

Course Code: CPE1405

Degree: Bachelor's Degree

Title: Fundamentals of Electrical, Electronics and Digital

Curriculum: B.Eng. (Computer Engineering)

Credits: 3(2-2-5)

Faculty: Faculty of Engineering and Industrial Technology

Course Specification (OBE3)

Section 1 General Information

1. Course Code and Title

English: CPE1405 Fundamentals of Electrical, Electronics and Digital

Thai: CPE1405 พื้นฐานไฟฟ้า อิเล็กทรอนิกส์ และดิจิทัล

2. Credits

3 Credits

3. Course Category

Required Course

4. Teacher(s) in Charge and Instructor(s)

Teacher(s) in Charge: Dr.Pongrapee Kaewsaiha

Instructor(s): Dr.Pongrapee Kaewsaiha

Contact: Faculty of Engineering and Industrial Technology, SSRU

E-mail: pongrapee.ka@ssru.ac.th

5. Semester and Academic Year

Semester: 1

Academic Year: 2026

Year: 1

6. Pre-requisites (if any)

-

7. Co-requisites (if any)

-

8. Venue

Faculty of Engineering and Industrial Technology, SSRU

9. Last Update

July 2025

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10. Consistency between the Curriculum and the University Vision, and Higher Education Curriculum Standards

University vision: “A leader in producing professionals”	Promote self-learning skills in practice and work development for professional careers (Lifelong learning)	Promote digital skills
This course is aligned with the professional qualification standards for the field of electrical and electronics engineering.	This course encourages students to use a wide variety of available resources and tools on the internet to promote self-directed learning.	This course allows students to use simulator applications to test the operation of circuits and identify errors.

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Section 2 Course Description and Course Learning Outcomes: CLOs

1. Course Description

(English) Fundamentals of electricity; Ohm's law; Kirchhoff's laws; current-voltage characteristics; electronic components; basic analog circuitry; binary number system; Boolean algebra and reduction; basic logic; combinational circuits; sequential circuits; latches; flip-flops; registers and counters; digital circuitry; control units; and digital projects

(Thai) พื้นฐานไฟฟ้า กฎของโอห์ม กฎของเคอร์ชอฟ คุณสมบัติกระแส-แรงดัน อุปกรณ์อิเล็กทรอนิกส์ วงจรแอนะล็อก พื้นฐาน ระบบเลขฐานสอง พีชคณิตแบบบูลีนและการลดรูป ลอจิกพื้นฐาน วงจรคอมบิเนชัน วงจรซีควเอนเชียล แลทช์ ฟลิปฟลอป รีจิสเตอร์และเคาน์เตอร์ วงจรคณิตศาสตร์ หน่วยควบคุม และโครงงานทางดิจิทัล

2. Number of Hours per Semester

Lecture	Practice/Field Work/Internship	Self-study
30 hours/semester 2 hours/week	30 hours/semester 2 hours/week	75 hours/semester 5 hours/week

Course type ☒ Lecture ☒ Practice

3. Number of Hours of Individual Student Counseling

- 1) Academic advising (at least 1 hour per week)
- 2) The use of digital technology in academic advising

4. Course Objectives

Upon completion of the course, students will be able to:

- 1) Explain the basic operating principles of electrical, electronic, and digital circuits
- 2) Analyze electrical, electronic, and digital circuits
- 3) Design electrical, electronic, and digital circuits to perform specified functions

5. Course Learning Outcomes (CLOs)

CLO 1 Explain the basic principles of electrical circuits, electronics, and digital systems

CLO 2 Analyze and design electrical, electronic, and digital circuits

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6. Relationship between Program Learning Outcomes (PLOs) and Course Learning Outcomes (CLOs)

PLOs	Knowledge (K)	Skills (S)	Ethics (E)	Characteristics (C)
PLO 1 Can apply basic knowledge to solve fundamental engineering problems.	✓			
PLO 2 Can apply knowledge to create works and develop innovations in computer engineering.	✓			
PLO 3 Can develop programs and improve code efficiently.	✓			
PLO 4 Can apply computer technology in the design and development of computer systems that meet user needs.		✓		
PLO 5 Can analyze and solve technical problems that arise in the computer engineering field.		✓		
PLO 6 Can demonstrate patience, diligence, honesty, responsibility, and the ability to work well with others.			✓	
PLO 7 Aware of and possess morality, ethics, and professional conduct in academic and professional fields.			✓	
PLO 8 Can apply information technology in the workplace, demonstrating leadership qualities, being creative, and possessing communication skills with various individuals in both Thai and English.				✓

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PLOs/CLOs Consistency	CLO 1	CLO 2
PLO 1 Can apply basic knowledge to solve fundamental engineering problems.	✓	
PLO 5 Can analyze and solve technical problems that arise in the computer engineering field.		✓

CLOs	Cognitive Domain (Knowledge)						Psychomotor Domain (Skills)	Affective Domain (Attitude)
	R	U	Ap	An	Ev	C		
CLO1		✓					1, 2	1, 2
CLO2			✓	✓			1, 2	1, 2

Cognitive Domain

R=Remembering U=Understanding Ap=Applying An=Analyzing Ev=Evaluating

C=Creating

Psychomotor Domain

1=Imitation 2=Manipulation 3= Precision 4= Articulation 5= Naturalization

Affective Domain

1= Receiving 2= Responding 3= Valuing 4= Organizing 5= Characterizing

Quality Assurance Criteria:

1.2 The curriculum reflects the expected learning outcomes of all subjects, is appropriately designed and organized and is consistent with the general education learning outcomes.

Course Learning Outcomes (CLOs) for OBE Curriculum

CLOs	Knowledge (K)	Cognitive Skills (S)	Morals and Ethics (E)	Interpersonal Relationship and Responsibility (C)	Additional Outcomes Specified by the Professional Council (if applicable)
CLO1	✓	✓			
CLO2		✓	✓	✓	

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7. Course Improvements based on Stakeholder Feedback

Stakeholder Feedback	Improvements based on Feedback
Separating electrical circuits and digital systems into two distinct subjects results in unnecessarily extensive content for each course. Computer engineering students do not need to deal with complex electrical circuit analysis, such as superposition analysis or the use of logic gates, which are often linked to programming, as microcontrollers are currently more commonly used.	The revised curriculum of 2025 merged two subjects, focusing on training students in the analysis of electrical and electronic circuits at a level necessary for real-world applications in hardware or IoT fields. This was combined with computer programming courses to allow students to experiment with writing programs for microcontroller boards to control electrical circuits.

Quality Assurance Criteria:

3.6 Information on course improvement based on stakeholder feedback to demonstrate that the teaching and learning process is continuously improved to ensure that it meets the needs of the industrial sector and is consistent with the expected learning outcomes.

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Section 3 Student Improvement in relation to Course Learning Outcomes (CLOs)

1. Consistency between Course Learning Outcomes (CLOs/LOs) and Teaching Methods, Measurement, and Evaluation

CLOs	Outcome	Teaching methods and feedback (Active Learning) (Must be related to Section 2, Item 6)	Methods of Measurement and Evaluation
CLO 1	K, S	The course includes lectures and practical exercises on electrical, electronic, and digital equipment, using online simulators to enhance understanding.	Quiz Assignment
CLO 2	S, E, C	Students will be required to analyze given electrical, electronic, and digital circuits, focusing on practical electrical circuits. They will then design circuits that perform the specified functions, ensuring the design aligns with the problem, requirements, and available resources.	Quiz Assignment

* OBE curriculum must have CLOs cover K S E C

* TQF curriculum must have LOs cover K S E C IT

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2. Learning Outcome Index Scoring criteria (rubrics) for measurement and assessment must be consistent with the learning outcome index.

CLO 1: Explain the basic principles of electrical circuits, electronics, and digital systems

Cognitive Level (Bloom's Taxonomy): Understanding

Behavior to be assessed (Action verb): Explain

Below Expectations (Performance 0% - 59%)	Meets Expectations (Performance 60% - 89%)	Exceeds Expectations (Performance 90% - 100%)
Unable to accurately explain the operating principles of electrical, electronic, and digital circuits	Explain the operating principles of electrical, electronic, and digital circuits according to the given problem, using the methods presented in this lesson	Explain the operating principles of real-world circuits, including the necessity of designing circuits in such a manner, and be able to provide feedback for improvement or suggest better approaches.

CLO 2: Analyze and design electrical, electronic, and digital circuits

Cognitive Level (Bloom's Taxonomy): Applying, Analyzing

Behavior to be assessed (Action verb): Design, Analyze

Below Expectations (Performance 0% - 59%)	Meets Expectations (Performance 60% - 89%)	Exceeds Expectations (Performance 90% - 100%)
Unable to analyze and design electrical circuits electronics and digital according to the given problem correctly	Analyze and design electrical, electronic, and digital circuits based on given problems using the methods presented in this lesson	Analyze and design electrical, electronic, and digital circuits for practical applications, and provide feedback or evaluations on the suitability of designed circuits in various aspects such as safety and efficiency

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Quality Assurance Criteria:

3.3 A variety of learning activities are organized, with a focus on learners.

3.4 Learning activities are organized to promote learning, learning how to learn, and instill in learners lifelong learning skills (e.g. creative and critical questioning, data processing skills, presentation skills, and new approaches).

3.5 Learning activities are organized to encourage learners to think creatively, innovate, and be entrepreneurial.

4.1 A variety of assessment methods are available, consistent with the achievement of expected learning outcomes and teaching objectives.

4.2 A clear policy for assessment and appeals is in place, communicated to learners, and consistently applied.

4.3 Assessment must have clear standards and processes that demonstrate learners' progress and achievement, communicated to learners, and consistently applied.

4.4 Assessment methods must demonstrate rubrics, marking schemes, timelines, and regulations, and must be fair, consistent, and impartial.

4.5 Assessment methods must demonstrate achievement of general education learning outcomes. and course learning outcomes

4.6 There is timely feedback on assessment results to learners.

4.7 The assessment of learners and processes is reviewed and improved continuously to ensure that it meets the needs of the work industry and is consistent with the expected learning outcomes.

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Section 4 Lesson Plan and Assessments

1. Lesson plan

Session	Topic	CLOs	Hours	Learning Activities and Instructional Media	Test Blueprint	Instructor
1	Introduction	CLO 1	T2, P2	- Pre-test: Exponents - Engineering notation - Metric (SI) prefixes - Basic concepts of electricity and electrical circuits - Electrical quantity - Quiz	Q (15 items)	PK
2	Resistive circuits	CLO 1, 2	T2, P2	- Resistance and resistors - Quiz - Workshop	Q (6 items) W (2 items)	PK
3	Ohm's law and Kirchhoff's law	CLO 1, 2	T2, P2	- Power sources - Ohm's law - Kirchhoff's circuit laws - Quiz -	Q (3 items) W (2 items)	PK

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Session	Topic	CLOs	Hours	Learning Activities and Instructional Media	Test Blueprint	Instructor
4	Nodal analysis	CLO 1, 2	T2, P2	- Nodal analysis - Worksheet - Quiz - Additional practice	Q (10 items) E (15 items)	PK
5	Capacitance and inductance	CLO 1, 2	T2, P2	- Capacitance - Inductance - Workshop - Exercise	E (4 items) W (2 items)	PK
6	Semiconductor devices	CLO 1, 2	T2, P2	- Semiconductor devices - Bipolar junction transistor (BJT) - How to test a transistor with a multimeter - PN2222A datasheet - Workshop - Exercise	E (1 items) W (1 items)	PK
7	Review	CLO 1, 2	T2, P2	Course review		PK
8	Mid-term examination	CLO 1, 2			M (6 items)	PK

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Session	Topic	CLOs	Hours	Learning Activities and Instructional Media	Test Blueprint	Instructor
9	Introduction to digital systems	CLO 1	T2, P2	- What is "digital" - Base-n numbers - Binary operations - Quiz - Exercise	Q (8 items) E (16 ข้อ)	PK
10	Combinational circuits	CLO 1, 2	T2, P2	- Logic gates - Quiz - Exercise	Q (25 items) E (6 items)	PK
11	Digital ICs	CLO 2	T2, P2	- Digital IC Listing - Difference between CMOS and TTL - CMOS and TTL logic - Reading IC number and pinout - 7400-series ICs - Workshop	W (2 items)	PK
12	Boolean algebra	CLO 1, 2	T2, P2	- Boolean algebra - Boolean simplification - Quiz	Q (4 items)	PK

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Session	Topic	CLOs	Hours	Learning Activities and Instructional Media	Test Blueprint	Instructor
13	Logic circuit design	CLO 1, 2	T2, P2	- Examples - Karnaugh map - Quiz - Exercise	Q (4 items) E (1 items)	PK
14	Flip-flop	CLO 1, 2	T2, P2	- SR Latches & Flip-flops - D, JK, T Latches & Flip-flops - Exercise	E (12 items)	PK
15	Lab session	CLO 2	T2, P2	- JK flip-flop - Pulse generator - Workshop	W (2 items)	PK
16	Review	CLO 1, 2	T2, P2	Course review		PK
17	Final examination	CLO 1, 2			F (6 items)	PK

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Note:

1. *T = Theory, P = Practice*
2. *Abbreviation of the teacher's name: PK - Dr.Pongrapee Kaewsaiha*
3. *"Teaching Activities" mean activities and media that teachers use to conduct learning and "Learning Activities" mean activities that teachers must determine and assign in class (or outside the class) so that students can have a "learning experience" by themselves.*
4. *Abbreviation of the test plan:*
Q: Quiz (Auto graded)
E: Circuit analysis exercises (Grade by the instructor)
W: Workshop using experimental equipment and/or simulators
M: Midterm examination (Grade by the instructor)
F: Final examination (Grade by the instructor)

2. Evaluation Plan

Measurement and Evaluation	Proportion	CLO 1	CLO 2
Quiz (Q)	20%	✓	
Circuit analysis exercises (E)	20%	✓	✓
Workshop (W)	20%		✓
Midterm examination (M)	20%	✓	✓
Final examination (F)	20%	✓	✓

3. Test Blueprint

Topic	Proportion	CLO 1	CLO 2
Quiz (Q)	20%		
Introduction		15 items	
Resistive circuits		6 items	
Ohm's law and Kirchhoff's law		3 items	
Nodal analysis		10 items	
Introduction to digital systems		8 items	
Combinational circuits		25 items	

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Topic	Proportion	CLO 1	CLO 2
Boolean algebra		10 items	
Logic circuit design		4 items	
Circuit analysis exercises (E)	20%		
Nodal analysis			15 items
Capacitance and inductance			4 items
Semiconductor devices			1 item
Introduction to digital systems			16 items
Combinational circuits			6 items
Logic circuit design			1 item
Flip-flop			12 items
Workshop (W)	20%		
Resistive circuits			2 items
Ohm's law and Kirchhoff's law			2 items
Capacitance and inductance			2 items
Semiconductor devices			1 item
Digital ICs			2 items
Lab session			2 items
Midterm examination (M)	20%	3 items	3 items
Final examination (M)	20%	3 items	3 items

4. Grading Criteria

Percentage	Grade	Explanation
86 – 100	A	Excellent
82 – 85	A-	Almost Excellent
78 – 81	B+	Very Good
74 – 77	B	Good
70 – 73	B-	Quite Good
66 – 69	C+	Fairly Good

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Percentage	Grade	Explanation
62 – 65	C	Fair
58 – 61	C-	Fairly Poor
54 – 57	D+	Quite Poor
50 – 53	D	Poor
46 – 49	D-	Very Poor
0 – 45	F	Failed

5. Course Learning Outcomes Assessment Criteria

Achievement Level	Achievement Criteria	Description
Level 3	At least 80% of students fall into either “Level 2 - Meets Expectations” or “Level 3 - Exceeds Expectations” categories.	Demonstrate outstanding learning outcomes, with the majority of students exceeding set expectations, such as scoring above standard criteria and demonstrating the ability to apply knowledge in complex situations.
Level 2	60-79% of students fall into either “Level 2 - Meets Expectations” or “Level 3 - Exceeds Expectations” categories.	Demonstrate expected learning outcomes. Most students can achieve the minimum goals, with learning outcomes reflecting good understanding and application of basic knowledge.
Level 1	Less than 60% of students fall into either of the “Level 2 Meets Expectations” or “Level 3 Exceeds Expectations” categories.	Indicate that learning outcomes are still below the expected criteria. Most students may not be able to achieve the intended outcomes at a satisfactory level and need to improve or develop their learning further.

Quality Assurance Criteria:

4.5 The method of assessing learners must demonstrate the achievement of general education learning outcomes and course learning outcomes.

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Section 5 Learning Resources and Support Facilities

1. Learning Media and Learning Support

- 1) Learning Management System
- 2) Learning resources from ARIT SSRU
- 3) Lab equipment
- 4) Websites and web applications
- 5) Technical and academic support: Line OpenChat

2. Learning Platform

pongrapee.net (Moodle)

3. Learning Media from External Sources

- 1) tinkercad.com
- 2) circuitlab.com
- 3) everycircuit.com
- 4) circuitverse.org

4. Supporting Research Studies

Kaewsaiha, P. (2025, February). Flexibility in Learning: Student Experiences in a HyFlex Circuit and Electronics Course. In *International Academic Multidisciplinary Research Conference (ICBTSOSLO2025)* (pp. 182-189).

Quality Assurance Criteria:

3.4 *There are teaching and learning activities to promote learning, learning how to learn, and instilling in students lifelong learning skills (e.g. creative and critical questioning, data processing skills, skills in presenting new ideas and new practices).*

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Section 6 Course Evaluation and Improvement

1. Course Evaluation by Students

- ☒ Course evaluation form
- ☒ Teacher evaluation form (reg.ssru.ac.th)
- ☒ Conversation, exchange of ideas between teachers and students
- ☐ Reflection of student behavior
- ☒ Suggestions from students through communication channels specified by the teacher
- ☐ Other (Please specify): ...

2. Strategies for Evaluating Teaching Management

- ☒ Student examination results
- ☒ Verification of academic achievement and student learning outcomes
- ☐ Assessment by the examination committee
- ☐ Observation by the teaching team
- ☐ Observation by stakeholders (Please specify): ...
- ☐ Other (Please specify): ...

3. Course Implementation Improvement Plan

- ☒ Organizing seminars or conferences on teaching and learning with stakeholders
- ☒ Conducting research on learning management inside and outside the classroom
- ☐ Other (Please specify): ...

4. Review of Student Learning Outcomes Aligned with GELOs and CLOs

- ☒ Establishing a committee to review the learning outcomes assessment results, such as exam review, assignment review, grading, and evaluation
- ☒ Review of grading and evaluation by the Gen-Ed academic committee
- ☒ Random checking of grading results by teachers/experts who are not responsible for the course
- ☐ Other (Please specify): ...

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5. Course Review and Improvement Plan

- ☒ Annual course improvement based on the auditor's suggestions in (4)
- ☒ Annual course revision based on student evaluations and feedback
- ☐ Other (Please specify): ...

พงษ์ระพี

(Dr.Pongrapee Kaewsaiha)

Teacher in charge

5 June 2026