

A	Excellent	-	consistently outstanding performance
B	Superior	-	achievement decidedly above the required level
C	Satisfactory	-	achievement sufficient to enable the student to progress with confidence in that course
D	Marginal	-	minimum acceptable level of achievement
F	Unsatisfactory -		insufficient achievement

*(All the above grades except F will be considered a pass.)*

IN	Incomplete	-	failure to complete course requirements, while progress is otherwise satisfactory
EX	Exemption	-	the student is excused from course and given credit for it, normally because the work has previously been covered in another educational institution

AG	Aegrotat Standing	- the student is unable to write the final examination due to circumstances beyond control (e.g. illness) and is given credit based on work throughout the semester
CR	Credit	- the student has taken the course and passed it, but no mark can be given due to the nature of course
SP	Supplemental Privileges	- the student has failed the course but is allowed a supplemental assessment. A failing grade without "SP" following it indicates that the student must repeat the course.
NA	Not Available	- the mark has not yet been reported
AU	Audit	- the student has attended the lectures but has not attempted the examinations
WD	Withdrawn	- student withdrew from the course in good standing prior to the deadline date established for withdrawals (before 3 <sup>rd</sup> session of the course)
CS	Completed Satisfactorily	- student has attended 80% or more of classes

## COLLEGE GRADING SYSTEM

The grade point average system was implemented with the 1987 Fall Term. Previous records do not show average.

Grades with numeric value are calculated into the grade point average (GPA). Grade designations of P (Pass), EX (Exemption), CR (Credit), and AG (Aegrotat), are not calculated into the average but do contribute to fulfillment of program requirements.

The term grade point average (GPA) is computed by dividing the total number of grade points earned by the total number of normative instructional hours attempted in the term.

The cumulative grade point average (GPA) is computed by dividing the total number of grade points earned to date in a program by the total number of normative instructional hours attempted to date in that program. A cumulative GPA is calculated for all courses applicable to the program.

Graduate status is awarded upon successful completion of all program requirements. Honours standing is awarded based on a cumulative GPA of 3.60 or higher. (Prior to Fall 2004, the GPA required for Honours standing was 3.30 or higher.)

A complete description of the grading policy is found in College Directive E11.

FROM SEPTEMBER 1987 TO AUGUST 1998			EFFECTIVE - SEPTEMBER 1998			
LETTER GRADE	NUMERIC VALUE	DESCRIPTION	LETTER GRADE	NUMERIC VALUE	DESCRIPTION	PERCENTAGE CONVERSION
A+	4.0		A+	4.0		90-100%
A	4.0	Excellent	A	3.8	Excellent	85-89%
A-	3.7		A-	3.6		80-84%
B+	3.3		B+	3.3		77-79%
B	3.0	Superior	B	3.0	Superior	73-76%
B-	2.7		B-	2.7		70-72%
C+	2.3		C+	2.3		67-69%
C	2.0	Satisfactory	C	2.0	Satisfactory	63-66%
C-	1.7		C-	1.7		60-62%
D+	1.3		D+	1.4		57-59%
D	1.0	Marginal	D	1.2	Marginal	53-56%
D-	1.0		D-	1.0		50-52%
F	0.0	Unsatisfactory	F	0.0	Unsatisfactory (Failure)	
FSP	0.0	Failure, supplemental privilege	FSP	0.0	Failure with supplemental privilege	
AG	—	Aegrotat	AG	—	Aegrotat	
AU	—	Audit	AU	—	Audit	
CR	—	Credit	CR	—	Credit	
EX	—	Transfer of Academic Credit (Exemption)	EX	—	Transfer of Academic Credit (Exemption)	
I	—	Incomplete	I	—	Incomplete	
P	—	Pass	P	—	Pass	
W	—	Withdrawn	MB	—	Modular-based. Used to denote ongoing study for modular-based course delivery. No credit value. (Limited use)	
N	—	Not Available	N	—	Not Available	
NSC	—	Not Satisfactorily Completed (Continuing Education only - non-credit)	NSC	—	Not Satisfactorily Completed (Continuing Education only - non-credit)	
SC	—	Satisfactorily Completed (Continuing Education only - non-credit)	SC	—	Satisfactorily Completed (Continuing Education only - non-credit)	
			W	—	Withdrawn	

## **Appendix 6.5: Work Experience for Degree Completion**

The College decreased the number of work terms from three to two in January 2007 and found itself in a position where it was necessary to place a student in an unpaid work experience in order for that student to gain experience in the field. The College is requesting approval for these changes.

### **Change in Number of Work Terms**

The original Ministerial Consent includes three paid work experiences, scheduled to enable students to continue with the same employer or industry sector over the period of study. In addition, students would participate in joint college teams in industry-led projects, related, where appropriate, to work experience, employer needs, and research projects.

Both Niagara and Algonquin have long histories of offering co-op programs, with related policies and processes for their technology programs, with almost 100% placement rates for each co-op semester. However, after three years of delivering the Photonics degree program, employer and student feedback, as well as, consultation with experienced co-op staff and faculty indicates consistently that three co-op terms are not feasible, or practical as we originally anticipated. Most importantly, as our partners in education, employers have declared difficulties committing to the amount of co-op required in this program delivery model.

A secondary point of concern was that employers prefer to offer the co-op work term during the summer months.

The Advisory Committee fully endorsed the change from three work terms to two.

We are requesting approval of this reduction of co-op work terms, from three terms to two terms, and the subsequent adjustment to the program structure. The proposed program structure is attached as **Appendix 6.5.1**. This change will **exceed the PEQAB standards** for “at least one separate, paid, full-time work term” (Handbook for Ontario Colleges, February 2006).

All work experience learning outcomes are accomplished in two co-op terms. The comparison of work experience learning outcomes is attached as **Appendix 6.5.3**. In addition the applied research and project leadership components are also currently addressed through the research course taken in Year 4. This structure will capitalize on the theoretical instruction provided in class, and build to the delivery of the capstone project in Year Four.

## **Unpaid Work Experience**

We request approval to continue to place students in an unpaid work experience if a paid placement cannot be found but where an unpaid work experience can be identified that will enable the student to meet the learning outcomes of the particular work term. The College will continue to make every effort to find paid work experiences for students in the Photonics degree program.

It is anticipated that these occasions will be rare but it is important for us to have this capability as has been demonstrated in one circumstance to date.

The work experience is very important part of the Bachelor of Applied Technology (Photonics) program. We are committed to placing our students in highly rewarding co-op work experience environments which will reinforce concepts taught in class.

These changes to program structure and work experience capitalize on the theoretical instruction provided in class, and build to the delivery of the capstone research project in the final semester. We strongly believe that the changes create improved retention in the program, and enhance student success.

Since the changes also reflect the current trends and needs in industry, they also allow our industry partners to provide better work experiences for students and job opportunities for graduates.

## Appendix 6.5.1: Program Structure Requirement

### Approved Program Structure

In the program consent, three mandatory co-op work terms are scheduled. The first work term is scheduled during the summer following the fourth semester of studies. After the first work term, the students alternate work and study terms, as shown in the delivery structure below. This results two co-op work terms occurring during the academic year rather than during the summer.

Applied Degree Structure	September	January	April
	Semester 1	Semester 2	Semester 3
Year One	Academic Studies	Academic Studies	Vacation
Year Two	Academic Studies	Academic Studies	Paid full-time co-op work experience
Year Three	Academic Studies	Paid full-time co-op work experience	Academic Studies
Year Four	Paid full-time co-op work experience	Academic Studies	Academic Studies
<b>Paid Full-time Consecutive Co-op Work Experience:</b> 3 co-op placements. Total of 45 weeks.			

**Employers have clearly indicated that they much prefer to have the students during the summer. Given the size of this industry is it critical that we respond to their request.**

### Proposed Program Structure

We propose to reduce the number of work terms by one, resulting in a total of two work terms. These would be offered during the summer after second year (level 04) and third year (level 06). These changes will **exceed the PEQAB standards** for “at least one separate, paid, full-time work term” (Handbook for Ontario Colleges, February 2006) and will respect the needs of industry.

Applied Degree Structure	September	January	April
	Semester 1	Semester 2	Semester 3
Year One	Academic Studies	Academic Studies	Vacation
Year Two	Academic Studies	Academic Studies	Paid full-time co-op work experience
Year Three	Academic Studies	Academic Studies	Paid full-time co-op work experience
Year Four	Academic Studies	Academic Studies	Graduation
<b>Paid Full-time Consecutive Co-op Work Experience:</b> 2 co-op placements. Total of 30 weeks.			

The proposed change includes a requirement to have the students undertake their final year project with industry. We feel this change is necessary for the following reasons:

- The landscape of the industry has changed since the proposal was submitted in 2002. Many jobs in the field, especially in the telecom and manufacturing industries have moved off-shore. At the same time many companies using the photonics technology in other fields such as in bio-photonics, sensing and environmental applications have come into existence. These companies are small and R&D based in most cases. They cannot commit to large co-op hiring. The College has a history of collaboration with these companies especially in the final year projects for the students. Some of these projects were funded by the Ontario Centers of Excellence (OCE)
- Concentrating the efforts of faculty and students to work on applied research projects with industry and to seek funding for these projects will raise the level and visibility of the program. This will lead to generating IP in the colleges, innovation and transfer of technology between the colleges and industry.

This requested change reflects current trends in the industry. It also ensures the requirement by PEQAB to demonstrate the students' readiness for employment in the field of practice by allowing him/her to work on an industrial project during the final year.

## **Appendix 6.5.2: Support for Work Experience**

Overall industry support for co-op work experiences for BAT (Photonics) students is positive. Many of the photonics companies are small and accepting large numbers of co-op students is not feasible for them.

The College participates regularly in the meetings and events of the Ottawa Photonics Cluster attended by many industry representatives. The co-op office sends information about the program and inquiries about possible work term placements to all photonics companies in the region.

When students are not able to be placed in paid co-op work terms, attempts will be made to find unpaid industry internships for them.

### Appendix 6.5.3: Work Experience Outcomes and Evaluation

#### Approved Work Experience Learning Outcomes (for three work terms):

Work Experience Outcomes (Approved) Common	Relationship between the work experience and program learning outcomes
Outcomes <b>common to all co-op work terms:</b>	
Students will have demonstrated an ability to:	
1. Assess and present their skills, knowledge and experience realistically.	Experiences in all three terms will contribute directly to the achievement of the program learning outcomes.
2. Use skills of reflective practice and independent learning to set and achieve personal learning goals.	In order to secure employment, students will assess their knowledge, skills and experience and present these to potential employers.
3. Contribute, as effective members of a working team, to the achievement of organizational goals and objectives.	They will also learn to assess their own performance in the workplace and to reflect on their experience to identify and build on learning that has occurred. This will contribute to their development as continuous learners.
4. Communicate effectively, verbally and in writing.	Students will join a team and communicate in a real world technology setting. They will learn to apply and adapt interpersonal and communication skills to function effectively as communicators and team members.
5. Use logical and critical thinking to analyze technical problems and offer options for solutions.	Students will use skills of critical and creative thinking to analyze and address increasingly complex situations encountered in the workplace.
6. Identify and discuss issues and ethical dilemmas commonly encountered in the technology workplace.	
7. Apply and adapt concepts, principles and skills learned in the College to a real world context.	
8. Use their work experience to extend and shape core concepts and skills related to the Photonics field.	Through their work experience, students will have an opportunity to consolidate and apply knowledge and skills learned at the College in a related technology area. In addition, their experience in industry settings will help them to extend existing learning and provide a stimulus and framework for new learning. This experiential learning will contribute to their development as highly competent technology workers.

<b>Work Experience Outcomes (Approved) Work Term I</b>	<b>Relationship between the work experience and program learning outcomes</b>
Specific focus of <b>first work experience</b> :	<p>During the first work experience students will familiarize themselves with the work setting and its specific culture and practices.</p> <p>As a contributing member of a work team they will 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.</p>
Students will have demonstrated an 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.	

<b>Work Experience Outcomes (Approved) Work Term II</b>	<b>Relationship between the work experience and program learning outcomes</b>
Specific focus of <b>second work experience</b> :	<p>During the second work experience students will gain confidence in their ability to apply and adapt their learning to new situations. They will be expected to apply concepts, principles and skills to make decisions and solve problems in more complex situations. They will also be expected to use a variety of resources to develop new knowledge and skills required to fulfill work expectations.</p>
Students will have demonstrated an ability to:	
1. Transfer knowledge and skills to new situations with increased confidence.	
2. Adapt learning and working style to the context of the situation.	
3. Use critical thinking skills to support decision-making and solve problems in an increasingly wide range of industry applications and contexts.	
4. 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.	

<b>Work Experience Outcomes (Approved) Work Term III</b>	<b>Relationship between the work experience and program learning outcomes</b>
Specific focus of <b>third work experience</b> :	<p>Students in their work experience will be prepared to fulfill a variety of roles within the work team including the application of leadership skills. They will be able to apply their technological knowledge and skills with less direction and supervision. They will be</p>
Students will have demonstrated an ability to:	
1. Adapt to the demands and culture of the workplace.	
2. Participate in an applied research project.	
3. Use leadership skills to help a team achieve	

organizational goals and objectives.	comfortable identifying where new learning is needed and taking action to address this need. During this work term students will participate in some form of applied research and identify a topic for their own final research project. Students who have completed their final work term will serve as mentors to students preparing for their first work experience.
4. Use experiential learning to challenge and extend previous learning and to shape new learning.	

**Proposed Work Experience Learning Outcomes (for two work terms):**

<b>Work Experience Outcomes (Proposed) Common</b>	<b>Relationship between the work experience and program learning outcomes</b>
Outcomes <b>common to all co-op work terms:</b> <b>NO CHANGE</b>	<p>Experiences in all three terms will contribute directly to the achievement of the program learning outcomes.</p> <p>In order to secure employment, students will assess their knowledge, skills and experience and present these to potential employers. They will also learn to assess their own performance in the workplace and to reflect on their experience to identify and build on learning that has occurred. This will contribute to their development as continuous learners.</p> <p>Students will join a team and communicate in a real world technology setting. They will learn to apply and adapt interpersonal and communication skills to function effectively as communicators and team members.</p> <p>Students will use skills of critical and creative thinking to analyze and address increasingly complex situations encountered in the workplace.</p> <p>Through their work experience, students will have an opportunity to consolidate and apply knowledge and skills learned at the College in a related technology area. In addition, their experience in industry settings will help them to extend existing learning and provide a stimulus and framework for new learning. This experiential learning will contribute to their development as highly competent technology workers.</p>
Students will have demonstrated an ability to:	
1. Assess and present their skills, knowledge and experience realistically.	
2. Use skills of reflective practice and independent learning to set and achieve personal learning goals.	
3. Contribute, as effective members of a working team, to the achievement of organizational goals and objectives.	
4. Communicate effectively, verbally and in writing.	
5. Use logical and critical thinking to analyze technical problems and offer options for solutions.	
6. Identify and discuss issues and ethical dilemmas commonly encountered in the technology workplace.	
7. Apply and adapt concepts, principles and skills learned in the College to a real world context.	
8. Use their work experience to extend and shape core concepts and skills related to the Photonics field.	

<b>Work Experience Outcomes (Proposed) Work Term I</b>	<b>Relationship between the work experience and program learning outcomes</b>
Specific focus of <b>first work experience</b> : <b>NO CHANGE</b>	During the first work experience students will familiarize themselves with the work setting and its specific culture and practices. As a contributing member of a work team they will 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.
Students will have demonstrated an 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.	

<b>Work Experience Outcomes (Proposed) Work Term II</b>	<b>Relationship between the work experience and program learning outcomes</b>
Specific focus of <b>second work experience</b> :	During the second work experience students will gain confidence in their ability to apply and adapt their learning to new situations. They will be expected to apply concepts, principles and skills to make decisions and solve problems in more complex situations. They will also be expected to use a variety of resources to develop new knowledge and skills required to fulfill work expectations.
Students will have demonstrated an ability to:	
1. Transfer knowledge and skills to new situations with increased confidence.	
2. Adapt learning and working style to the context of the situation.	
3. Adapt to the demands and culture of the workplace. <b>ADDED from third co-op</b>	
4. Participate in an applied research project. <b>ADDED from third co-op</b>	
5. Use leadership skills to help a team achieve organizational goals and objectives. <b>ADDED from third co-op</b>	
6. Use critical thinking skills to support decision-making and solve problems in an increasingly wide range of industry applications and contexts.	
7. Use experiential learning to challenge and extend previous learning and to shape new learning. <b>ADDED from third co-op</b>	
8. 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.	

Outcomes from the third work experience have been incorporated into the second work experience, as shown above. Students will be expected to demonstrate leadership skills to achieve team goals and objectives, as well as apply their technical knowledge independently.

## **Appendix 8.6.1: CV Release**

Algonquin College has on file and available for inspection, from all faculty and staff whose CVs are included in this submission, signatures that attest to the truthfulness and completeness of the information contained in their CV and agreeing to the inclusion of their curriculum vitae in any documents/web sites associated with the submission, review, and final status of the program application.