Empowering Higher Education through a Micro-Credential Program in Power Electronics Course

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Abstract
In line with the global and national shifts towards enhancing educational accessibility, flexibility, and quality, Malaysia has embarked on a transformative journey with the implementation of the Malaysian Education Blueprint 2015–2025 (Higher Education) and E-Learning Guidelines for Malaysian Higher Education Institutes. This strategic initiative acknowledges the pivotal role of e-learning in shaping the future of education by enabling greater access to knowledge and skills. The COVID-19 pandemic has further accelerated the growth of e-learning, emphasizing the need for innovative educational approaches. This paper presents a micro-credential program in the field of power electronics, aligned with Malaysia's commitment to advancing higher education through technology-driven solutions. The curriculum, which is tailored to meet the needs of a wide range of learners, covers all the fundamentals of power electronics and leaves participants with specific knowledge and abilities. This micro-credential program is designed to empower professionals and students, supporting their career objectives in the dynamic power electronics industry, by emphasizing accessibility, flexibility, and high-quality learning experiences.

Keywords: Micro-credentials, Power Electronics, Online Learning, Lifelong Learning, Massive Open Online Courses

Introduction

In 2014 and 2015, the Ministry of Education Malaysia established the e-Learning Guidelines for Malaysian Higher Education Institutions (HEIs) and Malaysian Education Blueprint 2015–2025 (Higher Education) to provide guidance for the transformation of the nation's education system. It encompasses a complete framework designed to address various aspects of education in Malaysia, outlining clear objectives and strategies to enhance the quality of education at all levels, from early childhood education to higher education, and to drive the e-Learning environments in the Malaysia education system (Ministry of Education Malaysia, 2014, 2015).

Ten shifts have been identified by the Ministry in the Education Blueprint to transform higher education in Malaysia, as shown in Figure 1 (Ministry of Education Malaysia, 2015). It addresses key performance issues within the system, specifically focusing on quality and efficiency aspects. It also considers the global trends that are causing disruptions in the higher education landscape. The third shift, which is Nation of Lifelong Learners, serves the purpose of equipping individuals with the necessary skills to adapt to the evolving demands of a high-income economy. Additionally, it aims to unlock the full potential of individuals outside the workforce through reskilling and upskilling initiatives. For the ninth shift, which is globalized online learning, blended learning models are anticipated to become a prevalent educational strategy in higher learning institutions (HLIs). The implementation of a strong cyber infrastructure that capable of supporting technologies such as video conferencing, live streaming, and Massive Open Online Courses (MOOCs) will benefit lots of students. Thus, Malaysian HLIs were urged to explore and actively engage with these online learning platforms to extend their global outreach.

The COVID-19 pandemic has further accelerated the growth of e-learning, as it has a significant impact on the global education and employment sectors. The situation demanded a reassessment of conventional pedagogical approaches by educational institutions, forcing them to consider the use of hybrid or online learning options for the future. Many businesses also accelerated their digital transformation efforts to adapt to the new normal. This led to increased demand for tech-related jobs. As the job market shifted, employees and job seekers focused on acquiring new skills and competencies to remain competitive in the changing employment landscape (Shanahan & Organ, 2022).

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Figure 1. The 10 shifts to transform higher education system in Malaysia (Ministry of Education Malaysia, 2015)

As for Malaysia, in response to the new normal due to the pandemic, Malaysian HEIs have taken proactive measures to embrace e-learning approaches specifically Open and Distance Learning (ODL) practices. ODL has emerged as a prominent trend in providing access to high-quality education, fostering lifelong learning possibilities, offering flexible learning techniques, and creating a conducive learning atmosphere for individuals. Students engaged in several forms of online educational activities, including attending virtual lectures, participating in online tutorials, and engaging in self-directed learning through online platforms such as Zoom, Google Meet, Google Classroom, Flipped Classroom, etc. In contrast to traditional physical examination practice, online assessments and assignments offer the advantage of providing students with immediate access to their grades and constructive feedback, enabling them to enhance their performance in subsequent evaluations.

To support these transformations, the Ministry has introduced the Data Plan and Device Package initiative in 2021, targeting the B40 group. Approximately 200,000 data plans and 4000 gadgets have been distributed to facilitate remote learning for students within this demographic. In the same year, a budget allocation of RM50 million had been approved for upgrading the Malaysian Research and Education Network to ensure students get better and faster internet access and connectivity (*Higher Education Institutions Must Adapt to Digital Changes Post-Covid-19*, n.d.).

Consequently, the concept of Micro-Credentials which enable individuals to take short courses at their own convenience and pace, is gaining more attentions (Chukowry et al., 2021). According to Malaysia Qualifications Agency (MQA), a Micro-Credential refers to a formal recognition of evaluated learning outcomes achieved via the completion of one or more specific courses. Its purpose is to equip learners with specific knowledge, values, skills, and competencies (Malaysia Qualifications Agency, 2020). Certain Micro-Credentials may be referred to as digital badges, online certificates, licenses, alternative credentials, endorsements, nano-degrees, or micro-masters (Malaysia Qualifications Agency, 2020; Shanahan & Organ, 2022).

This paper will present the implementation of Micro-Credentials for the Power Electronics course at Universiti Malaysia Pahang Al-Sultan Abdullah (UMPSA). A brief overview of Micro-Credentials of all around the world as well as in Malaysia will be given first. Next, it will discuss the development of Micro-Credential of Power Electronics course followed by the assessments. Finally, general recommendations will be given to enhance the implementation of this Micro-Credential.

Overview of Micro-Credentials Around the World

The post-pandemic period has seen numerous governments all over the world adopting Micro-Credentials as a means to facilitate the reintegration of individuals into the workforce through training and reskilling initiatives. In pursuit of this objective, governments are allocating substantial financial resources. For example, the Australian Federal Government announced a $4.3 million fund in 2020 to build a micro-credential market to assist re-employment initiatives. Similarly, in the same year, the Irish Government's Human Capital Initiative (HCI) allocated a noteworthy €12.3 million to provide funding for seven universities in support of their micro-credential projects. The governments of Alberta and Ontario, Canada have also demonstrated their commitment by investing a total of $65.1 million in Micro-Credential development and awareness programs.

As for Malaysia, Universiti Sains Malaysia (USM) has led the way with the establishment of Micro-credential@USM, a program designed to assist professionals from all organizations and industries, educators, and lifelong learners (CDAE, 2018). Following this are Universiti Malaya (UM), Universiti Putra Malaysia (UPM), and Universiti Teknologi Mara (UiTM) Pulau Pinang branch (UiTMCPP), which have all started the move since 2019 (Academic Development and Enhancement Centre (ADEC), 2019; Pusat Pembangunan dan Kecemerlangan Kepimpinan Akademik, 2019). A series of seminars and workshops have been conducted to train the module developers to design their modules (Ahmat et al., 2021). Nowadays, many public universities have taken part in offering this kind of learning such as Universiti Kebangsaan Malaysia (UKM), Universiti Teknologi Malaysia (UTM), Universiti Utara Malaysia (UUM), Universiti Islam Antarabangsa (UIA), Universiti Malaysia Sarawak (UNIMAS), and UMPSA.

Micro-Credentials at UMPSA

UMPSA has offers three distinct categories of Micro-Credentials namely Micro-Credentials (MC), Stand-Alone Micro-Credentials (SAMC), and Micro-Credentials Industry (MCI) (CIReL, 2022). Figure 2 illustrates the fundamental framework of MC in UMPSA, where each MC course carries a weight of 3 credit hours, contributing to a cumulative total of 120 Students Learning Time (SLT). This MC can be split into three modules, each having its own set of Course Learning Outcomes (CLO), which may be either identical or varied. Each module is also designed to be completed within a one credit hour timeframe, which corresponds to 40 SLT. It was suggested to have a maximum 3 chapters only for each module and they can have their own Learning Material (LM), Learning Activity (LA) and Learning Assessments (LS).

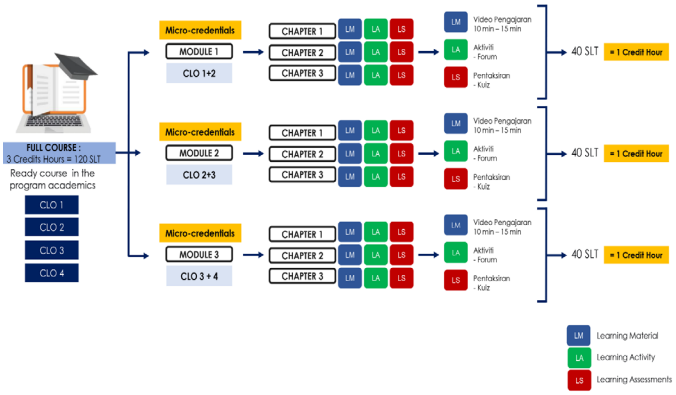

Figure 2. Micro-Credentials structure at UMPSA (CIReL, 2022)

Figure 3 depicts a flow chart outlining the process of MC development and registration at UMPSA. Initially, the course developer needs to identify and gather all the necessary details pertaining to the course and thereafter develop a comprehensive teaching plan including the delivery mode and assessments. Subsequently, the digital content shall be created in accordance with the e-learning content quality guidelines (GPKKeP) established by the Centre of Instructional Resources and e-learning (PSPe) at UMPSA before it can be uploaded to the designated platforms.

MC 01: Introduction to Power Electronics

For Power Electronics Course, it is under MC category where it is further divided into three modules: MC 01, MC 02, and MC 03 entitled Introduction to Power Electronics, DC Power Supplies and AC Power Supplies respectively as shown in Figure 4. Each module has its own Course Learning Outcome (CLO) and was allocated a total of 40 hours of Students Learning Time (SLT). For time being, only MC 01 has been established while MC 02 and MC 03 are still in progress. Figure 5 presents the synopsis and CLO pertaining to MC 01.

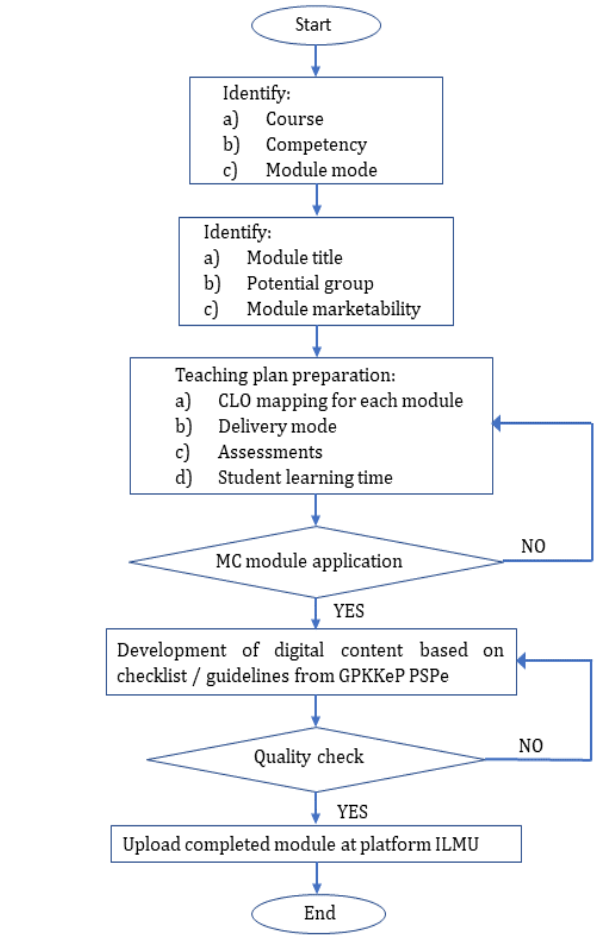

Figure 3. Flow chart for Micro-Credentials development and registration at UMPSA (CIReL, 2022)

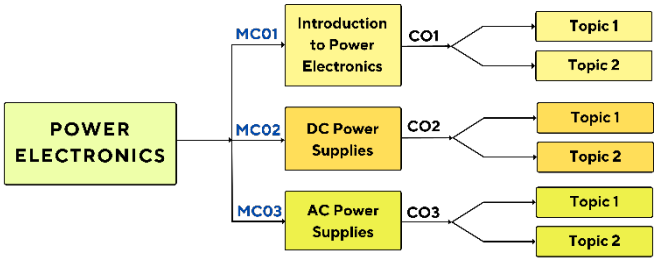

Figure 4. Micro-credential structure for power electronics course.

Synopsis:
This module presents a foundation of knowledge, understanding, analysis and design of power electronics circuits for a conversion and control of electrical energy.

Course Learning Outcome:
Describe the operating principles and the switching characteristics of a power electronics converter.

Figure 5. The synopsis and course learning outcome for MC 01.

The Development of e-content

Module MC 01 consists solely of two chapters, entitled "Fundamentals of Power Electronics" and "Rectifier". The topic of Fundamentals of Power

Electronics will encompass the study of electrical switches and their applications in power electronics. On the other hand, the later topic will explore both uncontrolled and controlled rectifiers. This module is designed to provide 40 hours of SLT which involves lectures, learning activities, and assessments. The laboratory activity will primarily be conducted using simulation methods. Thus, students are required to install the LTspice software to simulate the behaviour of the rectifiers.

The module's delivery employs a cutting-edge approach that incorporated the use of Green Screen technique as shown in Figure 6 and the Lightboard technology as demonstrated in Figure 7. Both recording sessions were taking place in the EduCreator Studio located at the Faculty of Electrical and Electronics Technology, UMPSA. Once the e-contents have undergone quality checks, they will be uploaded on the TINTA and iLMU platforms. The TINTA system is a digital self-paced learning platform that is accessible solely to staff and students of UMPSA. In contrast, iLMU is an Integrated Learning Management System for Universality that can be assessed by the external community.

Figure 6. e-content development using Green Screen technique.

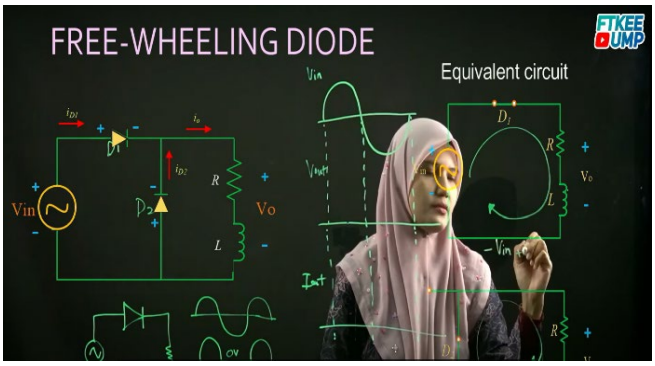

Figure 7. e-content development using Lightboard technology.

Assessments

In this module, students will undergo evaluation through a series of assessments, including one test, one lab report, and two quizzes. These assessments will contribute to the overall grade with respective weightings of 50%, 40%, and 10% as tabulated in Table 1. All assessments will be conducted online via the Moodle platform which employed a range of question formats such as multiple choices and embedded answers (Cloze). Figure 8 shows an example of the question using the Cloze method. Students are required to fill in the blank with the correct answer and it will be automatically graded.

Table 1: Assessment's List

Assessment	Percentage
Quiz	10 %
Lab report	40 %
Test	50 %

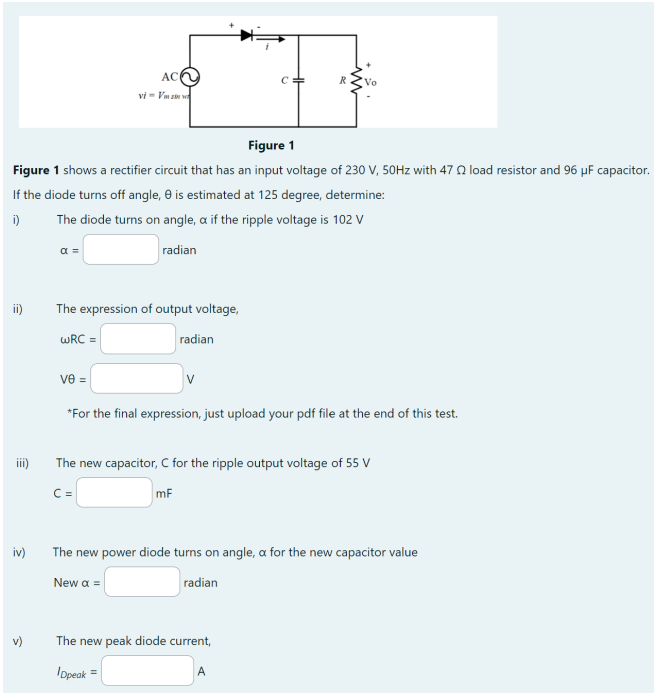

Figure 8. Sample questions using embedded answers (Cloze) method.

Recommendations

For the successful implementation of the Micro-Credentials programs, it is crucial to focus on several key strategies including raising awareness, providing incentives, and promoting Micro-Credentials in an effective manner. To accomplish this objective, universities need to proactively establish meaningful connections with relevant stakeholders, to gather valuable insights and secure their support, as well as to outreach potential learners. Simultaneously, it is imperative to provide incentives to the module developers to boost their motivation and commitment, while for the learners, scholarships can be offered to encourage their participation in the program. Finally, the establishment of a dedicated website or platform is essential in order to provide detailed information for

this program. It is also possible to use a variety of platforms, such as social media, webinars, workshops, and industry events to promote awareness of this program. Social media, webinars, workshops, and industry events can also be utilized to enhance the visibility and recognition of this program.

Conclusion

The development of micro-credentials in power electronics is essential to meet the growing demand for specialist knowledge in this field. However, it requires a comprehensive approach involving a well-structured module, the utilization of advanced technology for content delivery, and designing a suitable assessment. This program holds the potential to bridge the knowledge gap, enhance skill sets, and make education more accessible. As the demand for specialized expertise in this field continues to grow, these credentials can serve as a vital tool for career advancement and industry competitiveness, benefiting both individuals and the broader workforce.

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