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AN ACCREDITED PHOTONIC ENGINEERING PROGRAMME: A NOTABLE EXPERIENCE

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Abstract:

In most institutions of higher learning in Malaysia, photonic engineering is a field that is often offered at the postgraduate level. However, UniMAP took the initiative by offering the Photonic Engineering program at the undergraduate level and UniMAP was the only public university to offer Photonic Engineering Programme for undergraduates in Malaysia. This is in line with the current direction of the Malaysian government and electronic industry to further enhance research in the photonic field. The primary objective of this paper is to discuss the Photonic Engineering Programme offered by School of Microelectronic Engineering (SoME), Universiti Malaysia Perlis (UniMAP). The method of accreditation was implemented based on Outcome-Based Education (OBE); with accreditation outcome by Malaysian Engineering Accreditation Council (EAC). Extensive attainment based on OBE of the programme was conducted to illustrate the success of the programme. This includes the programme curriculum structure, Programme Educational Objectives (PEOs) as well as the Photonic's Programmes Outcomes (POs). The findings after the implementation of Photonic Engineering Programme have demonstrated a successful engineering program execution in the field of Photonics with the program successfully being accredited by the EAC. However, despite the accreditation success, the university has decided to shut down the program due to low intake of students. There is no affirmation that the programme could continue if student intakes are not up to the requirement which in this case most likely due to the low interest and unfamiliar name of Photonics programme among the new generation as potential undergraduate engineering students.

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Keywords:

Photonic Education, Engineering Education, Outcome-Based Education, Continuous Quality Improvement

Introduction

In Malaysia, Engineering Accreditation Council (EAC) is the governing body responsible for maintaining the quality of engineering education provided by the higher institution. In 2009, EAC has successfully accomplished the full signatory status of the Washington Accord (WA) for Malaysia delegated by Board of Engineers Malaysia (BEM). Thus, for an engineering degree programme to be accredited, the offering institution is required to implement the Outcome-Based Education (OBE) system outlined by the EAC. In addition, the purpose of accreditation is to ensure that continuous quality improvement (CQI) process is being practiced by the institution and according to Prados (2005), evidence that the graduates have achieved acceptable levels of the intended skills must be provided by the institution.

Accreditation of a program means it meets the standards expected by the public and is recognized by the educational community and industry. In engineering education, an accredited program allows graduates to apply for professional engineering qualifications. Agreements like the Washington Accord help countries recognize each other's accredited engineering programs, so graduates can work in other member countries. In short, it's important for engineering programs to be accredited, as it helps graduates become professional engineers and work internationally. Moreover, the process of engineering accreditations have been previously reported by several authors (Patil, A., & Codner, G. 2007; Van den Beemt A. et al., 2020; Prados et al., 2005, A Busaidi, H. 2020), Phillips et al., 2000). For instance, Mohd Said et al. (2013) explored a key question about whether undergraduate engineering education is necessary to maintain high standards in engineering programs in Malaysia. In a different work, Chowdhury et al. (2013) outlines the full accreditation process used by a Washington Accord Signatory nation and highlights steps institutions in Bangladesh can take to improve the quality of education and increase student and graduate satisfaction.

Universiti Malaysia Perlis (UniMAP) was first established in 2002 as the 17th public university in Malaysia, which specialized in engineering education. Currently, UniMAP has eight engineering schools, and the School of Microelectronic Engineering (SoME) is one of UniMAP's pioneer schools that focusing on the niche area of Electronic Engineering. SoME began offering its first engineering programme in 2002, which is the Bachelor of Microelectronic Engineering with Honours, which was then followed by its second programme known as the Bachelor of Electronic Engineering with Honours a year later. In the ninth Malaysian plan (The Economic Planning Unit 2006), Malaysian government has identified photonics as one of the country's priority sectors for country development. In line with this policy, the government is actively fostering photonics-related research and development activities at universities and research institutions and upgrading the skills of the Malaysian workforce.

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Taking advantage of this policy, UniMAP took the initiative to offer a new engineering degree programme known as the Bachelor of Engineering (Honours) (Photonic Engineering) in 2008 with the first enrolment of 23 students. According to accredited programme published by EAC (Engineering Accreditation Council Malaysia (EAC) 2020), there are 72 electronic engineering-based degree programmes that are currently being offered by public and private universities in Malaysia. However, from the best of our knowledge, UniMAP is the only public university that offers the Photonic Engineering programme apart from one other private university, which is Multimedia University (MMU). However, after nine successive years of the programme offering, it has been decided that the Photonic Engineering programme in UniMAP will cease to be offered as the number of students intake seems to be in line with the descending trend year after year.

This paper describes our experience in managing this programme, which includes the accreditation process and the quality assurance system it abides to during this process. Firstly, the curriculum structure of the Photonic Engineering programme will be discussed. This will be followed by the Programme Educational Objective (PEO) and Programme Outcome (PO) of the programme. We will also elaborate on the accreditation history of the programme. Finally, the students intake data along with the graduate employability will be discussed. The determination of the programme's objectives and outcomes, and the results of applying the continuous improvement process are also further explained in this paper. This paper also details out the reason behind the decision of closing this programme in year 2017.

Curriculum Structure

The Bachelor of Engineering (Honours) (Photonic Engineering) Programme is positioned under the Electronics discipline as stated in the EAC manual (Engineering Programme Accreditation Manual 2017). The School of Microelectronic Engineering academic committee members have designed a modified curriculum structure to meet the requirement standards set by the Ministry of Higher Education (MOHE) as well as feedback from the external examiner and stakeholders during their curriculum review for year 2010 and 2013. The photonic engineering curriculum was developed to be in line with the electronics discipline and focused on the devices and materials of the photonic area. Therefore, the programme was inclusive of subjects in physics and optics which are dominant in this area.

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YEAR 1		YEAR 2		YEAR 3			YEAR 4	
I	II	III	IV	V	VI		VII	VIII
EMT114/3 Introduction to Electric Circuits	EMT124/3 Fundamental of Electrical Engineering	EMT294/3 Principles of Optics	EMT283/3 Analog Electronic II	EMT393/3 Advanced Optics	EMT360/3 Control Engineering		EMT445/2 Final year Project	EMT446/4 Final Year Project
ECT111/3 Engineering Skills	EMT125/3 Digital Electronic Principles I	EMT235/3 Digital Electronic Principles II	EMT245/3 Introduction to Microprocessor Design	EMT394/3 Photonic Materials and Devices	EMT395/3 Photonic Fabrication Engineering		EMT496/3 Micro-Optical-Electro-Mechanical-System	EMT462/3 Optoelectronic System
EMT181/3 Physics for Electronics	EMT115/3 Programming Language	EMT295/3 Quantum Mechanics	EMT238/3 Electromagnetic Theory	EMT358/3 Communication Engineering	EMT369/3 Power Electronic		EMT475/3 Computer Organization Architecture	EMT488/3 Digital Signal Processing
EMT116/3 Electronic Devices	EMT182/3 Analog Electronic I	EMT293/3 Signal Analysis	EMT297/3 Physics of Semiconductor	EMT396/3 Principles of IC Design	EMT383/4 Photonic Design Project	EIT 302/4 Industrial Training	EMT478/3 Instrumentation	EMT494/3 Optical Communication
							EMT491/3 Optical Design	
EQT101/3 Engineering Mathematics I	EQT102/3 Engineering Mathematics II	EQT203/3 Engineering Mathematics III	EQT271/3 Engineering Statistics	EMT341/3 Management for Engineers	EMT342/2 Professional Engineers			
				UUT122/2 Skills and Technology in Communication				
	UUW129/2 Introduction of Philosophy				UUW224/2 Engineering Entrepreneurship		UUW235/2 Ethnic Relations	UUW233/2 Islamic & Asia Civilization
UVW410/2 University Malay Language		UVW201/2 English for General Commuication	UVW312/2 English for Technical Communication					
UZWXXX/1 Co-Curiculum	UZWXXX/1 Co-Curiculum							

Figure 1: Photonic Engineering Programme curriculum structure

However, in the year of 2013 the School of Microelectronic Engineering has reviewed the curriculum structure due to the process being conducted for every three years and for increasing the photonic niche area to around 30 % of the engineering courses. Additional photonic courses were added to the existing curriculum structure for the 2010/11 until 2012/13 cohort. A new curriculum structure was also devised and implemented for the 2013/14 cohort onwards as depicted in Figure 1. The curriculum structure includes all technical and non-technical attributes as outlined by the photonic programme outcome requirement. The integration of theory with practice through exposure to laboratory work was also considered in the structure. Based on Figure 1, the curriculum structure consists of 125 credit hours for subjects based on the Electronic Engineering field including mathematics, communications, IT skills and engineering management. The core engineering subjects consisted of 104 credit hours. The remaining 19 credit hours catered the general education components such as Engineers in Society, languages, Ethnic Relation, Islamic and Asian Civilization, Thinking Skills and co-curriculum. The first-year subjects consisted of topics ranging from mathematics, electronic devices, electric circuits, and IT skills. The students were first introduced to photonic subjects during their second year of study. Students were required to have the fundamental understanding of electronics and mathematics before proceeding with photonic subjects. The third and final year of the programme focused on the advanced and specific courses of the Photonic Engineering Programme which included Photonic Fabrication Engineering and Optoelectronic System. The photonic niche area was clearly presented where there were 10 courses specializing in photonic area contributing to 31 credit hours or 29% of the core engineering courses. The percentage of photonic courses is comparable to the photonic courses offered by Multimedia University Malaysia (MMU) and the University of New South Wales (UNSW) Australia. All three programmes have fundamentals of optics, and photonic devices. This programme also implements the fabrication of the photonic devices as well as blending appropriate photonic and electronic elements with new photonic subjects being introduced namely Micro-Optical-Electro-Mechanical Systems (MOEMS), Optical Communication and

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Photonic Fabrication Engineering. The Physics for Electronics was also introduced during the first year of study, which covers the basic knowledge of physics for materials, thermodynamics, wave, optics and introduction to quantum electronics.

Programme Educational Objectives

Programme educational objectives are specific statements that are consistent with the next mission and vision of the university and the school's expectation of the students in three to five years' time after their graduation; demonstrable in the career or professional life advancement. The development of the PEOs considered the requirements of the stakeholders, the mission and vision statements of the school and university, as tabulated in Table I.

Initially, there were five PEOs which are measured through a set of indicators. The indicators were established based on the previous observation of the school's alumni, and this will be used to forecast the future direction for the current students. The measurement of Programme Objectives achievement was conducted by the employers and alumni via the employer survey and alumni survey. The primary objective for conducting the employer survey was to obtain feedback regarding the graduates' performance directly from the employers. Written survey forms were distributed and collected either by mail, email, or fax. Similar to the employer survey, the main objective for conducting the alumni survey is to gain information about the graduates' abilities based on their own perception throughout their working experiences. The results from this survey will then be used to further develop and improve the programme. Figure 2 shows the initial PEO attainment of Photonic students graduating from the year of 2012 to 2013. Since PEO is measurable three to five years after the students have graduated, the PEO result of the first intake in 2008 was measured 4 years after they have graduated in 2012. For PEO1, the target is that 20% of the graduates are to achieve a senior position in their career.

Table 1: Programme Educational Objectives

PEO	Statements
PEO1	Graduates who are leaders in the field of Photonic Engineering or chosen field as demonstrated through career advancement
PEO2	Graduates who are members of and contribute to professional society
PEO3	Graduates who are engaged in lifelong learning or continuous education opportunities
PEO4	Graduates who contribute towards research and development
PEO5	Graduates who are entrepreneurial engineers

However, the attainment is only 15% for 2012 graduates and 5% for 2013 graduates, respectively. This was expected since the graduates have only been working for four years and still have not achieved any career advancement or senior position in their job.

For PEO2, the school targeted that 20% of the graduates will register with any professional bodies after graduation. Professional Membership awareness was evident among the graduates as more than 20% of the graduates registered in professional bodies, namely from IEM & IEEE. For PEO 3, we aim that 50% of the graduates will pursue higher education or professional certificates. However, this was also not achievable for the graduates of 2012 and 2013. Similarly, for PEO4, the target was also 50% of the alumni to contribute towards research and

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development. Nevertheless, the average attainment for both 2012 and 2013 graduates were only 26%. Finally, for PEO 5, it was expected that 20% of the graduates pursue entrepreneurship business and/or practicing entrepreneurial values. The attainment for this PEO was very low where only 7.5% average attainment was acquired.

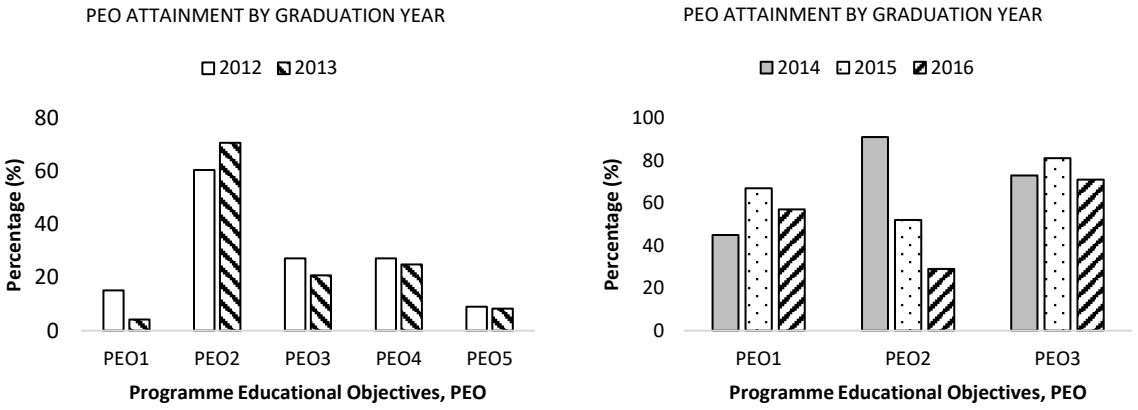

Figure 2: PEO Attainment Of Photonic Student By Year Of Graduation.

In 2017, the previous five (5) PEOs have been revised by the university and was reduced to three (3) PEOs. This was to avoid redundancy between the PEOs. The focus was given to assessment involving career advancement, professional and society and lifelong learning. The results were depicted in Figure 3. The result for PEO1 (career advancement) displays a significant increase compared to the previous graduates of 2012 and 2013, where the target of 20% was achieved for all graduates of 2014 to 2016. Even though the performance indicator of PEO1 was achieved, the school constantly conducted analysis to the CQI strategies in order to maintain the attainment of the PEOs. For the CQI of PEO 1, the school organized several interview sessions with industries namely Intel, National Instruments, OSRAM, Philips Lumiled to ensure that the graduates are hired immediately after their graduation. This will then give them a proper time frame to advance in their career after 3 years of working, at approximately the time where the PEO was to be measured. The mechanism for survey as a whole and continuous process can be improved by arranging more surveys from various sources and proper time frame.

For PEO 2, the target has been revised to 30% and the result in PEO 2 (professional society) has displayed the increment over the targeted value of 30% for 2014 compared to the graduating classes of 2015 and 2016. This is based on the number of graduates who have registered with IEEE UniMAP student branch that was frequently promoted to the students throughout their studies. The students are also encouraged to be associated with other learning societies such as IEM, MySET and MAKNA. Since 2016, the fourth-year students (cohort 2012/2013 and 2013/2014) are also mandated to be a student member of IEM. This is also one of the initiatives from the school to motivate the students to continue their memberships as graduate engineer of IEM after graduation. Since the PEO attainment for graduates 2016 has decreased, part of the CQI strategy was to increase the students' awareness towards existing professional society such as IEEE. The school has organized IEEE Day 2017, with the collaboration of IEEE Malaysia Section Sensors & Nanotechnology Joint Councils Chapter. The IEEE Circuit and System (CAS) Malaysia has also organized a networking high tea event

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in July 2017. This event was co-organized by the school in an effort to increase the students' awareness to be involved in a professional body. Several IEEE Malaysia chapters were also involved during the final year project exhibition, namely IEEE Electron Devices Society (EDS) Malaysia, IEEE Malaysia Section EMBS Chapter and IEEE Malaysia Section Sensors & Nanotechnology Joint Councils Chapter. UniMAP has also offered Student Voluntary Malaysian Medical Relief Society (MERCY) as part of the co-curriculum courses. To date, this course has attracted almost 200 students and it is expected that this trend would continue.

The interest of graduate engagement in lifelong learning (PEO 3) was measured by the number of students pursuing advanced studies after graduating including post graduate studies and advance diploma. Based on the survey, PEO 3 was attained for graduates of 2014 to 2016. As part of the CQI plan, the staffs in School of Microelectronic Engineering are progressively recruiting postgraduates to carry out research work, especially those related to Electronic Engineering. The number of graduates enrolling for Master and PhD programmes are seen to have progressively increased and these are mostly graduates of 2014 and 2015. In 2015, the School has also started to offer a Master by mixed mode programme, known as Master of Science in Microelectronic System Design Engineering. This programme was certified by the Malaysian Qualifications Agency (MQA), and the programme has been currently reviewed by the IAP and external examiner. The courses offered in the mixed mode programme were conducted by lecturers with sufficient knowledge in the related field, and the laboratories are equipped with a broad range of equipment and softwares suited to the need of industries for both teaching and research purposes.

Programme Outcome

The Programme Outcomes (POs) statements of the Photonic Engineering define the knowledge, skills and attitude which are expected to be achieved by the Photonic Engineering students upon graduation. The Programme Outcomes of the Photonic Engineering programme comply with the Engineering Accreditation Council (EAC) requirements and have been implemented beginning from the academic semester of 2011/2012. Each of the PO listed was also consistent and mapped to the specific heading detailed out by the accreditation bodies such as Washington Accord (WA), Accreditation Board for Engineering and Technology (ABET), and Engineering Accreditation Council (EAC). In general, the PO describes what students are expected to acquire by the time they graduate based on the following attributes: Engineering knowledge, problem analysis, design of solutions, investigations, modern tool usage, engineers and society, environment and sustainability, ethics, teamwork, communication skills, lifelong learning and project management and finance.

The involvements of IAPs, external examiner, students and alumni in the establishment and review of the new PO statements are similar to the involvement of the key personnel in the establishment and review of the PEOs. The attainments of the POs are evaluated through the course delivery and assessments, as well as the evaluation of the assessments. These are performed based on the teaching plan, the implementation of the lectures and laboratory work as well as other practical elements and assessments conducted. The evaluations of the POs are performed by evaluating the attainment of the COs first. Since the COs are mapped directly to the POs, the attainment of the COs will reflect the attainment of the POs. At the course level, the achievement criteria or passing threshold is defined as achieving 50% or higher in the assessment. Therefore, a student who has passed every assessment, is considered to have passed and attained the COs and POs for that particular unit. The performance target is set at

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50% of the students' attainment for all the assessed POs. At the programme level, the performance target for overall PO attainment (class average) is set for 50% for each PO. All students have to achieve 50% or greater in all twelve (12) POs during their four-year degree programme. The evaluations on the attainment of the Programme Outcomes are mainly based on the Direct Measurement Methods. Since the Course Outcomes are the performance criteria used, the grades of all assessments are firstly evaluated. Assessment methods such as final examination, mid-term examinations, assignments, projects, presentations, and laboratory reports are mapped to the related Course Outcomes. The mappings of the marks / grades obtained by the students are used to measure the attainment of the Course Outcomes.

For the evaluation of the course, average marks of the class is the indicator used. If the evaluation of an individual student is considered, then the marks / grades obtained by that particular student will be used. Attainment of programme outcomes involved enabling and culminating courses. Enabling courses are courses that help nurture, cultivate or develop the intended outcomes at the course level. Rogers (Brackin and Rogers 1999) recommends course level assessment since it would be helpful in understanding student strengths and weaknesses related to any given outcome and that these are separate from those given outcomes and that these are separate from those collected for the culminating experience. Meanwhile, culminating courses would be the highest level or the 'top-end' courses where student's ability related to the outcomes can be observed and one of this should be in the Final Year Project. According to Spady (1994), a demonstration of the student's ability related to the outcome should be at the end of, or literally the end of a programme and not "during the experience" as many academicians think.

Figure 3 shows the PO attainment of students who graduated from 2012 to 2019. Based on the results, it demonstrates that all POs have been achieved with at least 60% attainment. This shows that the graduated cohort has successfully achieved the targeted PO set for the Photonic Engineering Courses. However, the achievement of each PO was varied. In average, the lowest PO attainment recorded was for PO8, which is defined as the ability to understand the professional and ethical responsibilities and commitment to the community. Similar to PO6 and PO7, PO8 is measured through coursework which relates to project, and examination. Topics on professionalism, ethics, and commitment towards the community are also covered and assessed in EUT 440: Engineers in Society and EMT443: Engineering Management courses. The students were able to comprehend the concepts of engineering ethics and demonstrate the understanding through assignments write up and exams. Nevertheless, there are still areas of improvement that could be undertaken. For example, more exercises could be provided to students in class to familiarize them with types of ethics-related questions for this PO, and the exercise can be made in a small group. The highest PO attainment was observed in PO9. The PO9 is defined as the ability to function on multi-disciplinary teams. The PO9 was measured using specific rubrics. In EMT 383, students are divided into groups of 4-5 by the School, and they are required to work as a team to design a product. At the end of the project, each student was required to assess the important elements required in a team such as teamwork skill, participation, and responsibility of each team member based on specific rubrics given in the peer-to-peer evaluation form which was prepared by the School. Students also had vast opportunities to work in a team in several courses featuring group work such as EMT462. The attainment was very good, and students had no problem to work in a team.

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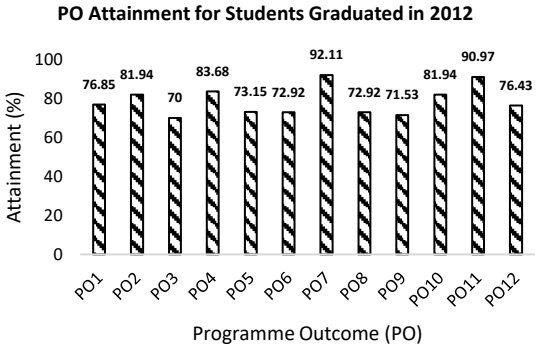
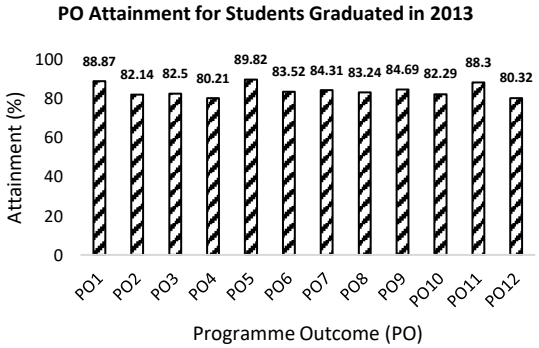
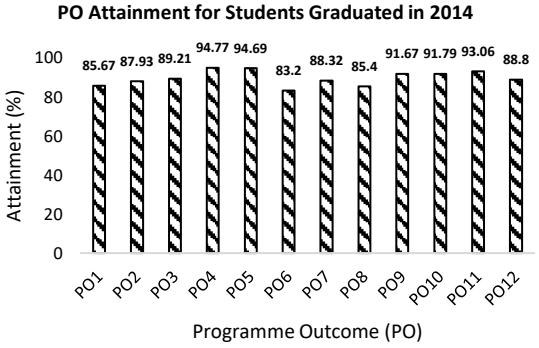
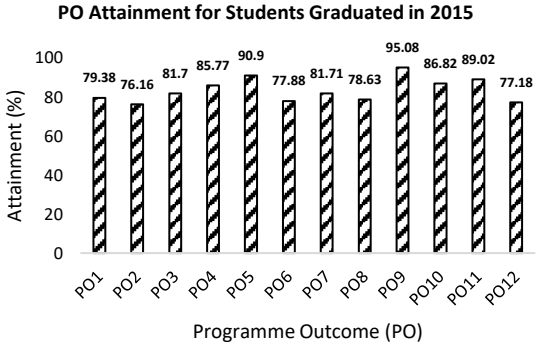
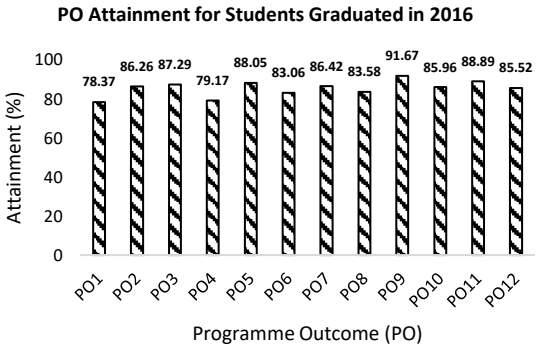
The PO5 is defined as the ability to use techniques, skills, and modern engineering tools necessary for complex engineering practices so as to be easily adaptable to industrial needs. Similar to the source of assessment of PO4, PO5 was measured through coursework which relates to laboratory and project. In EMT 491, students are required to design optical systems using design simulation tools such as Zeemax Software as part of their laboratory assessments. Students were also required to use appropriate modern engineering tools such as microcontroller in EMT 383 subject, and other modern engineering tools which depends on the topic of their final year project in EMT 446 subject. In EMT 383 subject, the ability of the students to use the modern engineering tools can be directly assessed by industrial panels and lecturers during the design project exhibition which requires the students to demonstrate their product. Students' communication skills were measured through PO10. The PO10 is defined as the ability to communicate effectively on complex engineering activities with the engineering community and with society at large. Similar to PO9, PO10 was also measured based on specific rubrics.

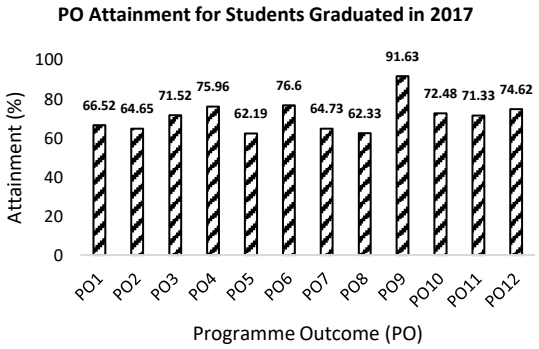












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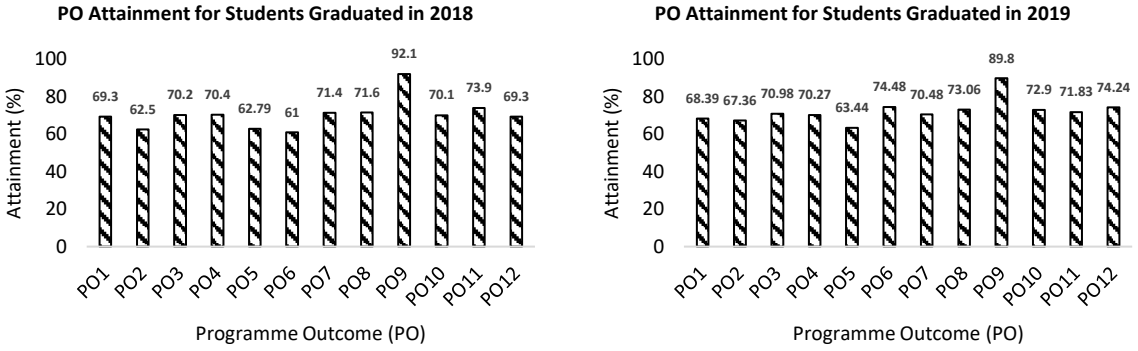

Figure 3: Students PO Attainment From Graduating Year Of 2012 to 2019

Since final year project focuses only on specific technical topics, the ability of the student to explain the technical contents in their final year project in an understandable situation and convincing manner can be easily accessed during students' final year project viva session. In both EMT 445 and EMT 446, the students were required to present their work to an examiner who is assigned to them by the School through a viva session which includes a presentation session as well a question-and-answer session. In addition, student registered for EMT 446 subject was also required to present their work through Final Year Project Exhibition (FYPEX). The rubrics for assessment was prepared by the School. In EMT383 subject, PO10 is evaluated through presentation made during Design Exhibition Day. During the presentation, students also have to demonstrate the prototype of their project. The overall quality of presentation is assessed using a specific rubric which also covers the technical aspect of the project. At the end of every academic year, a CQI meeting was conducted at the School level with the presence of academic staff, IAP, and external examiner to discuss the PO attainment results and to receive suggestions for improvement. In order to tackle the problem for the low PO, the respective course that relate to that PO are to be investigated. Once the proposed changes and improvements are agreed by all the parties, it must be approved by the programme committee, followed by the School Board, and finally endorsed by the University Senate before implementing on the following batch of students. The proposed changes or improvements for the identified course as suggested by the previous course coordinator which will be required to be documented by the following course coordinator and presented during the pre-semester meeting. The action plans will then be implemented on the following batch of students and their performance in the course will be carefully monitored (Parker, P.E. et al. 2001; Finelli, C. J. & Froyd, J. E. 2019; Davis, D. C. et al 2002).

Accreditation History

The objective of accreditation is to ensure that graduates of the accredited engineering programmes satisfy the minimum academic requirements for registration as a graduate engineer with the Board of Engineers Malaysia (BEM) and for admission to graduate membership of IEM. In addition, the objective of accreditation is to ensure that Continual Quality Improvement (CQI) is being practiced by Institute of Higher Learning (IHLs). Accreditation may also serve as a tool to benchmark engineering programmes offered by IHLs in Malaysia. The Photonic Engineering programme has been accredited four times since it was established. During the EAC visit, the engineering programme was typically accredited based

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on the implementation of Outcome Based Education (OBE), Curriculum, Staffs, students and facilities and its Quality Management System (QMS).

Table 2 shows the accreditation year obtained and its duration since the year 2012. Throughout the accreditation process, the programme has received numerous feedbacks from the EAC panel. Each accreditation report entails the strengths, weaknesses, concerns, and opportunities for improvement of the programmes. The Photonic Engineering programme had initially attained a two-year accreditation from EAC for cohorts 2008 and 2009 (graduates of 2012 and 2013). Then, a three-year accreditation for cohorts 2010 – 2012 (graduates of 2014 – 2016) was granted by EAC in 2014. In 2017, a new submission for a new cycle accreditation for cohorts 2013 and onwards (graduates of 2017 and onwards) was made. This resulted in a 3-year accreditation for the students graduating from 2017 to 2019. The major concern during this technical visit was on the understanding of OBE especially on CQI which varied among the academic staff. Minor concerns reported include ineffectiveness of assessment rubric to assess subjects such as engineering design project, labs and final year project. The assessment rubrics developed for the assessment of FYPs, industrial trainings and lab assignments need to be revisited as well as its implementation in order to accurately assess the actual performance of students. The programme has addressed and closed all the concerns raised by the EAC panel during the visit in 2019.

Table 2: Accreditation History

Accreditation Visit	Accredited (Graduate Year)
2012 (New cycle)	2012 – 2013
2014 (Continuing)	2014-2016
2017 (New cycle)	2017-2019
2019 (Continuing)	2020-2022

Students Intake and Graduate Employability

The Photonic Engineering programme was offered in 2008 where the first intake consisted of only 26 students, as shown in Figure 4(a). Throughout the 10 years programme being offered, the average student intake per academic semester is only 46. The highest students' intake was in the academic year of 2011/2012, where a total of 77 students enrolled for the programme. Since then, the number of intakes started to decrease by 21% in the following academic semester. From 2013 to 2014 and 2015, the number of students were 55, 53 and 54, respectively. This was then followed by another decrease of 41% in 2016. Finally, in 2017, only 24 students registered for the Photonic Engineering programme offered by the university.

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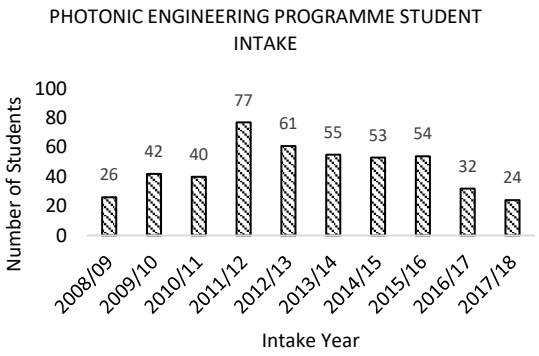
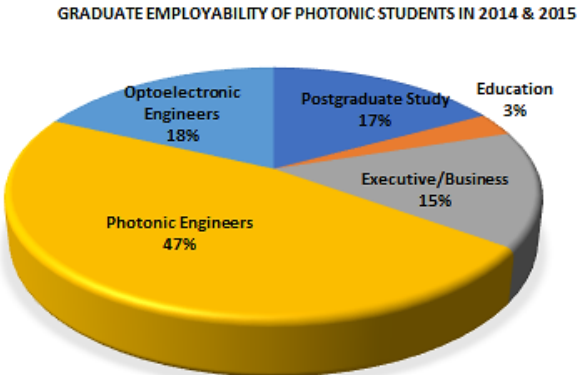


Figure 4: (A) Photonic Students' Intake



(b) Distributions of Photonics Students Employability in 2014 & 2015

The average CGPA of students who were admitted to the Photonic Engineering programme ranged from 2.0 to 2.5. However, upon graduation, there was an increase in the number of students who graduated with their CGPA ranging between 2.5 to 3.0. Graduates produced by the Photonics Engineering programme also gained attention in the Photonics industry in Malaysia. This was evident as depicted in Figure 4(b), where over 60% of graduates managed to secure a job in the Photonics and Optoelectronics sector. Among the optical giant companies that hire Photonics engineers are OSRAM, Philips Lumileds, Al-Nair Photonics and Venture Electronic.

Discussion

The Engineering Accreditation Council (EAC) is the body delegated by the Board of Engineers Malaysia (BEM) to accredit engineering degree programmes. Accreditation is granted based on students' graduation years. The first accreditation for the Photonic Engineering programme was conducted in 2012 for students who enrolled in 2008. As this is a new engineering programme, the school is required to submit the application for programme accreditation at least six months before the final examination of the first intake of students.The accreditation assessment is based on several criteria, including Programme Educational Objectives (PEO), Programme Outcomes (PO), academic curriculum, students, academic and support staff, facilities, and quality management systems (QMS). The process typically involves two stages: an initial assessment of qualifying requirements and a detailed evaluation of the programme against the accreditation criteria. The results of this process have been discussed in the previous section, where it was noted that the Photonic Engineering programme has met all the accreditation criteria.

Malaysia has been involved in semiconductor industry for more than three decades. Building up from this foundation, the country has embarked into the fast-growing sector of photonics. Malaysia's relatively new photonics sector has also benefitted from the participation of multinationals companies such as Finisar Corporation, Osram of Germany, Rohm-Wako Electronics and Nichia Corporation of Japan. In recognition of the sector's potential, the Malaysian government has identified photonics as one of the country's priority sectors for development. In line with this policy, the government is actively fostering photonics-related research and development activities at universities level and research institutions. In most institutions of higher learning, photonic engineering is a field that is often offered at the postgraduate level. However, UniMAP took the initiative by offering the Photonic Engineering

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program at the undergraduate level. The offering of Photonic Engineering programmed by School of Microelectronics Engineering, UniMAP fit to the aspiration of the Malaysian government. However, it is baffling that this programme has to be dropped from being offered, since the job market for the graduates in this area are massive. The question is, why such decision was being made? The answer lies on the number of students' intake as described in the previous section. In Malaysia, students can choose the field of their studies, i.e science or art, as early as when they are in their upper secondary school level. According to Academy of Sciences Malaysia, there are only 90,000 science students in 2017, far less than the 270,000 required annually (Azman, M.N.A, et. Al. 2018). This worrying trend will further cause a shortage of science graduates in the coming years, especially in engineering. According to (Mohamed Radzi, N. A. & Sulaiman, S 2018; Subheesh, N. P. & Sethy, S. S.; Brackin, P. 2002), the main reason behind their lack of interests in engineering is the misunderstanding of engineering field itself and having the thought that being an engineer has no or little contribution to the society. However, 59% of the students were not interested because they think that engineering field is difficult to study. However, after a half day engineering programme was introduced, they recorded that 78% of the students were interested in engineering prior to the 8.5% that was interested before the event. This proves that an engineering event is crucial in keeping and increasing students' interests in engineering field.
A lot of efforts are being conducted by the government to encourage school students to enrol in engineering subjects through the integration of Science, Technology, Engineering, and Mathematics (STEM) education in teaching and learning in the year 2017. The National STEM movement, with the aim of nurturing greater interest and understanding in STEM among students from primary and secondary school, was also established to further increase the awareness and interest of students in the science and engineering field.

We hypothesized that another reason for lack of students' intake is that the name Photonic engineering itself is too specific, and students are not accustomed with the term Photonic as they are typically familiar with the traditional engineering field such as electronic, electrical, mechanical and civil engineering. This further shows that events and promotion to enhance students' interest is very imperative, as they have no prior knowledge of what Photonic engineering is about. Although this programme has been dropped from being further offered, the photonic engineering education is still being offered as part of the postgraduate and research studies in UniMAP. The facilities that we have in place have assisted several students to graduate in Masters and Phd in the photonic engineering field. This ensures that the continuation of Photonic engineering education is still in place despite the current problem.

Conclusion

This paper summarizes the Photonic Engineering programme curriculum structure, its programme educational objectives and programme outcomes. The programme accreditation history has also been briefly elaborated along with the graduate employability statistics. Universiti Malaysia Perlis (UniMAP) is the only public university in Malaysia that offered Photonic Engineering as part of an undergraduate engineering degree programme. However, after seven years, this programme is no longer being offered despite the rising photonics-based industries which highly demand engineers with a photonic education background. The lack of interest from the students was evident based on the number of student intake throughout the seven years that this programme was being offered. Although the university has stopped offering Photonic Engineering as part of its undergraduate engineering program, the knowledge of photonic is still being pursued by the postgraduate students at this university.

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