MODULE DESCRIPTION

Module title: **Energy Efficient Smart Lighting (EESL)**
Module code: 61ECE216
Study program: **Electrical and Computer Engineering (ECE)**

Module coordinator/Lecturer:

Type	Lecturer	Email	Office	Office hours
Lecture	**Dr. Bui Minh Duong**	duong.bm@vgu.edu.vn	B111	9:00-11:00 AM, Mon and Fri
Tutorial	None			
Lab	**Mr. Tran Quang Nhu**	nhu.tq@vgu.edu.vn	B102	None
Other	None			

Classification: ☐ Compulsory ☐ Compulsory optional ☒ Optional/Elective

Semester: Summer Semester

Student workload:

Credits	4	ECTS
Contact hours	56	AHs
Assignments and independent learning	64	AHs
Total Working hours	**120**	AHs

Frequency: The module is offered each academic year

Prerequisites: None

Co-requisites: None

Duration: 15 weeks

Course objective:

This course is to study state-of-the-art optoelectronic devices for lighting and displays with an emphasis on innovation, develop a good understanding and deep appreciation of the device architecture and operating principles of LEDs and major display technologies, and introduce smart lighting systems and their control and interaction systems. Moreover, the course instructs students the hardware and software control of luminaires, sensory design, smart urban lighting, energy efficiency indoor lighting technologies, and sustainable (indoor or outdoor) lighting. In addition, business aspects of intelligent lighting solutions and energy efficient lighting solutions will be presented and discussed in the course to help students have a comprehensive insight in economic benefits of smart lighting. Last but not least, life-cycle analysis and costs of smart lighting systems will be introduced in this course.

Intended learning outcomes:

On successful completion of this module, the learner will be able to:

- Get insight in the concept of smart lighting and its applications;
- Get knowledge of smart lighting technologies (e.g. light emitting diodes (LEDs), plasma display panels (PDPs), field emission displays (FEDs), liquid crystal displays (LCDs), organic/inorganic

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light-emitting devices (OLEDs), electroluminescent displays (ELDs), and electrochromic displays (ECDs));

- Understand and make use of control systems of smart lighting through student projects and seminars;
- Learn how to strive for the balance between energy and human oriented lighting control;
- Learn about intelligent lighting solutions and economic benefits of smart lighting;

Module content:

No.	Topics
1.	Introduction to smart lighting technologies (light emitting diodes (LEDs), plasma display panels (PDPs), field emission displays (FEDs), liquid crystal displays (LCDs), organic/inorganic light-emitting devices (OLEDs), electroluminescent displays (ELDs), and electrochromic displays (ECDs));
2.	Electroluminescence (the basics of LED lamps, light-emitting diodes operating principles and lighting metrics)
3.	White light from LEDs
4.	LED luminaires and LED ballasts and drivers
5.	Controls and interaction (communication) (Analog control, Digital control, Standard protocols for lighting control, Networks and buses, Computers in lighting control, and Cordless control)
6.	Hardware and software control of luminaires
7.	Sensory design
8.	Smart urban lighting
9.	Energy efficiency indoor lighting
10.	Sustainable (outdoor) lighting
11.	Business aspects of intelligent lighting solutions
12.	Business aspects of energy efficient lighting solutions
13.	Energy labelling light sources and certificates
14.	Life-cycle analysis (environmental) and life-cycle costs (economic)

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Learning activities:

Activities	Expectation/Explanation
Attendance	Students should attend 100% classes. The attendance will be checked by doing 15-minute quick tests for each lecture. **There is an extra point of 10% for the attendance completion**.
Individual Assignments/ Homework	Every lecture has an assignment/homework. The submission deadline will be given at the end of the lecture. All works presented must meet professional standards regarding materials and format. **The homework occupies 20% of the total grade of the course.** Since it is a faculty's strong belief that a student's success is directly proportional to success with homework, it is imperative that the homework should be done. **No late homework will be accepted**.
Group work	None
Self-study	At least 3 hours per week
Internship	None
Lab or Workshop	Lab 1: White light from LEDs, LED luminaires and LED ballasts and drivers Lab 2: Controls and communication networks in smart lighting Lab 3: Hardware and software control of luminaires Lab 4: Sensory design Lab 5: Smart urban lighting, energy efficiency indoor lighting, sustainable (outdoor) lighting

Mode of Assessment:

Online interaction: None
Mini tests: 15-minute quick tests for each lecture
Assignments: Every lecture has an assignment/homework or project
Group project: None
Exam: A final exam occupies 100% of the total grade of the course. It is a closed-book exam however students can use a cheat-sheet with the size of A4. It is very important to note that students cannot be allowed to increase the area of the A4-size paper.
Length of examination: 90 minutes

Grading policy:

Assessment method	Percentage of total	Assessment date
15-minute quick tests	10% (extra point)	
Assignments	20% (extra point)	
Final exam/Written exam	100%	Followed by a VGU's timetable
Total grade	**130%**	

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Performance	German Grade	Vietnamese Grade
≥95%	1,0	9,5 – 10
≥90%	1,3	9,0 - 9,4
≥85%	1,7	8,5 - 8,9
≥80%	2,0	8,0 - 8,4
≥75%	2,3	7,5 - 7,9
≥70%	2,7	7,0 - 7,4
≥65%	3,0	6,5 - 6,9
≥60%	3,3	6,0 - 6,4
≥55%	3,7	5,5 - 5,9
≥50%	4,0	5,0 - 5,4
<50%	5,0	< 5,0

Integrity:

Academic dishonesty is a completely unacceptable mode of conduct and will not be tolerated in any form. All persons involved in academic dishonesty will be disciplined in accordance with University regulations and procedures. Discipline may include suspension or expulsion from the University. "Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, and the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts".

Module materials:

Required texts:

1. Simpson Robert S., "**Lighting control: technology and applications**," Focal Press, 2003.
2. Paola Sansoni, Luca Mercatelli, and Alessandro Farini, "**Sustainable Indoor Lighting**," Springer-Verlag London, 2015.
3. Benya James, James Benya, and Donna Leban, "**Lighting retrofit and relighting: a guide to energy efficient lighting**," John Wiley & Sons, Inc., 2011.
4. Tran Quoc Khanh, Peter Bodrogi, Quang Trinh Vinh, and Holger Winkler, "**LED Lighting - Technology and Perception**," Wiley-VCH, 2015.
5. Sheng Liu and Xiaobing Luo, "**LED packaging for lighting applications: design, manufacturing and testing**," Chemical Industry Press, 2011.
6. Toyoki Kozai, Kazuhiro Fujiwara, and Erik S. Runkle, "**LED Lighting for Urban Agriculture**," Springer Science+Business Media Singapore, 2016.

Recommended texts:

1. E. F. Schubert, "Light-emitting Diodes", Cambridge Univ. 2006.
2. J.-H. Lee, D. N. Liu, S.-T. Wu, "Introduction to Flat Panel Displays," The SID (the Society for Information Display) - Wiley Series in Display Technology, 2009.
3. S. Dutta Gupta, "Light Emitting Diodes for Agriculture – Smart lighting," Springer Nature Singapore Ltd., 2017.

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Written/updated by	Approved by head of discipline/dean
Dr. Bui Minh Duong	**Dr. Thai Truyen Dai Chan**
Date: 24/06/2020	Date: ……/……./……