Institute of Technology of Cambodia

Faculty: Electrical Engineering

Department: Electrical and Energy Engineering

Engineer's degree in Electronics and Automation

Curriculum Improvement

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Academic 2021-2022

Contents

1. Description of Curriculum Improvement

Under Higher Education Improvement Project (HEIP), the Department of Electrical and Energy Engineering has MoU with the University of Toulouse (INP ENSEEIHT, France). The curriculum improvement in Electronics and Automation field is an important indicator of the project. Therefore, the department staffs develop a new curriculum due to some mismatched subjects or advanced subjects of the curriculum implemented in 2013 which is shown in the following table:

No.	Shortcomings of the old program	Percentage	Suggestions for the program improvement
1	The expected outputs do not meet the market demand	<30%	- Do a survey for the market needs - Prepare the expected outputs of the new curriculum by using the survey results
2	Duplicate subjects/ teaching content	30%	- Improve the subjects to support output results - Modify the teaching hour and Lab hour and the contents of each subject
3	Advance subject do not use in the current market	15%	- Improve the course learning outputs
4	Disorder subjects	20%	- Improve the order of the subjects
5	Few soft skills subjects	<5%	- Add soft skills subjects
6	The Course Learning Outcomes do not meet Program Learning Outcome	80%	- Improve Course Learning Outcome of each subject
7	Experimental subject: equipment matter, low-quality lab manuals, and less lab hours	50%	- Improve the experiment subject to support the expected output - Improve lab quality: manuals, equipment, lab hours

According to the matter of the existing curriculum, the department staffs identify the curriculum improvement of the Electronics and Automation field as a priority by using the budget of the Higher Education Improvement Project (HEIP). In order to determine the Program Educational Outcome (PEO)

in responding to market needs, the department staffs have developed a survey questionnaire that can be analyzed and measured to support the new program.

2. Survey Results

The surveys were conducted in person (30 samples) and online (18 samples). Among the 48 samples, there are 20 electricity companies in Phnom Penh, 20 companies in Svay Rieng province, and 8 companies in Kampong Chhnang province. The participants were 20 Engineers (42%), 20 Electricians (42%), and 8 Human resources (6%). In the survey form, 11 skills in Electronics and Automation have been developed for companies. The following table shows the survey results:

No.	Skills	Market Need				
		None	Low	Moderate	Fairly High	High
1	Embedded System Design	11%	16%	16%	34%	**23%**
2	Industrial Network	6%	0%	0%	33%	**61%**
3	Control System Design	0%	0%	6%	22%	**72%**
4	Production Line Design	0%	0%	5%	30%	**65%**
5	Mechatronics	6%	11%	44%	11%	**28%**
6	Extra-Low Voltage Design	0%	5%	15%	25%	**55%**
7	Produce Management and Operation	0%	5%	23%	39%	**33%**
8	Communication Skill	0%	11%	0%	33%	**56%**
9	Computer Literature	5%	0%	0%	45%	**50%**
10	Work Ethic, Health and Safety	5%	0%	5%	39%	**51%**
11	Languages Proficiency	0%	5%	11%	45%	**39%**

According to the results, we observe that 7 skills with a need higher than 50% are important for designing a new curriculum to meet the market need. Additionally, this new program supports also the research and graduate program.

Therefore, the new curriculum has three main objectives: 1- Technical skills (60% in industrial automation and embedded electronics), 2- Research and pursuing higher education skills (25%), and 3- Electrical entrepreneurship (15%).

3. New Curriculum of Electronics and Automation

The new curriculum was developed by using Outcome-Based Education (OBE). The figure below shows Program Educational Objectives (PEOs) that must be involved by all stakeholders such as feedback from the market, mission and vision of the department, and GEE alumni, etc.

The objectives of the educational program are evaluated by the institutional board based on the expected outcomes of the program (Program Learning Outcomes - PLOs). The expected outcomes of the program are assessed by the program level and supported by Course Learning Outcomes (CLOs). Therefore, the standard evaluation of each subject is crucial to achieve the effective objectives of the program (PEOs).

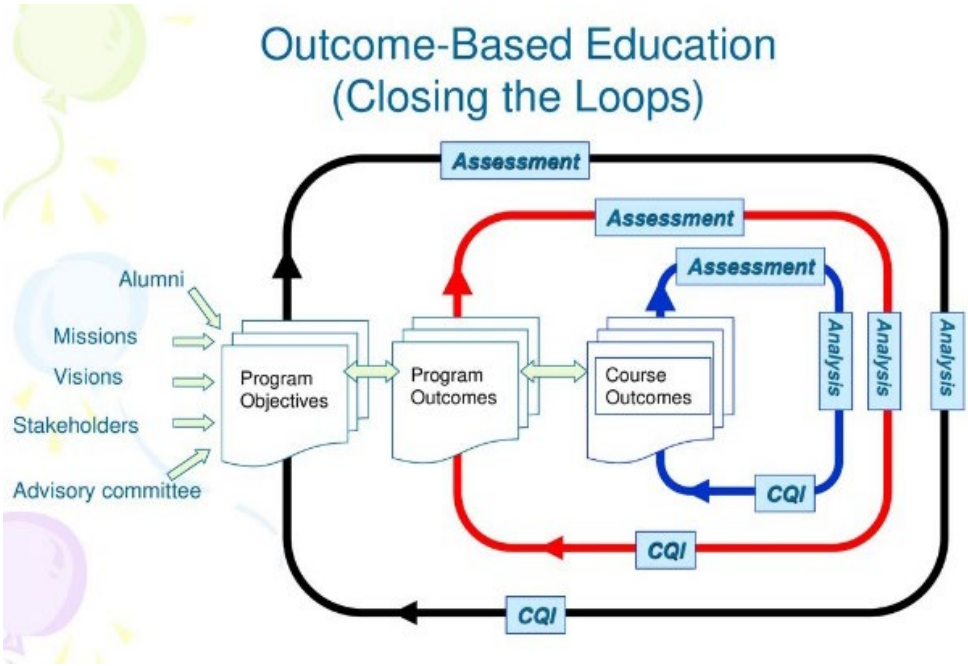


Figure 1: Outcome-Based Education Method Diagram

3.1. Program Aim

The program aims of the Department of Electrical and Energy Engineering, *Electronics and Automation* field are as follows:

- Provide the capacity building to meet current and future work in the field of Electronics and Automation.
- Provide the critical thinking skills to develop the new electronic devices based on research work for the current needs of industry 4.0.
- Provide analytical skills in Electronics and Automation for industries.
- Provide the project design skills, including full capacity in leadership and teamwork.
- Provide the psychomotor skills, testing electronic equipment, and training program.
- Provide basic financial management, and leadership skills to become future entrepreneurs.

3.2. Program Educational Objectives (PEOs)

In response to the market and the Institutional need, the educations program has three main objectives:

- **PEO1**: Students will become fully qualified engineers in Electronics and Automation field to meet current and future market needs nationally and internationally.

- **PEO2**: Students capable of pursuing higher education abroad (Master's degree and Ph.D.), which will increase the number of researchers in the institute, and relevant institutions and ministries.
- **PEO3**: Students can become entrepreneurs in the future by providing basic techniques skills, financial management, and leadership in educational programs.

3.3. Program Learning Outcomes (PLOs)

To support the above three main objectives (PEOs), 11 PLOs of the educational programs have been developed in accordance with the Cambodia Qualifications Framework (CQF):

a. Knowledge

PLO1. Able to have basic knowledge in the field of Electronics and Automation for the installation and operation of production lines.
PLO2. Able to use the equipment in the field of Electronics and Automation for troubleshooting.
PLO3. Able to make the maintenance schedule for equipment and automation systems in industries.

b. Cognitive Skills

PLO4. Highly skilled in analyzing complex problems in the field of Electronics and Automation for systems installed in industries.
PLO5. Highly innovative in developing new electronic devices based on research work and current needs of industry 4.0.
PLO6. Expertise in developing efficient automation systems to meet current and future needs.

c. Interpersonal Skills and Responsibility

PLO7. Expertise in assessing social needs for professional development and participating in lifelong learning in technical and environmental skills.
PLO8. Have effective leadership skills for teamwork, company, and country.

d. **Communication Information Technology Numerical Skills,**

PLO9. Have efficient communication skills both writing and oral among technical communities and societies.
PLO10. Have the skills to create arithmetic in computer software for analysis and problem-solving.

e. Psychomotor Skills

PLO11. Able to use measurement tools, electronic device testers, and conduct effective training programs to others.

3.4. Admission

To enroll the engineering degree in Electronics and Automation Engineering, students must:

- Have technical and vocational degrees level 5 or
- Have a high school graduation certificate or
- Have a foundation year certificate or
- Have an equivalent degree.

3.5. Number of Credits

In the Electronics and Automation Engineering program, students must study for 5 years and receive a total of 149 credits.

3.6. Curriculum Subjects

Basic Major Subjects	Core Major Subjects	Non-Major Subjects/ General subjects	Elective Major Subjects
1. Electrical circuit 2. Electronic analog and filter 3. Computer Programming 4. Feedback control system 5. Signals and systems 6. Digital Electronics 7. Microprocessor Architecture 8. Electrical machine 9. Numerical method and optimization 10. Statistics 11. Electrical engineering lab 12. Electronic lab 13. Electricity 14. Vibration and wave 15. Informatic	1. Programmable logic controller 2. Sensor and actuators 3. Electronics Circuit Design and Manufacturing 4. Digital circuit design 5. Motor Drive 6. Power electronics 7. Modern control system 8. Industrial Network 9. Electrical machine and power electronic lab 10. Control and automation lab 11. Embedded electronics 12. Industrial Automation 13. Advance Control and automation lab 14. Extra-Low Voltage Design	1. Communication and interpersonal relation 2. Research Methodology 3. English 4. French 5. Project management 6. Technopreneurship 7. Work-Life and social psychology 8. Final year internship 9. History 10. Philosophy 11. Environment 12. Management and accounting 13. Marketing 14. Chemistry 15. Geometry 16. Mechanics 17. Calculus 18. Thermodynamic 19. Technical drawing 20. Probability 21. Linear algebra	1. Student project - Part 1 2. Student project - Part 2 3. Internship Report

3.7. Curriculum Structure

❖ **1st year**

Semester 1		Semester 2	
Subject	**Credit**	**Subject**	**Credit**
French	3 (0.0.3)	French	3 (0.0.3)
Geometry	2 (1.1.0)	Calculus I	3 (2.1.0)
Mechanics I	3 (2.1.0)	Thermodynamic	3 (2.1.0)
Management and accounting	3 (3.0.0)	Technical drawing	2 (1.1.0)
Philosophy	2 (2.0.0)	Marketing	2 (2.0.0)
Environment	2 (2.0.0)	Informatic	2 (1.0.1)
		History	2 (2.0.0)
Total	**15**	**Total**	**17**

❖ **2nd year**

Semester 1		Semester 2	
Subject	**Credit**	**Subject**	**Credit**
French	3 (0.0.3)	French	2 (0.0.2)
English	2 (0.0.2)	English	3 (0.0.3)
Mechanic II	3 (2.1.0)	Linear algebra	3 (2.1.0)
Calculus II	3 (2.1.0)	Probability	3 (2.1.0)
Chemistry	3 (2.1.0)	Vibration and wave	3 (2.1.0)
Electricity	3 (2.1.0)		
Total	**17**	**Total**	**14**

❖ **3rd year**

Semester 1		Semester 2	
Subject	**Credit**	**Subject**	**Credit**
French	2 (0.0.2)	French	1 (0.0.1)
English	1 (0.0.1)	English	2 (0.0.2)
Computer Programming	1 (1.0.0)	Feedback control system	2 (1.1.0)
Signals and systems	2 (1.1.0)	Numerical method and optimization	1 (1.0.0)
Electrical circuit	3 (2.1.0)	Digital electronics	2 (1.1.0)
Electronic analog and filter	3 (2.1.0)	Microprocessor architecture	1 (1.0.0)
Electrical engineering lab	3 (0.0.3)	Electrical machine	2 (1.1.0)
Statistics	2 (1.1.0)	Electronic lab	3 (0.0.3)
		Communication and interpersonal relation	1 (1.0.0)
Total	**17**	**Total**	**15**

❖ **4th year**

Semester 1		Semester 2	
Subject	**Credit**	**Subject**	**Credit**
French	1 (0.0.1)	French	1 (0.0.1)
English	1 (0.0.1)	English	1 (0.0.1)
Power electronics	3 (2.1.0)	Sensor and actuators	2 (2.0.0)
Motor drive	3 (2.1.0)	Programmable logic controller - PLC	3 (2.1.0)
Modern control system	2 (1.1.0)	Electronics circuit design and manufacturing	1 (1.0.0)
Industrial network	1 (1.0.0)	Digital circuit design	1 (1.0.0)
Electrical machine and power electronic lab	3 (0.0.3)	Control and automation lab	4 (0.0.4)
Research methodology	1 (1.0.0)	Student project – Part 1	1 (0.0.1)
Total	**15**	**Toal**	**14**

❖ **5th year**

Semester 1		Semester 2	
Subject	**Credit**	**Subject**	**Credit**
French	1 (0.0.1)	Final year internship	9
English	1 (0.0.1)		
Project management	2 (2.0.0)		
Embedded electronics	2 (2.0.0)		
Industrial automation	2 (2.0.0)		
Advance control and automation lab	3 (0.0.3)		
Extra-low voltage design	2 (2.0.0)		
Student project – Part 2	1 (0.0.1)		
Work-Life and social psychology	1 (1.0.0)		
Technopreneurship	1 (1.0.0)		
Total	**16**	**Total**	**9**

Note:

- 3 (3.0.0) means that lecture has 3 credits
- 3 (2.1.0) means that lecture has 2 credits and the tutorial has 1 credit
- 3 (2.0.1) means that lecture has 2 credits and Lab has 1 credit

3.8. Conditions for Obtaining a Degree

Students can earn a degree in Electronics and Automoation Engineering with the following condition:

- Completed all subjects according to the number of credits in the program
- Completed the semester exam
- Completed the internship
- Successfully write and defend the final thesis

3.9. Name of Degree

Successful students will receive an Engineer's Degree in Electronics and Automation Engineering.

4. Conclusion and Implementation of the New Program

Curriculum improvement was completed in 2021 with the results of fruitful discussions by Depatment staffs and experts from the University of Toulouse, France. In addition, this program was also evaluated and approved by the Board of Trustees of the Institute of Technology of Cambodia. The new program is implemented in the academic year of 2021-2022 with 130 students enrolled.

Phnom Penh 27 June 2022

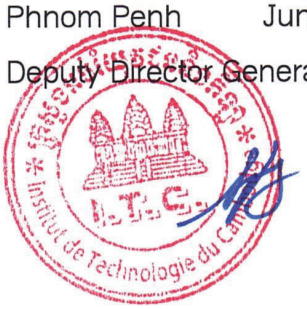
Head of the department

Dr. Chrin Phok

Seen and Approved

Phnom Penh June 2022

Deputy Director General of ITC



Mr. Soy Ty

5. Appendix A: Detail of Course Syllabus

Table 1: Comparison of the updated curriculum versus the old curriculum

No.	Academic year	Nb of subject (old curriculum)	Nb of subject (Updated curriculum)	New subject	Percentage of new subjects in the updated curriculum
1	Foundation study (Year 1 and Year 2)	20	20	--	0%
2	Year 3	13	15 (11 main subjects, 2 lab packages)	- Computer programming - Communication and interpersonal relation - Electrical machine	20%
3	Year 4	12	14 (9 main subjects, 2 lab packages)	- Research methodology - Industrial network protocol - Electronics circuit design and manufacturing - Digital circuit design - Student project – Part 1	36%
4	Year 5	9	11 (3 main subjects, 1 lab package, final internship)	- Embedded electronics - Industrial automation - Extra-low voltage design - Work life and social psychology - Technopreneurship - Student project – Part 2	55%
Total		54	60	14	23%

6. Appendix B: Detail of Course Syllabus for 3rd to 5th Year

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

ANALOG ELECTRONICS

Subject: Analog Electronics, Year: 3 Semester: 1 Credit: 3
Lecturer: Mr. TEP Sovichea, Master Degree from N7-INP, France
Tel.: 061 645 160 E-mail: sovichea.tep@itc.edu.kh

1. Course Description

This subject is to provide the fundamental concept of analog electronics on semiconductor structure, operation, and its application. Moreover, this subject is also focus on conception of transistors and operational amplifier. Analog electronics is a main subject for digital electronics, power electronics, and feedback control system design.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to understand the operation of diodes, transistors (BJT, FET, MOSFET), and operational amplifier	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to analyze on the analog electronics circuit	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to invent the electronics device for the need of market	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Do modeling and make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Assignment (quality reports)	25	CLO2, CLO3
3	Quality oral presentation	25	CLO2, CLO3
4	Mid-Term exam	20	CLO1, CLO2
5	Final Exam	20	CLO1, CLO2

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	2h	CLO1 CLO2 CLO3	- Ability to understand the application of analog electronics	Lecture 1: Introduction to analog electronic	- Lecture/Tutorial - Ask key question for students' reflection	- Taking note - Ask questions for clearly understanding	Attendance	- PPT Present - Lecture Note
2	2h	CLO1 CLO2 CLO3	- Ability to understand the general characteristics of semiconductor materials (P-Type, N-Type) - Ability to understand the basic operation of a P-N junction in the no-bias, forward-bias, and reverse-bias regions	Lecture 2: Introduction to semiconductor and P-N junction	- Lecture/Tutorial - Case Study 1 - Demonstration and explanation about the problem in case study. - Define scope of work for this case study	- Taking note - Actively participate in class activities - Ask question for understand the lecture, and for case study problem	Attendance Demonstration on case study	- PPT Present - Lecture Note
3 → 3	4h / 4h	CLO1 CLO2 CLO3	- Ability to understand the I-V characteristic of diode family (Diode, Zener, LED) - Ability to find the equivalent circuit of diode family - Ability to understand the operation of Diodes in: clippers, clampers, half-wave and full-wave rectification	Lecture 3: Diode and its application	- Lecture/Tutorial - Assignment 1 - Define scope of work for assignment - Demonstrate the software for simulation work	- Taking note - Ask questions for clearly understanding the lecture and the assignment - Start learning on how to use simulation tool	- Attendance - Quiz 1	- PPT Present - Lecture Note

5	2h / 2h	CLO1 CLO2 CLO3	- Ability to understand the construction of BJTs (NPN, PNP) - Ability to understand the characteristic and the operation of BJTs	Lecture 4: Bipolar Junction Transistor (BJT)	- Lecture/Tutorial - Demonstrate the software for simulation work	- Taking note - Ask questions for clearly understanding the lecture	- Attendance - Quiz 2	- PPT Present - Lecture Note - Computer, LCD, ink markers
6 → 7	4h / 4h	CLO1 CLO2 CLO3	- Ability to analyze the BJTs' operation (dc levels, saturation and cutoff region) - Ability to compute a load-line analysis of the most common BJT	Lecture 5: BJTs operation point analysis	- Lecture/Tutorial - Demonstrate the software for simulation work	- Taking note - Ask questions for clearly understanding the lecture	- Attendance - Homework 1	- PPT Present - Lecture Note - Computer, LCD, ink markers
8	2h	**Mid-term**						
9 → 10	4h / 4h	CLO1 CLO2 CLO3	- Ability to find the equivalent model ac parameters - Ability to compute the characteristic on BJT amplifier (small signal: overall gain, input/output impedance)	Lecture 6: BJTs small signal analysis	- Lecture/Tutorial - Assignment 2 - Define scope of work for assignment - Demonstrate the software for simulation work -	- Taking note - Ask questions for clearly understanding the lecture and the assignment - Start learning on how to use simulation tool	- Attendance - Quiz 3	- PPT Present - Lecture Note - Computer, LCD, ink markers
11	2h / 2h	CLO1 CLO2 CLO3	- Ability to understand the construction of FETs (JFETs, MOSFETs, MESFETs) - Ability to understand the characteristic and the operation of FETs	Lecture 7: Field-Effect Transistors (FETs)	- Lecture/Tutorial - Case Study 1 - Demonstration and explanation about the problem in case study. - Define scope of work for this case study	- Taking note - Actively participate in class activities - Ask question for understand the lecture, and for case study problem	- Attendance - Homework 2	- PPT Present - Lecture Note - Computer, LCD, ink markers

12	2h / 2h	CLO1 CLO2 CLO3	- Ability to analyze the FETs' operation (dc analysis, saturation, cutoff region, FET networks) - Ability to compute a load-line analysis of FET networks	Lecture 8: FETs operation point analysis	- Lecture/Tutorial - Assignment 3 - Define scope of work for assignment - Demonstrate the software for simulation work	- Taking note - Ask questions for clearly understanding the lecture and the assignment - Start learning on how to use simulation tool	- Attendance	- PPT Present - Lecture Note
13 → 14	4h / 4h	CLO1 CLO2 CLO3	- Ability to understand the construction of operational amplifier - Ability to distinguish the mathematic operation of AOP (Non-inverting, Inverting, Adder, differential, integral, derivative)	Lecture 9: Operational amplifier (op-amp)	- Lecture/Tutorial	- Taking note - Ask questions for clearly understanding the lecture - Preparation for presentation	- Attendance - Presentation 1	- PPT Present - Lecture Note
15 → 16	4h / 4h	CLO1 CLO2 CLO3	- Ability to distinguish the difference applications of op-amp - Ability to use op-amp as: comparator, integrator, Schmitt-trigger	Lecture 10: Op-amp applications	- Lecture/Tutorial	- Taking note - Ask questions for clearly understanding the lecture - Preparation for presentation	- Attendance - Presentation 2	- PPT Present - Lecture Note - Computer, LCD, ink markers
17	2h	Final Exam						

6. References

[1] Boylestad, R. L., & Nashelsky, L. "*Electronic devices and circuit theory*". Prentice Hall, 2012.

[2] Mancini, R. "Op amps for everyone: design reference." Newnes, 2003.

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

ANALOG FILTER

Subject: Analog Filter, Year: 3 Semester: 1 Credit: 3
Lecturer: Mr. CHHORN Sopheaktra, Master Degree from CU, Thailand
Tel.: 010 668 465 E-mail: pheaktra@itc.edu.kh

1. Course Description

This subject is to provide the fundamental concept of analog filter which study on the structure, operation, and application of passive and active filter. Some parts of this subject are reserved for students capable to do research in that filed. This subject is a main subject to support other subjects such as digital electronics, power electronics, and control system.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to understand the operation of passive and active filter which use to decrease the disturbance	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to analyze the passive and active filter circuit	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to build filter for harmonics cancellation in analog circuit	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Do modeling and make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Assignment (quality reports)	25	CLO2, CLO3
3	Quality oral presentation	25	CLO2, CLO3
4	Mid-Term exam	20	CLO1, CLO2
5	Final Exam	20	CLO1, CLO2

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	2h / 0h		- Ability to understand the application of analog filter in circuit, electronics, power electronics, control, …	Lecture 1: Introduction to analog filter, time and frequency domain of the system	- Lecture - Tutorial	- Note - Q/A	Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
2	2h / 2h		- Ability to derive the transfer function in frequency domain - Ability to plot Bode-diagram of different transfer function (0, 1st and 2nd order)	Lecture 2: Transfer function and Bode plot diagram	-Tutorial - Lecture - Case study 1	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
3	2h / 2h		- Ability to understand the basic component and structure of 1st order passive filter (low-pass and high-pass filter) - Ability to derive the transfer function and plot bode diagram of 1st order passive filter - Ability to compute the main parameter of the passive filter (cut-off frequency, phase margin and group delay) - Ability to design the 1st order passive filter	Lecture 3: 1st order passive filter	- Lecture - Tutorial	- Note - Q/A	- Attendance - Quiz 1	- PPT Present - Lecture Note - Computer, LCD, ink markers

4	2h / 2h		- Ability to understand the basic component and structure of 2^{nd} order passive filter (low-pass and high-pass filter) - Ability to derive the transfer function and plot bode diagram of 2^{nd} order passive filter - Ability to compute the main parameter of the passive filter (cut-off frequency, phase margin and group delay) - Ability to design the 2^{nd} order passive filter	Lecture 4: 2^{nd} order Passive filter	- Lecture - Tutorial - Assignment 1	- Note - Q/A	- Attendance - Quiz 2	- PPT Present - Lecture Note - Computer, LCD, ink markers

5 → 7	6h / 4h		- Ability to understand the basic component and structure of N^{th} order passive filter (low-pass and high-pass filter) - Ability to derive the transfer function and plot bode diagram of N^{th} order passive filter - Ability to compute the main parameter of the passive filter (cut-off frequency, phase margin and group delay) - Ability to design the N^{th} order passive filter - Ability to understand the applications of different filter coefficients such as, Bessel, Butterworth, Type-I and Type-II Chebyshev	Lecture 5: N^{th} order passive filter	- Lecture - Tutorial - Assignment 2	- Note - Q/A	- Attendance - Quiz 3	- PPT Present - Lecture Note - Computer, LCD, ink markers
8	2h	Mid-term						
9	2h / 0h		- Ability to understand the basic component and structure of 1^{st} order active filter (low-pass and high-pass filter) - Ability to derive the transfer function and plot bode diagram of 1^{st} order active filter	Lecture 7: 1^{st} order active filter	- Lecture - Tutorial - Case Study 2	- Note - Q/A	- Attendance - Homework 1	- PPT Present - Lecture Note - Computer, LCD, ink markers

			- Ability to compute the main parameter of the active filter (cut-off frequency, phase margin and group delay) - Ability to design the 1st order active filter (Sallen-Key and Multiple feedback filter)					
10→11	4h / 2h		- Ability to understand the basic component and structure of 2nd order active filter (low-pass and high-pass filter) - Ability to derive the transfer function and plot bode diagram of 2nd order active filter - Ability to compute the main parameter of the active filter (cut-off frequency, phase margin and group delay) - Ability to design the 2nd order active filter (Sallen-Key and Multiple feedback filter)	Lecture 8: 2nd order active filter	- Lecture - Tutorial - Assignment 3	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers

12	2h / 2h		- Ability to understand the structure of multiple stage filter - Ability to derive total transfer function to cascade filter - Ability to design multiple stage active filter	Lecture 9: Multiple stage active filter (cascade filter)	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
17		**Final Exam**						

6. References

[1] Winder, S. (2002). *Analog and digital filter design*. Elsevier.

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

COMPUTER PROGRAMMING

Subject: Computer Programming, Year: 3 Semester: 1 Credit: 1
Lecturer: Mr. CHIN Chandaraly, Master degree from CU, Thailand
Tel.: 077 722 887 E-mail: chandaraly.chin@itc.edu.kh

1. Course Description

This subject is to provide the fundamental concept of computer on hard part and soft part on C programming: Algorithm, Database, flow control, and standard library. Moreover, there will have a part on preparation of character into string, dynamic memory allocation, standard I/O, definition of micro, C runtime library, and key for problem solving. This subject is a main support subject for Microprocessor, PLCs system, Industrial Network Protocol, etc.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to understand the basic of computer and its devices	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to write code languages and computer operation	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to build algorithm and send to computer for solving	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Do modeling and make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Assignment (quality reports)	25	CLO2, CLO3
3	Quality oral presentation	25	CLO3
4	Mid-Term exam	20	CLO1, CLO2
5	Final Exam	20	CLO1, CLO2

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	1h		- Ability to understand computer hardware, main parts and how to a build own desktop - Ability to understand software, interact between user and computer	Lecture 1: Introduction to computer hardware and software	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
2-3	2h		- Ability to understand program conception and execution - Ability to create a program using a command-line compiler	Lecture 2: Basic of program writing, compiling and debugging in C	- Lecture - Tutorial	- Note - Q/A	- Quiz 1 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
4-5	2h		- Ability to define variable, data types, size, constants and declaration - Ability to operate arithmetic, relational, logical, bitwise operator	Lecture 3: Type, Operator, Expression	- Lecture - Tutorial	- Note - Q/A	- Quiz 2 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
6-7	2h		- Ability to define statement, block, loop, goto, and error handling	Lecture 4: Control flow	- Lecture - Tutorial	- Note - Q/A	- Homework 1 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
8	1h	**Midterm**						
9-11	3h		- Ability to code function and modular programming	Lecture 5: Functions and Program Structure	- Lecture - Tutorial	- Note - Q/A	- Homework 2 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers

			- Ability to define variable scope, static and global variable, standard I/O, string I/O, and file I/O					
12-14	3h		- Ability to create pointers and memory addressing, arrays and pointer arithmetic, strings as arrays Pointers to pointers, and multidimensional arrays	Lecture 6: Pointers and Arrays	- Lecture - Tutorial	- Note - Q/A	- Quiz 3 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
15-16	2h		- Ability to create user-defined datatypes, structs, unions, bit fields, memory allocation, linked lists, and binary trees	Lecture 7: Structures	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
17		**Final Exam**						

6. References

[1] Kernighan, Brian, and Dennis Ritchie. *The C Programming Language*. 2nd ed. Upper Saddle River, NJ: Prentice Hall, 1988.

[2] Steve Oualline. Prictical C Programming. 3rd ed. O'Reilly, 1997

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

DIGITAL ELECTRONICS

Subject: Digital Electronics, Year: 3 Semester: 2 Credit: 2
Lecturer: Mr. TEP Sovichea, Master Degree from N7-INP, France
Tel.: 061 645 160 E-mail: sovichea.tep@itc.edu.kh

1. Course Description

This subject is to provide the students the digital electronics structure, operation, and its application (such as digital circuit design for computer, phone, watch, etc.). Some parts of this subject are reserved for enhancing students' research capability. This subject is a main support subject for microcontroller, digital circuit design, digital signal processing, and embedded systems.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to understand the operation and construction of Digital Electronics for computer and automation system	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to analyze the operation of digital electronics circuit	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to build the digital electronics system for the need of society	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Do modeling and make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Assignment (quality reports)	25	CLO2, CLO3
3	Quality oral presentation	25	CLO3
4	Mid-Term exam	20	CLO1, CLO2
5	Final Exam	20	CLO1, CLO2

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	1h/2h	- Ability to explain the basic differences between digital and analog quantities - Ability to represent signed number in binary by reviewing the decimal, octal, and hexadecimal number system, count in the binary number system and convert between the number systems - Ability to understand floating-point numbers, range of numbers and precision in binary system.	Lecture 1: Number systems	- Give lecture - Whiteboard demonstration - Ask questions	- Taking notes - Working individually on exercises - Group research and discussion	- Exercises - Quiz - Attendance	- Lecture slides presentation - Lecture notes - Computer, LCD, ink markers
2	1h/2h	- Ability to understand the commonly used binary codes such as BCD codes, Excess-3 codes, Gray codes, Alphanumeric codes and Seven-segment codes	Lecture 2: Binary codes	- Give lecture - Whiteboard demonstration - Ask questions	- Taking notes - Working individually on exercises - Group research and discussion	- Exercises - Quiz - Attendance	- Lecture slides presentation - Lecture notes - Computer, LCD, ink markers
3	1h/2h	- Ability to understand the basics of binary addition and subtraction, BCD addition and subtraction using Excess-3 codes binary multiplication and division, and floating-point arithmetic	Lecture 3: Digital arithmetic	- Give lecture - Whiteboard demonstration - Ask questions	- Taking notes - Working individually on exercises - Group research and discussion	- Exercises - Quiz - Attendance	- Lecture slides presentation - Lecture notes - Computer, LCD, ink markers

4	1h/2h	- Ability to understand logic 0/1, truth table, logic gates (NOT, AND, OR, NAND, NOR, XOR, XNOR, AND-OR-INVERT (AOI)), universal gates, Schmitt gate, common applications of logic gates	Lecture 4: Logic gates and related devices	- Give lecture - Whiteboard demonstration - Ask questions	- Taking notes - Working individually on exercises - Group research and discussion	- Exercises - Quiz - Attendance	- Lecture slides presentation - Lecture notes - Computer, LCD, ink markers
5	1h/2h	- Ability to apply the basic laws and rules of Boolean algebra, DeMorgan's theorems to Boolean expressions - Ability to describe gate combinations with Boolean expressions - Ability to evaluate Boolean expressions - Ability to simplify expressions by using the laws and rules of Boolean algebra	Lecture 5: Boolean algebra and simplification techniques - Part 1	- Give lecture - Whiteboard demonstration - Ask questions	- Taking notes - Working individually on exercises - Group research and discussion	- Exercises - Quiz - Attendance	- Lecture slides presentation - Lecture notes - Computer, LCD, ink markers
6	1h/2h	- Ability to convert any Boolean expression into a sum-of-products (SOP) form - Ability to convert any Boolean expression into a product of-sums (POS) form - Ability to understand the canonical form of SOP and POS - Ability to converter a related Boolean expression to a truth table by using Karnaugh map - Ability to use "don't care" conditions to simplify logic functions	Lecture 6: Boolean algebra and simplification techniques - Part 2	- Give lecture - Whiteboard demonstration - Ask questions	- Taking notes - Working individually on exercises - Group research and discussion	- Exercises - Quiz - Attendance	- Lecture slides presentation - Lecture notes - Computer, LCD, ink markers

7	1h/2h	- Ability to implement combinational circuit for basic building blocks of arithmetic circuit, namely: half-adder, full-adder, half-subtractor, and full-subtractor, adder-subtractor circuit, and BCD adder circuit	Lecture 7: Combinational logic - arithmetic circuit 1	- Give lecture - Whiteboard demonstration - Ask questions	- Taking notes - Working individually on exercises - Group research and discussion	- Exercises - Quiz - Attendance	- Lecture slides presentation - Lecture notes - Computer, LCD, ink markers
8	1h/2h	- Ability to distinguish between ripple adder and look-ahead carry adder - Ability to implement multiplier circuit, magnitude comparator: less than, equal and greater than condition	Lecture 8: Combinational logic - arithmetic circuit 2	- Give lecture - Whiteboard demonstration - Ask questions	- Taking notes - Working individually on exercises - Group research and discussion	- Exercises - Quiz - Attendance	- Lecture slides presentation - Lecture notes - Computer, LCD, ink markers
9	Mid-Term						
10	1h/2h	- Ability to understand the construction of 2-to-1 mux - ability to implement n-to-1 mux using 2-to-1 mux, conditional circuit using 2-to-1 mux, boolean functions with multiplexers - Ability to understand data selector circuit, priority encoder - Ability to implement 1-to-2 and n-to-1 demux - Ability to understand decoder circuit	Lecture 9: Combinational logic - multiplexers and demultiplexers	- Give lecture - Whiteboard demonstration - Ask questions	- Taking notes - Working individually on exercises - Group research and discussion	- Exercises - Quiz - Attendance	- Lecture slides presentation - Lecture notes - Computer, LCD, ink markers

11	1h/2h	- Ability to use logic gates to construct basic latches - Ability to explain the difference between an S-R latch and a D latch - Ability to recognize the difference between a latch and a flip-flop - Ability to explain how D and J-K flip-flops differ - Ability to understand the significance of propagation delays, set-up time, hold time, maximum operating frequency, minimum clock pulse widths, and power dissipation in the application of flip-flops - Ability to apply flip-flops in basic applications - Ability to explain how retriggerable and nonretriggerable one-shots differ - Ability to build a 555 timer to operate	Lecture 10: Latches and Flip-Flops	- Give lecture - Whiteboard demonstration - Ask questions	- Taking notes - Working individually on exercises - Group research and discussion	- Exercises - Quiz - Attendance	- Lecture slides presentation - Lecture notes - Computer, LCD, ink markers
12	1h/2h	- Ability to identify the basic forms of data movement in shift registers - Ability to explain how serial in/serial out, serial in/parallel out, parallel in/serial out, and parallel in/parallel out shift registers operate - Ability to describe how a bidirectional shift register operates - Ability to compute the sequence of a Johnson counter,	Lecture 11: Shift registers	- Give lecture - Whiteboard demonstration - Ask questions	- Taking notes - Working individually on exercises - Group research and discussion	- Exercises - Quiz - Attendance	- Lecture slides presentation - Lecture notes - Computer, LCD, ink markers

		the ring counter to produce a specified sequence - Ability to Construct a ring counter by using a shift register (serial-to-parallel data converter)					
13	1h/2h	- Ability to describe the difference between an asynchronous and a synchronous counter - Ability to analyze counter timing diagrams and counter circuits - Ability to explain the propagation delays affect counter operation - Ability to compute and modify the modulus of a counter - Ability to distinguish the difference between a 4-bit binary counter and a decade counter - Ability to use an up/down counter to generate forward and reverse binary sequences for determining the sequence of a counter	Lecture 12: Counters	- Give lecture - Whiteboard demonstration - Ask questions	- Taking notes - Working individually on exercises - Group research and discussion	- Exercises - Quiz - Attendance	- Lecture slides presentation - Lecture notes - Computer, LCD, ink markers
14	1h/2h	- Ability to understand the types of programmable logic, SPLDs and CPLDs, and explain their basic structure - Ability to describe the basic architecture of two types of SPLDs—the PAL and the GAL - Ability to analyze the operation of macrocells	Lecture 13: Programmable logic	- Give lecture - Whiteboard demonstration - Ask questions	- Taking notes - Working individually on exercises - Group research and discussion	- Exercises - Quiz - Attendance	- Lecture slides presentation - Lecture notes - Computer, LCD, ink markers

		- Ability to distinguish between CPLDs and FPGAs - Ability to explain the basic operation of a look-up table (LUT) - Define intellectual property and platform FPGA - Ability to analyze the embedded functions by implementing a basic software for design flow of a programmable device					
15	1h/2h	- Ability to explain the basic memory characteristics, RAM, static RAMs (SRAMs), dynamic RAMs (DRAMs), ROM, various types of PROMs, the characteristics of a flash memory. - Ability to describe the expansion of ROMs and RAMs to increase word length and word capacity - Ability to analyze special types of memories such as FIFO and LIFO	Lecture 14: Data storage	- Give lecture - Whiteboard demonstration - Ask questions	- Taking notes - Working individually on exercises - Group research and discussion	- Exercises - Quiz - Attendance	- Lecture slides presentation - Lecture notes - Computer, LCD, ink markers

16	1h/2h	- Ability to understand the computer architecture, practical computer system - Ability to describe the purpose of buffers, decoders, and wait-state generators in a computer system - Ability to define and explain the advantage of DMA - Ability to provide the basic elements of a microprocessor - Ability to explain the basic architecture of a microprocessor (CPU) and its operation. - Ability to list-down some microprocessor addressing Modes, microprocessor polling, interrupts, exceptions, and bus requests - Ability to analyze the operating system of a computer - Ability to explain pipelining, multitasking, Multiprocessing, and simple assembly language program	Lecture 15: Computer concepts	- Give lecture - Whiteboard demonstration - Ask questions	- Taking notes - Working individually on exercises - Group research and discussion	- Exercises - Quiz - Attendance	- Lecture slides presentation - Lecture notes - Computer, LCD, ink markers
17	**Final Exam**						

6. References

[1] Maini, A. K. (2007). *Digital electronics: principles, devices and applications*. John Wiley & Sons.

[2] Floyd, T. L. (2010). *Digital Fundamentals, 10/e*. Pearson Education India.

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

COMMUNICATION AND INTER-PERSONNAL SKILL

Subject: Communication and Inter-personal Skill, Year: 3 Semester: 2 Credit: 1
Lecturer: Dr. CHRIN Phok, PhD. from N7-INP, France
Tel.: 096 9790999 E-mail: pchrin@itc.edu.kh

1. Course Description

This subject is to provide the students on how to communicate with other in the manner of professionalism. This subject is also very important for students to adapt themselves into work-life.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to communicate with other with and without technical area	PLO7, PLO8, PLO9
CLO2	Able to know the important of inter-personal skill for work-life	PLO7, PLO8, PLO9

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Do modeling and make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3, CLO4, CLO5
2	Assignment (quality reports)	25	CLO2, CLO3, CLO4
3	Quality oral presentation	25	CLO5
4	Mid-Term exam	20	CLO1, CLO2
5	Final Exam	20	CLO1, CLO2

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	LLOs	Lecture	Teaching Method	Learning Method	Assessment	Material
1	- Ability to define a communication and inter-personal skill for work-life	Lecture 1: Understanding interpersonal styles and techniques of communication	- Explain the content of lectures - Provide examples which related to the lecture - Asking question to the student to observe their understanding of the lecture	- Taking note - Group discussion - Role plays - Case studies	- Oral test - Quiz - Attendance	- Lecture note (slide) - Book reference
2	- Ability to change yourself for improving overall teamwork	Lecture 2: Self-awareness and exploring differences	- Explain the content of lectures - Provide examples which related to the lecture - Asking question to the student to observe their understanding of the lecture	- Taking note - Group discussion - Role plays - Case studies	- Oral test - Quiz - Attendance	- Lecture note (slide) - Book reference -
3	- Ability to use the skill for work-life	Lecture 3: Assertiveness skill	- Explain the content of lectures - Provide examples which related to the lecture - Asking question to the student to observe their understanding of the lecture	- Taking note - Group discussion - Role plays - Case studies	- Oral test - Quiz - Attendance -	- Lecture note (slide) - Book reference -
4	- Ability to communicate correctly with other people	Lecture 4: Communicating feeling and nonverbal communication	- Explain the content of lectures - Provide examples which related to the lecture - Asking question to the student to observe their understanding of the lecture	- Taking note - Group discussion - Role plays - Case studies	- Oral test - Quiz - Attendance -	- Lecture note (slide) - Book reference -
5	- Ability to use effective communication	Lecture 5: How to achieve effective communication	- Explain the content of lectures - Provide examples which related to the lecture - Asking question to the student to observe their understanding of the lecture	- Taking note - Group discussion - Role plays - Case studies	- Oral test - Quiz - Attendance	- Lecture note (slide) - Book reference
6	- Ability to be a good listener	Lecture 6: Effective listening techniques	- Explain the content of lectures - Provide examples which related to the lecture - Asking question to the student to observe their	- Taking note - Group discussion - Role plays	- Oral test - Quiz - Attendance	- Lecture note (slide) - Book reference

			understanding of the lecture	- Case studies		
7	Ability to upgrade the communication level	Lecture 7: Communication in relationships	- Explain the content of lectures - Provide examples which related to the lecture - Asking question to the student to observe their understanding of the lecture	- Taking note - Group discussion - Role plays - Case studies	- Oral test - Quiz - Attendance	- Lecture note (slide) - Book reference
8	Ability to know the power and its influence	Lecture 8: Personal power and influencing skills	- Explain the content of lectures - Provide examples which related to the lecture - Asking question to the student to observe their understanding of the lecture	- Taking note - Group discussion - Role plays - Case studies	- Oral test - Quiz - Attendance	- Lecture note (slide) - Book reference
9	Ability to receive the critique for growing	Lecture 9: Attribute, values and perceptions	- Explain the content of lectures - Provide examples which related to the lecture - Asking question to the student to observe their understanding of the lecture	- Taking note - Group discussion - Role plays - Case studies	- Oral test - Quiz - Attendance	- Lecture note (slide) - Book reference
10	Ability to use the feedback strategies to improve communication skill	Lecture 10: Feedback strategies	- Explain the content of lectures - Provide examples which related to the lecture - Asking question to the student to observe their understanding of the lecture	- Taking note - Group discussion - Role plays - Case studies	- Oral test - Quiz - Attendance	- Lecture note (slide) - Book reference
11	Ability to identify the interpersonal power in the working environment	Lecture 11: Interpersonal power	- Explain the content of lectures - Provide examples which related to the lecture - Asking question to the student to observe their understanding of the lecture	- Taking note - Group discussion - Role plays - Case studies	- Oral test - Quiz - Attendance	- Lecture note (slide) - Book reference
12	Ability to solve the problem	Lecture 12: How to deal with different situation and conflict	- Explain the content of lectures - Provide examples which related to the lecture - Asking question to the student to observe their understanding of the lecture	- Taking note - Group discussion - Role plays - Case studies	- Oral test - Quiz - Attendance	- Lecture note (slide) - Book reference
13	Ability to solve the conflict	Lecture 13: Conflict management	- Explain the content of lectures	- Taking note	- Oral test - Quiz	- Lecture note (slide)

		strategies and techniques	- Provide examples which related to the lecture - Asking question to the student to observe their understanding of the lecture	- Group discussion - Role plays - Case studies	- Attendance	- Book reference
14	Ability to negotiate with other	Lecture 14: Negotiating conflict in relationships	- Explain the content of lectures - Provide examples which related to the lecture - Asking question to the student to observe their understanding of the lecture	- Taking note - Group discussion - Role plays - Case studies	- Oral test - Quiz - Attendance	- Lecture note (slide) - Book reference
15	Ability to deal with different people	Lecture 15: Dealing with difficult people and with people under stress	- Explain the content of lectures - Provide examples which related to the lecture - Asking question to the student to observe their understanding of the lecture	- Taking note - Group discussion - Role plays - Case studies	- Oral test - Quiz - Attendance	- Lecture note (slide) - Book reference
16	Ability to work in group	Lecture 16: Working together	- Explain the content of lectures - Provide examples which related to the lecture - Asking question to the student to observe their understanding of the lecture	- Taking note - Group discussion - Role plays - Case studies	- Oral test - Quiz - Attendance	- Lecture note (slide) - Book reference

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

CLECTRICAL CIRCUIT

Subject: Electrical Circuit, Year: 3 Semester: 2 Credit: 2.5
Lecturer: Dr. CHRIN Phok, PhD. from N7-INP, France
Tel.: 096 97 90 999 E-mail: pchrin@itc.edu.kh

1. Course Description

This subject is to provide the fundamental concept of electrical circuit such as theory of Kirchhoff Thevenin, and Norton. Moreover, this subject will also give the analyze concept of equivalent circuit for DC and AC circuit. This is a main subject in studying of Electrical and Energy Engineering.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to apply Ohm law, current flow, voltage, and other parameters in circuit	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to knowledge on theory of Kirchhoff and Thevenin/Norton	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to analyze the operation of electrical circuit for DC and AC (1-phase and 3-phase)	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Do modeling and make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Quiz	25	CLO1, CLO2, CLO3
3	Homework	25	CLO1, CLO2, CLO3
4	Mid-Term exam	20	CLO1, CLO2, CLO3
5	Final Exam	20	CLO1, CLO2, CLO3

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	2h/2h		- Ability to use mathematic for electrical circuit analysis - Ability to distinguish the circuit variables and its units	Lecture 1: Introduction to electrical circuit	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
2-3	4h/4h		- Ability to compute the current and voltage by using Ohm's Law - Ability to compute current and voltage by using node/branches/loops, Kirchoff's Laws.	Lecture 2: Basic Law of Circuit	- Lecture - Tutorial	- Note - Q/A	- Quiz 1 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
4-5	4h/5h		- Ability to compute current and voltage of the complex circuit by using Nodal/Mesh analysis.	Lecture 3, Method of Analysis	- Lecture - Tutorial	- Note - Q/A	- Quiz 2 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
6-7	4h/5h		- Ability to find the equivalent circuit by using Thevenin /Norton. - Ability to convert current/voltage sources transformation - Ability to compute current and voltage of multiple sources circuit by	Lecture 4: Circuit Theorem	- Lecture - Tutorial	- Note - Q/A	- Homework 1 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers

			superposition theorem.					
8	2h	**Midterm**						
9-10	2h/4h		- Ability to apply the complex number for AC circuit elements	Lecture 5: Sinusoidal and Phasor	- Lecture - Tutorial	- Note - Q/A	- Homework 2 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
11-12	2h/4h		- Ability to compute AC current/voltage for steady-state condition by using nodal/mesh analysis	Lecture6: Sinusoidal Steady State Analysis	- Lecture - Tutorial	- Note - Q/A	- Quiz 3 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
13-14	2h/4h		- Ability to find instantaneous/ average/maximum power transfer /effective power of AC circuit.	Lecture7: AC Power Analysis	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
15-16	2h/4h		- Ability to compute current/voltage/power for 3-phase electrical circuit (Network configuration: Star-Star, Delta-Star, …)	Lecture8: 3-Phase Circuit	- Lecture - Tutorial	- Note - Q/A	- Homework 3 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
17		**Final Exam**						

6. References

[1] Matthew Sadiku, Charles Alexander “Fundamentals of Electric Circuits,” 5th edition, Kindle Edition , July 1, 2012

[2] William, Kemmerly, Jack, Durbin, Steven “Engineering Circuit Analysis,” 8th edition McGraw-Hill, 2011

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

NUMERICAL METHOD AND OPTIMIZATION

Subject: Engineering Optimization Tools, Year: M1 Semester: 1 Credit: 2.5
Lecturer: Dr. AM Sok Chea, PhD. from UGA, France
Tel.: 096 34 55 449 E-mail: Sokchea_am@itc.edu.kh

1. Course Description

Engineering Optimization Tools provides students the concept of using optimization design to solve engineering problem. The genetic algorithms based on MATLAB script will be used as a main tool for teaching and learning in this subject. After learning this course, students will gain capacity on modeling the engineering problem as well as defined function objective for optimization design.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Understand the optimization problem and modeling	PLO1, PLO2, PLO3, PLO4, PLO6, PLO7, PLO12, PLO13
CLO2	Develop optimization model by using simulation tool (MATLAB/Simulink): Genetic Algorithm	PLO1, PLO2, PLO3, PLO4, PLO6, PLO7, PLO12, PLO13
CLO3	Able to perform research in the filed of optimization design for engineering problem	PLO9, PLO10, PLO11

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Develop simulation model
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Assignment (quality reports)	25	CLO1, CLO2, CLO3
3	Quality oral presentation	25	CLO1, CLO2, CLO3
4	Mid-Term exam	20	CLO1, CLO2
5	Final Exam	20	CLO1, CLO2

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment Methodology	Materials
1-3	6h/3h	- Ability to understand the optimization problem of engineering - Ability to define function objective: one objective or multi-objective.	Lecture 1: Optimization Problem: Function Objective	- Lecture - Tutorial	- Note Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
4-6	6h/3h	- Ability to define optimization constraints. - Ability to define variables and parameters. - Ability to define boundary for each variable.	Lecture 2: Optimization Constraint	- Lecture - Tutorial - Case Study 1	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
7-9	6h/3h	- Ability to compute the solution of system equation by using Linear Systems, Gauss Elimination Method, LU Factorization Methods, Gauss-Seidel (algorithm)	Lecture 3: Optimization Problem Solving: Mathematical Model	- Lecture - Tutorial - Assignment 1	- Note - Q/A	- Attendance - Quiz 1	- PPT Present - Lecture Note - Computer, LCD, ink markers
10	1h	Mid-Term					
11-16	12h/6h	- Ability to understand the genetic algorithm tool for solving the	Lecture 4 : Genetic Algorithms by using MATLAB script	- Lecture - Tutorial	- Note - Q/A	- Attendance - Quiz 2	- PPT Present - Lecture Note - Computer, LCD, ink markers

		optimization problem. - Ability to apply the genetic tool for solving the engineering problem such as electrical system optimization, civil engineering optimization, … - Ability to analyze the optimization result under Front Pareto form. - Ability to obtain numerical result of optimization script.					
17	2h	Final Exam					

6. References

[1] Ramin S. Esfandiari "Numerical Method for Engineers and Scientists Using MATLAB®," 2nd edition, 2017

[2] Steven C. Chapra, Raymond P. Canale "Numerical Methods for Engineers," 7th edition, 2015

[3] Steven T. Karris "Numerical Analysis Using MATLAB® and EXCEL®" 3rd edition, Orchard Publications 2007

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

ELECTRICAL MACHINE

Subject: Electrical Machine, Year: 3 Semester: 2 Credit: 2
Lecturer: Dr. VAI Vannak, PhD. from UGA, France
Tel.: 012 617 364 E-mail: vannak.vai@itc.edu.kh

1. Course Description

This subject is to provide the fundamental concept of electrical transformer, electrical machine, AC motors, DC motors, etc. Moreover, this subject focuses on the operation of synchronous and induction machine as well as DC machine.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to knowledge on operation of transformer, motor, AC machine (synchronous and induction), and DC machine	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to identify the different between generator and motor	PLO1, PLO2, PLO3, PLO4, PLO5
CLO3	Able to model the machine for suitable application	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Do modeling and make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3, CLO4, CLO5
2	Assignment (quality reports)	25	CLO2, CLO3, CLO4
3	Quality oral presentation	25	CLO5
4	Mid-Term exam	20	CLO1, CLO2
5	Final Exam	20	CLO1, CLO2

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	2h/2h		▪ Ability to understand the basic concepts of Machinery. ▪ Ability to demonstrate the machinery's principle. ▪ Ability to apply general concepts to a linear Machine.	Lecture 1: Introduction to Machinery Principles	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
2-3	3h/4h		▪ Ability to understand the behavior of ferromagnetic Materials ▪ Ability to introduce the induced voltage from time-changing magnetic field, induced on a living wire, induced voltage on a moving conductor in magnetic field, and the linear DC machine. ▪ Ability to understand the real, reactive, and apparent power in AC circuit.	Lecture 2: AC Machinery Fundamentals	-Tutorial - Lecture - Case study 1 -	- Note - Q/A	- Attendance -	- PPT Present - Lecture Note - Computer, LCD, ink markers
4-5	2h/4h		▪ Ability to understand the notion of Laplace transform and the region of convergence. ▪ Ability to compute the Laplace transform of a given signals, and	Lecture 3: Laplace transforms for continuous-time system	- Lecture - Tutorial	- Note - Q/A	- Attendance - Quiz 1	- PPT Present - Lecture Note - Computer, LCD, ink markers

			its inverse Laplace transform. ▪ Ability to convert the Laplace transform to transfer function. ▪ Ability to understand the use of unilateral Laplace transform for circuit analysis. ▪ Ability to use Laplace Transform to solve differential equations.					
6-7	2h/4h		▪ Ability to understand the notion of z-transform and the region of convergence for discrete-time signal. ▪ Ability to solve the z-transform of a given discrete-time signal, and its inverse z-transform.	Lecture 4 (1): The z-Transform for discrete-time system	- Lecture - Tutorial - Assignment 1	- Note - Q/A	- Attendance - Quiz 2	- PPT Present - Lecture Note - Computer, LCD, ink markers
8	2h	**Midterm**						
9-10	2h/4h		▪ Ability to compute the properties of the z-transform. ▪ Ability to understand the concept of transfer function of a discrete-time system using z-transform. ▪ Ability to implement a discrete-time system in a computer program based on the transfer function in Z.	Lecture 4 (2): The z-Transform for discrete-time system	- Lecture - Tutorial - Assignment 2	- Note - Q/A	- Attendance - Quiz 3	- PPT Present - Lecture Note - Computer, LCD, ink markers
11-12	2h/4h		▪ Ability to understand the spectral	Lecture 5:	- Lecture	- Note	- Attendance	- PPT Present

			representation of the signals with Fourier series. ▪ Ability to determine the Fourier series of a periodic signal, the Fourier transform of any signal, the frequency response of continuous-time LTI systems. ▪ Ability to understand the concept of filtering and bandwidth.	Fourier Analysis of continuous-time signals and systems	- Tutorial - Case Study 2	- Q/A	Homework 1	- Lecture Note - Computer, LCD, ink markers
13-14	2h/4h		▪ Ability to compute the discrete Fourier series. ▪ Ability to determine the discrete Fourier transform of any signal.	Lecture 6 (1): Fourier Analysis of discrete-time signals and systems	- Lecture - Tutorial - Assignment 3	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
15-16	2h/4h		▪ Ability to understand the difference between discrete Fourier transform and discrete Fourier series. ▪ Ability to determine the frequency response of a discrete-time LTI systems.	Lecture 6 (2): Fourier Analysis of discrete-time signals and systems	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
17		**Final**						

6. References

[1] Schaum's Outline of Signals and Systems, 3rd Edition (Schaum's Outlines), by Hwei Hsu.

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

SIGNALS AND SYSTEMS

Subject: Signals and Systems, Year: 3 Semester: 1 Credit: 2
Lecturer: Dr. KIM Bunthern, PhD. from N7-INP, France
Tel.: 077 512 157 E-mail: kimbunthern@itc.edu.kh

1. Course Description

This subject is to provide the fundamental concept of electrical signals and electrical systems. This subject will detail about analog and digital signals which is a main tool for control system design. The study focuses also on analysis of signal in time-domain and frequency-domain.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to understand the various signals and systems which used in electricity and electronics	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to analyze the analog and digital signal	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to build the model for signals and systems in analog and in digital	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Do modeling and make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Assignment (quality reports)	25	CLO2, CLO3
3	Quality oral presentation	25	CLO3
4	Mid-Term exam	20	CLO1, CLO2
5	Final Exam	20	CLO1, CLO2

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	2h/2h		▪ Ability to understand the notion of signal and system utilized in the study of electrical systems. ▪ Ability to understand the different type of signals/systems and its real application. ▪ Ability to formulate a system by identifying the input and output signals.	Lecture 1: Introduction to Signals Systems	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
2-3	3h/4h		▪ Ability to understand the notion of LTI system and convolution integral, discrete LTI system and convolution sum. ▪ Ability to compute the systems which described by differential equations.	Lecture 2: LTI systems and Convolution	-Tutorial - Lecture - Case study 1 -	- Note - Q/A	- Attendance -	- PPT Present - Lecture Note - Computer, LCD, ink markers
4-5	2h/4h		▪ Ability to understand the notion of Laplace transform and the region of convergence. ▪ Ability to compute the Laplace transform of a given signals, and its inverse Laplace transform.	Lecture 3: Laplace transforms for continuous-time system	- Lecture - Tutorial	- Note - Q/A	- Attendance - Quiz 1	- PPT Present - Lecture Note - Computer, LCD, ink markers

			▪ Ability to convert the Laplace transform to transfer function. ▪ Ability to understand the use of unilateral Laplace transform for circuit analysis. ▪ Ability to use Laplace Transform to solve differential equations.					
6-7	2h/4h		▪ Ability to understand the notion of z-transform and the region of convergence for discrete-time signal. ▪ Ability to solve the z-transform of a given discrete-time signal, and its inverse z-transform.	Lecture 4 (1): The z-Transform for discrete-time system	- Lecture - Tutorial - Assignment 1	- Note - Q/A	- Attendance - Quiz 2	- PPT Present - Lecture Note - Computer, LCD, ink markers
8	2h	**Midterm**						
9-10	2h/4h		▪ Ability to compute the properties of the z-transform. ▪ Ability to understand the concept of transfer function of a discrete-time system using z-transform. ▪ Ability to implement a discrete-time system in a computer program based on the transfer function in Z.	Lecture 4 (2): The z-Transform for discrete-time system	- Lecture - Tutorial - Assignment 2	- Note - Q/A	- Attendance - Quiz 3	- PPT Present - Lecture Note - Computer, LCD, ink markers
11-12	2h/4h		▪ Ability to understand the spectral representation of the	Lecture 5: Fourier Analysis of continuous-time	- Lecture - Tutorial - Case Study 2	- Note - Q/A	- Attendance Homework 1	- PPT Present - Lecture Note

			signals with Fourier series. ▪ Ability to determine the Fourier series of a periodic signal, the Fourier transform of any signal, the frequency response of continuous-time LTI systems. ▪ Ability to understand the concept of filtering and bandwidth.	signals and systems				- Computer, LCD, ink markers
13-14	2h/4h		▪ Ability to compute the discrete Fourier series. ▪ Ability to determine the discrete Fourier transform of any signal.	Lecture 6 (1): Fourier Analysis of discrete-time signals and systems	- Lecture - Tutorial - Assignment 3	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
15-16	2h/4h		▪ Ability to understand the difference between discrete Fourier transform and discrete Fourier series. ▪ Ability to determine the frequency response of a discrete-time LTI systems.	Lecture 6 (2): Fourier Analysis of discrete-time signals and systems	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
17		**Final**						

6. References

[1] Schaum's Outline of Signals and Systems, 3rd Edition (Schaum's Outlines), by Hwei Hsu.

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

FEEDBACK CONTROL SYSTEM

Subject: Feedback control systems Year: 3 Semester: 2 Credit: 2.5
Lecturer: Dr. Chrin Phok
Tel.: 095504499 E-mail: pchrin@itc.edu.kh

1. Course Description

This subject provides the basic knowledge of control system, math's modeling of physical, (time domain and frequency) Dynamic response of system, Stability of System, opened-loop/closed-loop control, controller design. This subject is also designed to support others subject: Modern Control, PLC, Industrial Automation, Power Electronics and Motor Drive.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to understand the basic knowledge of control system (Electrical System, Mechanical, electromechanics)	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to derive the mathematical model of physical system, system stability for both time domain and frequency domain	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to compute the analog controller Lead compensator, Lag compensator, P, PI, PID	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Case Studies
- Group work (Assignment)

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Case studies	20	CLO2, CLO3
3	Assignment	20	CLO2, CLO3
4	Mid-Term exam	20	CLO1, CLO2, CLO3
5	Final Exam	30	CLO1, CLO2, CLO3

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed LLOs

Weeks		CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	**2h/2h**	CLO1	- Ability to understand the concept of control theory such as its application in real world / History / Open loop and closed loop control for both electrical and mechanical systems	Lecture 1: An Overview and Brief History of Feedback Control	- Lecture - Tutorial	- Listen/Note - Asking question	- Attendance	- Lecture Note /PPT - LCD
2-4	**4h/6h**	CLO1 CLO2	- Ability to find the mathematical model (electrical and mechanical system) for representing in state space model	Lecture 2: Mathematical models of systems.	- Lecture/ Tutorial - Demonstrate the model of the electrical system / mechanical system	- Participate in modeling the system - Do the case studies and submit	- Attendance - Case studies	- Lecture Note/PPT - Hardware of a physical system - LCD
5-6	**4h/4h**	CLO1 CLO2 CLO3	- Ability to convert a feedback control system model into mathematically response - Ability to compute Time-Domain Specifications (Overshot, rise time, setting time, steady state error) for designing controller - Ability to analyze the $1^{st}/2^{nd}$ /N^{th} order systems by using impulse, step, ramp and sine response.	Lecture 3: Dynamic Response	- Lecture/ Tutorial - Demonstrate of the system response - Compute the time domain Specs - Compute the time response for different inputs	- Participate in computing: time domain specs, system response - Group works on: time domain specs, system response	- Attendance - Do the simulation model in Matlab/Simulink - Assignment on closed loop system response	- Lecture Note/PPT - Matlab tool - Own PC

7	**2h/2h**		- Ability to obtain the transfer function of close loop system - Ability to compute the initial value and final value of closed-loop system response - Ability to analyze steady state error of feedback system	Lecture 4: A First Analysis of Feedback control system	- Lecture/ Tutorial - Compute the CLTF - Compute of initial/final value/ steady state error - Demo simulation of CLTF in Matlab	- Compute initial/final value/ steady state error - Do simulation in Matlab: steady state error of CLTF	- Attendance - Simulation result - Individual report of the CLTF	- Lecture Note/PPT - Matlab tool - Own PC
8	**2h**	**Midterm**						
9-10	**2h/4h**	CLO2 CLO3	- Ability to simulate the mathematical model of system: linear/nonlinear differential equation using numerical method - Ability to use Matlab /Simulink for verifying theory	Lecture 5. Modeling and Simulation of Feedback Systems	- Lecture/ Tutorial - Model of a given physical system, model and do the simulation in Matlab Environment	- Derive the model by themself - Build the simulation model - Present the results	- Attendance - Completed report with simulation results of a feedback system	- Lecture Note/PPT - Matlab - Own PC
11-12	**2h/4h**	CLO2 CLO3	- Ability to analyze the stability of linear feedback systems using Routh's criterion / Root locus	Lecture 6. Stability of Linear Feedback Systems.	- Lecture/ Tutorial - Provide the real practice of system stabilities	- Define the stabilities of linear system - Case studies of system stabilities	- Attendance - Individual report of linear feedback systems stabilities	- Lecture Note/PPT - Hardware demo for the stabilities
13-14	**4h/4h**	CLO2 CLO3	- Ability to design closed loop system controller such as Lead-Lag / Compensation, PID Using mathematical model / Electrical circuit / Mechanical system	Lecture 7. The Design of Feedback Control Systems	- Lecture/ Tutorial - Calculate the analog controller of a feedback control system - Build the simulation of feedback control system	- Derive the controller of a given system by themself - Build the simulation model	- Attendance - Present in classroom	- Lecture Note/PPT - Matlab - Own PC

15-16	**4h/4h**		- Ability to convert the complex transfer function to log magnitude and phase diagram - Ability to analyze the stability of closed loop system using bode plot / Nyquist Criterion - Ability to design closed loop controller in frequency response	Lecture8, Frequency Domain	- Lecture/ Tutorial - Compute TF in frequency domain - Stability in frequency domain - Compute controller in frequency domain	- Derive model in frequency domain - Compute: stability + controller in frequency domain - Group Assignment in frequency domain	- Attendance - Report + presentation	- Lecture Note/PPT - Matlab - Own PC
17		**Final Exam**						

6. References

[1]. FranklinPowell and Emami-Naeni, “Feedback control of dynamical systems,” Prentice Hall, 2006.

[2]. Richard C. Dorf, Robert H. Bishop, “Modern Control Systems,” 12th Edition, 2011

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

MICROCONTROLLER ARCHITECTURE

Subject: Micro-controller Architecture, Year: 3 Semester: 2 Credit: 2
Lecturer: Mr. TEP Sovichea, Master Degree from N7-INP, FRance
Tel.: 061 645 160 E-mail: sovichea.tep@itc.edu.kh

1. Course Description

Microcontroller (MCU) is the heart of every embedded electronic system from as simple as a digital watch to mission-critical spacecraft. Therefore, it is absolutely necessary that students grasp the understanding of MCU architecture, and how to program/debug in Assembly as well as in C language. What makes the MCU even more special, is that there are many integrated peripherals such as, Timers, UART, ADC and DAC, which can accelerate the development time and cut down the cost significantly. In this course, students will learn how to program and setup an 8-bit MCU EFM8LB12F64E from Silicon Labs, that include all the features we have discussed above. In addition, students will also get the hands-on experience with programming and external components interfacing, that gives them the knowledge they need for designing higher level of embedded system.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Understand the architecture of one of the most popular microcontrollers (MCU) families. The students will be able to use other MCU families and be flexible with various embedded system design.	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Use an integrated development environment (IDE) to program and debug an MCU, which allows the students to work with large and complex code.	PLO1, PLO2, PLO3, PLO4, PLO5
CLO3	Program an MCU using Assembly and C languages, which is the preferred language by many embedded system engineers.	PLO1, PLO2, PLO3, PLO4, PLO5
CLO4	Understand and use peripherals integrated into an MCU	PLO1, PLO2, PLO3, PLO4, PLO5
CLO5	Interface an MCU to simple external components and use interrupt to get an insight of how MCU is used in the real world.	PLO1, PLO2, PLO3, PLO4, PLO5
CLO6	Use timers in various modes, which is mostly set up for motor control	PLO1, PLO2, PLO3, PLO4, PLO5
CLO7	Communicate using a serial interface, so that the MCU can transfer data between PCs for advanced monitoring and control	PLO1, PLO2, PLO3, PLO4, PLO5
CLO8	Understand and use analog to digital converters (ADC), digital to analog converters (DAC) and comparators, which are essential for mixed-signal engineers	PLO1, PLO2, PLO3, PLO4, PLO5
CLO9	Students will be able to use this knowledge and experience to design all kinds of embedded system, that can be used in a vast electronic sector, such as consumer	PLO1, PLO2, PLO3, PLO4, PLO5

	electronics, automobile industry, automation, aeronautics, robotics, just to name a few.	

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Do modeling and make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1 → CLO9
2	Assignment (quality reports)	25	CLO1 → CLO9
3	Quality oral presentation	25	CLO1 → CLO9
4	Mid-Term exam	20	CLO1 → CLO9
5	Final Exam	20	CLO1 → CLO9

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment
1	CLO1	After this lecture, students should be able: - Understand the architecture of 8051 microcontrollers - Why 8-bit microcontroller is still being used - The differences between Harvard and Neumann architecture - Basic 8051 memory organization - Common Special Function Registers that are available to all 8050 microcontrollers	Lecture 1: Course overview and 8051 architecture	- Give lecture - Whiteboard demonstration - Answer questions	- Taking notes - Working on tutorial questions - Asking questions - Group work	- Attendance - Tutorial questions 1	- Lecture notes - Computer, LCD, ink markers
2	CLO1, CLO4	After the lecture, students should be able: - Recognize CIP-51 microcontroller core from Silicon Labs - Understand the Memory organization and additional SFR available in EFM8LB12F64E - Get the insight of other peripherals such as digital IO port, crossbar, Timers, ADC, DAC, analog comparators, and voltage references	Lecture 2: System overview of EFM8LB12F64E	- Give lecture - Whiteboard demonstration - Answer questions	- Taking notes - Working on tutorial questions - Asking questions - Group work	- Attendance - Tutorial questions 2 - Prelab: Working with the tools	- Lecture notes - Computer, LCD, ink markers

3	CLO2	After this lecture, students should be able to: - Understand the microcontroller development flow and environment - Understand SLSTK2030A block diagram - Get familiar with Simplicity Studio IDE - Know how to build the DEMO project - Most important of all, understand the debug environment and how to work with the debugger	Lecture 3: Simplicity Studio platform overview	- Give lecture - Whiteboard demonstration - Answer questions	- Taking notes - Working on tutorial questions - Asking questions - Group work	- Attendance	- Lecture notes - Computer, LCD, ink markers
4	CLO3, CLO5	After this lecture, students should be able to: - Understand the different types of addressing modes, such as immediate constant addressing, direct and indirect addressing, register addressing, etc. - Understand 8051 instructions such as, arithmetic operation, logic operation, Boolean operations, data transfer and branching. - Students will be able write a simple assembly program to control the state of an LED.	Lecture 4: 8051 instructions set	- Give lecture - Whiteboard demonstration - Answer questions	- Taking notes - Working on tutorial questions - Asking questions - Group work	- Attendance - Tutorial questions 3	- Lecture notes - Computer, LCD, ink markers

5	CLO3, CLO5	After this lecture, students should be able to: - Understand the different types of system clock and how to it is configured - Understand the operation of watchdog timer - Understand the GPIOs and how it is configured - Understand Crossbar and pin assignment priority	Lecture 5: System Clock, Crossbar and GPIO	- Give lecture - Whiteboard demonstration - Answer questions	- Taking notes - Working on tutorial questions - Asking questions - Group work	- Attendance - Tutorial questions 4 - Lab 1: Blinky (no timers) using ASM	- Lecture notes - Computer, LCD, ink markers
6	CLO2, CLO3,	After this lecture, students should be able: - Understand code generation flow - Understand segment control statement - Understand address control statement - Understand symbol definition - Understand the differences between memory reservation (DS) and memory initialization (DB, DW, DD) - Understand the basic assembly programming template	Lecture 6: Assembler directives	- Give lecture - Whiteboard demonstration - Answer questions	- Taking notes - Working on tutorial questions - Asking questions - Group work	- Attendance - Tutorial questions 5 - Lab 2: 16x16 multiply	- Lecture notes - Computer, LCD, ink markers
7	CLO3	After this lecture, students should be able to: - Understand C programming structure - Understand internal data memory declaration - Know the differences between bit-valued and bit-addressable data - Understand external data memory declaration	Lecture 7: Programming using C language	- Give lecture - Whiteboard demonstration - Answer questions	- Taking notes - Working on tutorial questions - Asking questions - Group work	- Attendance - Tutorial questions 6 - Lab 3: Blinky (no timers) using C	- Lecture notes - Computer, LCD, ink markers

		- Get familiar with C and register level operators such as, relational, logical, bit-wise and compound operators					
8	CLO1	After this lecture, students should be able to: - Understand what an interrupt and ISR is - Understand interrupt execution flow - Understand interrupt organization in EFM8LB12F64E - Understand the interrupt priorities - Understand the differences between software/timer interrupt and hardware interrupt	Lecture 8: Interrupts	- Give lecture - Whiteboard demonstration - Answer questions	- Taking notes - Working on tutorial questions - Asking questions - Group work	- Attendance - Tutorial questions 7	- Lecture notes - Computer, LCD, ink markers
9	Mid-Term						
10	CLO3, CLO5, CLO6	After this lecture, students should be able to: - Understand the functional overview of a Timer - Understand Timer programming sequence - Know the different types of Timer in EFM8LB12F64E - Configure Timer overflow period - Write an Interrupt Service Routine (ISR) to blink an LED or compute a task	Lecture 9: Timer operations and programming	- Give lecture - Whiteboard demonstration - Answer questions	- Taking notes - Working on tutorial questions - Asking questions - Group work	- Attendance - Tutorial questions 8 - Lab 4: Blinky (timer with ISR) - Lab 5: Switch debouncing	- Lecture notes - Computer, LCD, ink markers
11	CLO3, CLO5, CLO6	After this lecture, students should be able to: - Understand the functional overview of a Programmable Counter Array (PCA)	Lecture 10: PCA operation and programming	- Give lecture - Whiteboard demonstration - Answer questions	- Taking notes - Working on tutorial questions - Asking questions - Group work	- Attendance - Lab 6: Input capture - Lab 7: PWM	- Lecture notes - Computer, LCD, ink markers

		- Understand the various features of a PCA, such as edge capture, PWM, arbitrary waveform generation - Configure a PCA as edge capture for a square wave frequency measurement - Configure a PCA as PWM output for LED/DC motor intensity control					
12	CLO3, CLO5, CLO7	After this lecture, students should be able to: - Understand the differences between synchronous and asynchronous serial communications - Understand UART block diagram and clock requirements in EFM8LB12F64E - Configure UART SFRs - Understand the operation modes and baud rate calculation - Initialize UART0 using Timer 1 - Configure UART transmit and receive interrupt - Send simple commands through UART to the PC and plot the data in a virtual oscilloscope	Lecture 11: Serial communication	- Give lecture - Whiteboard demonstration - Answer questions	- Taking notes - Working on tutorial questions - Asking questions - Group work	- Attendance - Tutorial questions 9 - Lab 8: Serial communication and LCD	- Lecture notes - Computer, LCD, ink markers
13	CLO3, CLO5, CLO8	After this lecture, students should be able to: - Understand what an DAC is - Understand the different types of DAC such as voltage DAC (VDAC) and current DAC (or IDAC)	Lecture 13: DAC and comparator	- Give lecture - Whiteboard demonstration - Answer questions	- Taking notes - Working on tutorial questions - Asking questions - Group work	- Attendance - Lab 9: Analog comparator - Lab 10: DAC	- Lecture notes - Computer, LCD, ink markers

		- Configure DAC's output scheduling and scaling - Understand the functional block diagram of analog comparators - Configure analog watchdog windows					
14	CLO3, CLO5, CLO8, CLO9	After this lecture, students should be able to: - Understand what an ADC is - Understand the input range of ADC - Understand the different types of ADC, such as single slope, dual slope, SAR and Sigma-Delta - Configure SAR end-of-conversion interrupt, conversion frequency and sample time - Program ADC using polling and interrupt method - Read multiple ADC channels using AMUX as well as the die temperature - Select different reference voltage for ADC	Lecture 14: ADC	- Give lecture - Whiteboard demonstration - Answer questions	- Taking notes - Working on tutorial questions - Asking questions - Group work	- Attendance - Tutorial questions 10 - Lab 11: ADC	- Lecture notes - Computer, LCD, ink markers
17	Final						

6. References

[1] Chew, M. T., & Gupta, G. S. (n.d.). *Embedded Programming with Field-Programmable Mixed-Signal µControllers.*

[2] Gingl, Z., & Mingesz, R. Z. (2014). Laboratory practicals with the C8051Fxxx microcontroller family.

[3] EFM8LB1 Reference Manual (Revision 0.5). (December, 2018). Silicon Labs.

[4] EFM8LB1 Datasheet (Revision 1.3). (December, 2018). Silicon Labs.

[5] UG126: EFM8LB1-SLSTK2030A User's Guide (Revision 0.6). (February, 2019). Silicon Labs Lab Manuals

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

POWER ELECTRONICS

Subject: Power Electronics, Year: 4 Semester: 1 Credit: 3
Lecturer: Dr. AM Sok Chea,
Tel.: 096 34 55 449 E-mail: Sokchea_am@itc.edu.kh

1. Course Description

This subject is to provide the fundamental concept of power electronics system which can converter from AC/DC voltage to another AC/DC voltage level. The detailed description about power electronics devices is also provided for forming the power converter. One main part of the lecture is mainly focus on how to design power converter for a suitable application.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to understand the power electronics components, topology and applications	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to model the converter by simulation work	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to build the power electronics circuit	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO4	Able to perform research in Power Electronics	PLO6, PLO7
CLO5	Able to increase soft-skill: report + presentation	PLO8, PLO9, PLO11

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Do modeling and make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3, CLO4, CLO5
2	Assignment (quality reports)	25	CLO2, CLO3, CLO4
3	Quality oral presentation	25	CLO5
4	Mid-Term exam	20	CLO1, CLO2
5	Final Exam	20	CLO1, CLO2

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	2h/2h	CLO1	- Ability to select power electronics system for suitable application. - Ability to distinguish different power electronics devices, especially power semiconductors.	Lecture 1: Power Electronics Technology	- Tutorial/lecture - Asking key question	- Group discussion - Asking key question	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
2-3	4h/4h	CLO1 CLO2 CLO3 CLO4 CLO5	- Ability to compute the half-wave rectifier with Diode. - Ability to analyze the half-wave rectifier operation and devices selection. - Ability to simulate the half-wave rectifier with case study.	Lecture 2: Circuit with switches and diodes	- Tutorial/lecture - Demonstrate simulation tool (MATLAB/Simulink) - Provide 12-15 problems (case study) and define student name for simulation and presentation work.	- Taking note - Make a half-wave model and verify result with simulation work - Report submission - Oral presentation (only assigned students)	- Attendance - Quality of report - Quality of presentation	- PPT Present - Lecture Note - Problems and assigned name of student for presentation
4-5	4h/4h	CLO1 CLO2 CLO3 CLO4 CLO5	- Ability to compute the half-wave-controlled rectifier with Thyristor. - Ability to analyze the half-wave-controlled rectifier operation and devices selection. - Ability to simulate the half-wave-controlled rectifier with case study.	Lecture 3: Thyristor and single-phase half-wave-controlled rectifier	- Tutorial/lecture - Provide 12-15 problems (case study) and define student name for simulation and presentation work.	- Taking note - Make a half-wave model and verify result with simulation work - Report submission (all students) - Oral presentation (only assigned students)	- Attendance - Quality of report - Quality of presentation	- PPT Present - Lecture Note - Problems and assigned name of student for presentation
6-7	4h/4h	CLO1 CLO2 CLO3 CLO4	- Ability to compute the full-wave rectifier with Diodes bridge.	Lecture 4: 3-phase diode rectifier	- Tutorial/lecture - Provide 12-15 problems (case study)	- Taking note - Make a half-wave model and verify	- Attendance - Quality of report	- PPT Present - Lecture Note

		CLO5	- Ability to analyze the full-wave rectifier operation and devices selection. - Ability to compute and analyze the operation of 3-phase rectifier. - Ability to simulate the full-wave rectifier and 3-phase rectifier with case study.		and define student name for simulation and presentation work.	result with simulation work - Report submission (all students) - Oral presentation (only assigned students)	- Quality of presentation	- Problems and assigned name of student for presentation
8	2h	Midterm						
9-10	4h/4h	CLO1 CLO2 CLO3 CLO4 CLO5	- Ability to compute the 3-phased controlled rectifier with Thyristor. - Ability to analyze the 3-phase controlled rectifier operation and devices selection. - Ability to simulate the 3-phase controlled rectifier with case study.	Lecture 5: 3-phase Thyristor controlled rectifier	- Tutorial/lecture - Provide 12-15 problems (case study) and define student name for simulation and presentation work.	- Taking note - Make a half-wave model and verify result with simulation work - Report submission (all students) - Oral presentation (only assigned students)	- Attendance - Quality of report - Quality of presentation	- PPT Present - Lecture Note - Problems and assigned name of student for presentation
11-12	2h/4h	CLO1 CLO2 CLO3 CLO4 CLO5	- Ability to compute the buck, boost, buck-boost converter. - Ability to analyze the buck, boost, buck-boost converter's operation and devices selection. - Ability to simulate the DC-DC converter with case study.	Lecture 6: DC-DC non-isolated converter	- Tutorial/lecture - Provide 12-15 problems (case study) and define student name for simulation and presentation work.	- Taking note - Make a half-wave model and verify result with simulation work - Report submission (all students) - Oral presentation (only assigned students)	- Attendance - Quality of report - Quality of presentation	- PPT Present - Lecture Note - Problems and assigned name of student for presentation

13-14	2h/4h	CLO1 CLO2 CLO3 CLO4 CLO5	- Ability to compute the Flyback, Forward, Push-pull converter. - Ability to analyze the Flyback, Forward, push-pull converter's operation and devices selection. - Ability to simulate the DC-DC converter with case study.	Lecture 7: DC-Power Supply	- Tutorial/lecture - Provide 12-15 problems (case study) and define student name for simulation and presentation work.	- Taking note - Make a half-wave model and verify result with simulation work - Report submission (all students) - Oral presentation (only assigned students)	- Attendance - Quality of report - Quality of presentation	- PPT Present - Lecture Note - Problems and assigned name of student for presentation
15-16	2h/4h	CLO1 CLO2 CLO3 CLO4 CLO5	- Ability to compute the 2-level inverter converter. - Ability to analyze the 2-level inverter's operation and devices selection. - Ability to simulate the DC-AC inverter with case study.	Lecture 8: Inverter	- Tutorial/lecture - Provide 12-15 problems (case study) and define student name for simulation and presentation work.	- Taking note - Make a half-wave model and verify result with simulation work - Report submission (all students) - Oral presentation (only assigned students)	- Attendance - Quality of report - Quality of presentation	- PPT Present - Lecture Note - Problems and assigned name of student for presentation
17	2h	Final Exam						

6. References

[1] S. N. Manias, “Power Electronics and Motor Drive Systems,” Elsevier Inc., 2017

[2] D. W. Hart, “Power Electronics,” McGraw-Hill, 2011

[3] R. W. Erickson, D. Maksimovic, “Fundamentals of Power Electronics,” 2nd Edition, Kluwer Academic Publishers, 2004

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

MORDERN CONTROL SYSTEM

Subject: Feedback control systems Year: 3 Semester: 2 Credit: 2.5
Lecturer: Dr. Chrin Phok, PhD. From N7-INP, FRance
Tel.: 096 97 90 999 E-mail: pchrin@itc.edu.kh

1. Course Description

This subject is to provide student the analysis and design skill of automation system which mostly use in industrial such as drone, manipulator robot, water level control and power electronics circuit. This subject is also proof the important of mathematical equation in actual control design.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to have a basic knowledge on control system	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to develop the mathematical model of the physical behavior system as well as define the stability, controllability, observability on linear system and discrete system	PLO1, PLO2, PLO3, PLO4, PLO5
CLO3	Able to model the control system by using simulation tools (Matlab/Simulink, PSIM)	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO4	Able to design the controller for linear system	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Case Studies
- Group work (Assignment)

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3, CLO4
2	Case studies	20	CLO2, CLO3, CLO4
3	Assignment	20	CLO2, CLO3, CLO4
4	Mid-Term exam	20	CLO1, CLO2, CLO3
5	Final Exam	30	CLO1, CLO2, CLO3

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed LLOs

Weeks		CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1-2	**2h/4h**		- Ability to understand the feedback system of industrial and the way to implement - Ability to applied the control system with various application.	Lecture 1: Introduction to control system and its application	- Lecture/Tutorial - Present its application	- Listen/Note - Asking question	- Attendance	- Lecture Note /PPT - LCD
3-4	**2h/5h**		- Ability to convert continuous time model to discrete time model - Ability to analyze stability in discrete time - Ability to implement discrete PID controller in hardware	Lecture 2: Discrete time domain	- Lecture/ Tutorial - Continuous time model Vs Discrete time model - Implementation of discrete controller	- Student shows continuous system and Discrete - Implement controller in the digital devices/ simulation tool	- Attendance - Short presentation - Simulation result	- Lecture Note/PPT - Digital device/Hardware - Own PC
5-6	**2h/5h**		- Ability to represent Mathematical models of dynamic systems into both continuous and discrete time domain	Lecture 3: State Space Representation	- Lecture/ Tutorial - Modeling of Continuous time model and Discrete time model in state space model	- Participate in modeling the system (continuous and discrete) - Do the case studies	- Attendance - Short report	- Lecture Note/PPT - Own PC
8	**2h**	**Midterm**						
9-10	**2h/4h**		- Ability to convert nonlinear model to linear model using	Lecture 4: Linearization	- Lecture/ Tutorial - Provide the sample linearization of a	- Linearized the a given nonlinear system	- Attendance - Short report	- Lecture Note/PPT - Own PC

			linearization method of Taylor Series.		given converters/system			
11-12	**2h/4h**		- Ability to analyze the stabilizability, controllability, observability of linear stat space model	Lecture 5, State Space Analysis.	- Lecture/ Tutorial - Provide the different example of SS system: stabilizability, controllability, observability	- Participate in lecture section - Assignment	- Attendance - Group discussion	- Lecture Note/PPT - Own PC
13-15	**4h/6h**		- Ability to design state feedback controller using pole placement, LQR and design state estimator using state observer, Kalman filter.	Lecture 6. State Feedback Design	- Lecture/ Tutorial - Compute controller using Matlab - Design state estimator using Matlab	- Derive state space controller - Compute: LQR, state estimator Kalmen filter - Group Assignment	- Attendance - Report + presentation	- Lecture Note/PPT - Matlab - Own PC
16	**2h/2h**		- Ability to implement control system into hardware.	Lecture8, Implementation of Digital Control	- Lecture/ Tutorial - Implementation of digital controller in simulation tool - Applied digital controller in real devices	- Student build digital simulation - Implement controller in the digital devices	- Attendance - Short report - Hardware implementation	- Lecture Note/PPT - Hardware - Own PC
17		**Final Exam**						

6. References

[1]. M. Sami Fadali, Antonio Visioli, “Digital Control Engineering Analysis and Design,” Second Edition. 2009

[2]. Katsuhiko Ogata, “Modern Control Engineering,” Fifth Edition, 2009

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

INDUSTRIAL NETWORK PROTOCOL

Subject: Industrial Network Protocol, Year: 4 Semester: 1 Credit: 1
Lecturer: Dr. CHRIN Phok,
Tel.: 096 97 90 999 E-mail: pchrin@itc.edu.kh

1. Course Description

This subject is to provide the basic knowledge on operation and standard data communication network in industrial.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to obtain the standard and operation of data of devices in network.	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to analyze the obstacle of network and propose the solution	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to create industrial network with different devices	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Assignment (quality reports)	25	CLO1, CLO2, CLO3
3	Quality oral presentation	25	CLO3
4	Mid-Term exam	20	CLO1, CLO2
5	Final Exam	20	CLO1, CLO2

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1-2	4h	CLO1 CLO2 CLO3	- Ability to understand the operation of digital electronics - Ability to define storage system for registration	Lecture 1: Basic Digitals Electronics	- Tutorial/lecture - Asking key question	- Group discussion - Asking key question	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
3-5	6h	CLO1 CLO2 CLO3	- Ability to understand the OSI model - Ability to operate the TCP/IP protocol	Lecture 2: OSI Model and TCP/IP Protocol	- Tutorial/lecture - Demonstrate simulation tool - Assignment research work (Case Study 1)	- Taking note - Group discussion - Asking key question	- Attendance	- PPT Present - Lecture Note - Problems and assigned name of student for presentation
6-7	4h	CLO1 CLO2 CLO3	- Ability to understand the serial communication - Ability to use RS232 and RS485	Lecture 3: Serial Communication and Hardware layer	- Tutorial/lecture - Demonstrate simulation tool - Assignment research work (Case Study 2)	- Taking note - Group discussion - Asking key question - Presentation	- Attendance - Presentation	- PPT Present - Lecture Note - Problems and assigned name of student for presentation
8-10	6h	CLO1 CLO2 CLO3	- Ability to understand Modbus Protocol - Ability to use Modbus protocol with TCP/IP	Lecture 4: Modbus Protocol	- Tutorial/lecture - Demonstrate simulation tool	- Taking note - Group discussion - Asking key question	- Attendance - Quiz	- PPT Present - Lecture Note
11	2h	Midterm						
12-16	10h	CLO1 CLO2 CLO3	- Ability to use profibus protocol - Ability to use Can protocol	Lecture 5: 3-Profibus and CAN	- Tutorial/lecture - Demonstrate simulation tool	- Taking note - Group discussion - Asking key question - Presentation	- Attendance - Presentation	- PPT Present - Lecture Note
17	2h	Final Exam						

6. References

[1] Richard Zurawski, Industrial Communication Technology Handbook, Second Edition, CRC Press
[2] Modicon Modbus Protocol Reference Guide MODBUS over Serial Line Specification and Implementation Guide V1.02
[3] MODBUS MESSAGING ON TCP/IP IMPLEMENTATION GUIDE V1.0b

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

PROGRAMMABLE LOGIC CONTROLLER - PLC

Subject: Programmable Logic Controller - PLC, Year: 4 Semester: 2 Credit: 3
Lecturer: Mr. CHAN Tola, Master Degree from N7-INP, France
Tel.: 070 507 514 E-mail: tola.chan@itc.edu.kh

1. Course Description

This subject is to provide the fundamental concept of PLC in industrial operation such as data collection system, industrial automation system, and interaction amongst human being, machine and local server.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to have a basic knowledge on automation system in industrial application	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to design different industrial automation system	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to code with "Ladder" languages	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO4	Able to identify equipment for industrial automation and automation panel	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Make a simulation for each assignment as well as real practice with existing PLC panels
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3, CLO4
2	Assignment (quality reports)	25	CLO2, CLO3, CLO4
3	Quality oral presentation	25	CLO4
4	Mid-Term exam	20	CLO1, CLO3
5	Final Exam	20	CLO1, CLO3

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	2h		- Ability to understand PLC with different model - Ability to identify PLC application and its language	Lecture 1: PLC overview	-Tutorial - lecture - Asking question to the student to observe their understanding of the lecture	- Taking note - Discussion - practice - Debate	- Attendant	- Lecture note(slide) - Book reference
2	2h		- Ability to understanding of I/O number on PLC model - Ability to know how to select PLC according to demand application	Lecture 2: I/O device, memory and Motor controls	-Tutorial - lecture - Asking question to the student to observe their understanding of the lecture - Assignment 1	- Taking note - Discussion - practice - Debate - Individual assignment - group assignment	- Oral tests - Quiz - Close book examination - oral presentation - Open book examination - Attendant	- Lecture note(slide) - Book reference
4 → 5	4h		- Ability to understanding of PLC language - Ability to use Ladder Diagram language - Ability to do simulation with software and hardware	Lecture 3: PLC programming	-Tutorial - lecture - Asking question to the student to observe their understanding of the lecture - Assignment 2	- Taking note - Working on individual exercise	- Oral question - Exercise - Quiz - Attendant	- Lecture note(slide) - Book reference
6	2h		- Ability to configure of Timer On/Timer Off and motor control with Timer	Lecture 4: PLC Timer Instruction	-Tutorial - lecture - Asking question to the student to observe their understanding of the lecture - case study - Assignment 3	- Taking note - Working on individual - Exercise - Group discussion	- Oral question - Exercise - Quiz - Attendant	- Lecture note(slide) - Book reference

7	2h		- Ability to configure of counter Up/ counter down - Ability to define the Status control with Counter	Lecture 5: PLC Counter Instruction	-Tutorial - lecture - Asking question to the student to observe their understanding of the lecture - case study - Assignment 4	- Taking note - Working on individual - Exercise - Group discussion	- Oral question - Exercise - Quiz - Attendant	- Lecture note(slide) - Book reference
7	2h		- Ability to code mathematic operation (Add, Sub, Mul, and Div)	Lecture 6: Math Instruction	-Tutorial - lecture - Asking question to the student to observe their understanding of the lecture - Assignment 5		- Oral question - Exercise - Quiz - Attendant	- Lecture note(slide) - Book reference
8 ÷ 9	4h		- Ability to define condition of operation: Greater than function, Less than function, Equal than function, Greater than and Equal function, Less than and Equal function	Lecture 7: Compare, Jump and Subroutine Function	-Tutorial - lecture - Asking question to the student to observe their understanding of the lecture - Assignment 6	- Taking note - Working on individual - Exercise - Group discussion	- Oral question - Exercise - Quiz - Attendant	- Lecture note(slide) - Book reference
10	2h			Midterm				
12	2h		- Ability to use Shift Right integer, Shift Left integer, Shift Right word, Shift Left word	Lecture 8: Logic and Bit Shift Instructions	-Tutorial - lecture - Asking question to the student to observe their understanding of the lecture - Assignment 7.	- Taking note - Working on individual - Exercise - Group discussion	- Oral question - Exercise - Quiz - Attendant	- Lecture note(slide) - Book reference Computer, LCD, ink markers

13	2h		- Ability to define Variable declaration, Data conversion, MOVE function	Lecture 9: Data Handling Instruction	-Tutorial - lecture - Asking question to the student to observe their understanding of the lecture - Assignment 8.	- Taking note - Working on individual - Exercise - Group discussion	- Oral question - Exercise - Quiz - Attendant	- Lecture note(slide) - Book reference Computer, LCD, ink markers
14	2h		- Ability to use HMI software - Ability to configure HMI configuration - Ability to Setup communication for PLC and HMI - Ability to simulate HMI	Lecture 10: Human Machine Interface (HMI)	-Tutorial - lecture - Asking question to the student to observe their understanding of the lecture - Assignment 9.	- Taking note - Working on individual - Exercise - Group discussion	- Oral question - Exercise - Quiz - Attendant	- Lecture note(slide) - Book reference Computer, LCD, ink markers
15	2h		- Ability to setup Inverter by software/manual - Ability to setup communication for PLC and Inverter - Simulation	Lecture 11: Invertor, Variable Speed Control (VSD)	-Tutorial - lecture - Asking question to the student to observe their understanding of the lecture - Assignment 10.	- Taking note - Working on individual - Exercise - Group discussion	- Oral question - Exercise - Quiz - Attendant	- Lecture note(slide) - Book reference
15-16	4h		- Ability to setup communication for PLC, HMI and Inverter to be able to communicate with each other	Lecture 12: - Communication PLC to HMI - Communication PLC to Invertor	-Tutorial - lecture - Asking question to the student to observe their understanding of the lecture - Assignment 11.	- Taking note - Working on individual - Exercise - Group discussion	- Oral question - Exercise - Quiz - Attendant	- Lecture note(slide) - Book reference
17		**Final Exam**						

6. References

[1] Frank D. Petruzella, Programmable Logic Controllers, Fifth edition, McGraw-Hill Education

[2] KLS Sharma, Overview of Industrial Process Automation, Second edition

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

DIGITAL CIRCUIT DESIGN

Subject: Digital Circuit Design, Year: 4 Semester: 2 Credit: 1
Lecturer: Mr. CHHORN Sopheaktra,
Tel.: 010 668 465 E-mail: pheaktra@itc.edu.kh

1. Course Description

This subject is to provide student the fundamentals concept to analyze and to design digital circuit. Digital system is main part in most applications such laptop, digital signal processing, telecommunication system.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to have a basic knowledge on design of digital circuit.	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to analyze the operation of digital circuit in actual application such as laptop, DSP, telecommunication system.	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to build the digital circuit with high efficiency and reliable	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Assignment (quality reports)	25	CLO1, CLO2, CLO3
3	Quality oral presentation	25	CLO3
4	Mid-Term exam	20	CLO1, CLO2
5	Final Exam	20	CLO1, CLO2

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	2h		- Ability to understand the Basic Logic, the Combination Logic Building Block - Ability to understand the Sequential Logic Building Blocks.	Lecture 1: Digital System Design with VHDL	- Tutorial/lecture - Asking key question	- Group discussion - Asking key question	Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
2-3	4h		- Ability to understand the Structure of a Typical Digital System - Ability to use the Hardware design with RTL VHDL - Ability to compute the steps of the Design Process	Lecture 2: RTL Design Methodology.	- Lecture - Tutorial - Assignment 1	- Note - Group discussion on Assignment task	Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
4-5	4h		- Ability to distinguish Hardware Description Languages (HDL) and Traditional Programming Languages (PL) - Ability to define the different between VHDL and Verilog - Ability to design Entity with VHDL - Ability to understand Testbenches	Lecture 3: VHDL Basics-Testbenches	- Lecture - Tutorial - Case Study 1	- Taking Note - Actively participate in class activities - Ask question related to lecture and case study - Group work on Case study problem	- Attendance - Quiz 1	- PPT Present - Lecture Note - Computer, LCD, ink markers
6-7	4h		- Ability to descript the VHDL system - Ability to use the Wires and Buses - Merging wire and Buses	Lecture 4: Data Flow Modeling in VHDL	- Lecture - Assignment2	- Note - Group discussion on Assignment task - Q/A	Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers

8-10	4h		- Ability to understand the Fixed Shifters and Rotators - Ability to use the Multiplexers with VHDL - Ability to use the Decoders and Encoder with VHDL - Ability to understand the fundamental of ROM and Buffer, Combinational Logic Synthesis	Lecture5: Data Flow Description of Combinational -Circuit Building Blocks	- Lecture - Tutorial - Assignment 3	- Note - Group discussion on Assignment task - Q/A	- Attendance - Quiz 2	- PPT Present - Lecture Note - Computer, LCD, ink markers
11-13	6h		- Ability to use the behavioral design style: Registers and counters - Ability to understand the Generic Component Instantiation - Ability to use mixing Description Styles inside of an Architecture - Ability to generate scheme for components	Lecture6: Behavioral Modeling of Sequential-circuit Building Block	- Lecture - Tutorial - Case study 2	- Taking Note - Actively participate in class activities - Ask question related to lecture and case study - Group work on Case study problem	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
14-16	6h		- Ability to define the different between two competing implantation approaches: ASIC and FPGA - Ability to use the Clock Management - Ability to understand to FPGA Design Flow - Knowing the Tools used in FPGA Design Flow - Understand the Memory types	Lecture 7: FPGA Devices and Design Flow	- Lecture - Tutorial - Presentation 1	- Taking Note - Actively participate in class activities - Presentation on finding results from assignments	- Attendance - Quiz 3 - Presentation from students on Assignments	- PPT Present - Lecture Note - Computer, LCD, ink markers
8	**2h**	**Final Exam**						

6. References

[1] Jean-Pierre Deschamps, Gery Jean Antoine Bioul Gustavo, Gustavo D. Sutter " Synthesis of Arithmetic Circuit". A Jhon Wiley & Sons, Inc., PUPLICATION.

[2] Douglas L. Perry "VHDL Programming by example". The McGraw-Hill Companies, Inc, United States of America.

[3] Stephen Brown, Zvonko Vranesic "Fundamentals of Digital Logic with VHDL Design" McGraw-Hill Inc., 1221 Avenue of the America, New York.

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

ELECTRONICS CIRCUIT DESIGN AND MANUFACTURING

Subject: Electronics Circuit Design and Manufacturing, Year: 4 Semester: 2 Credit: 1
Lecturer: Mr. CHHORN Sopheaktra, Master degree from CU, Thailand
Tel.: 010 668 465 E-mail: pheaktra@itc.edu.kh

1. Course Description

This subject is to provide the fundamental concept of design of electronics circuit and prototype for controlling electrical instrument. Students are also capable to do research in the field of electronics for response to the current and future market.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to have knowledge on design and manufacture the electronics circuit.	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to analyze the operation of the designed electronics circuit.	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to produce official layout files for sending to industrial for fabrication.	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Do modeling and make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Assignment (quality reports)	30	CLO1, CLO2
3	Quality oral presentation	30	CLO2
4	Final Exam	30	CLO1, CLO2

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	2h		- Ability to understand the Printed Circuit Board and circuit design - Ability to understand the Kicad design Process	Lecture 1: Introduction to Electronic Circuit Design	- Lecture - Tutorial - Key questions for alert students the important aspects.	- Taking note - Actively participate in class activities	Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
2	2h		- Ability to learn how create a simple schematic. - Ability to learn how to find the schematic component in the library. - Ability to use the hotkeys to quickly find a component - Ability to create a custom schematic component. - Ability to annotate parts in the schematic - Ability to check the design by using electrical rules check.	Lecture 2: Schematic and Wiring.	- Lecture - Tutorial - Case Study 1 - Explain problem in case study	- Taking Note - Actively participate in class activities - Ask question on case study problem	Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
3 → 4	4h		- Ability to associate schematic components with footprints - Generate the Netlist and Import the Netlist in the Pcbnew - Ability to create a custom footprint - Ability to understand the Footprint features, like pins, pads, silkscreen boarders, and labels. - Ability to create and import a netlist. - Ability to know how to modifying the schematic and	Lecture 3: Footprint	- Lecture - Tutorial - Assignment 1	- Note - Q/A	- Attendance - Quiz 1	- PPT Present - Lecture Note - Computer, LCD, ink markers

			update the PCB design based on the updated schematic. - Ability to define the boundary of the PCB - Ability to wire between the pins of the two footprints - Ability to add text label					
5→6	4h		- Ability to design multi layer PCB - Ability to use the Through-hole and smd component with the PCB - Ability to control the track width - Ability to improve the electrical characteristic of the PCB by increasing the width of the Ground and Vcc track. - Ability to create a custom track width with the design rule - Ability to customize the width of a track - Ability to add copper fills - Ability to import 3D shape from Solidwork of Fusion360 to footprint	Lecture 4: Enhancing the design	- Lecture - Assignment2	- Taking note - Presentation	- Attendance - Presentation	- PPT Present - Lecture Note - Computer, LCD, ink markers
7	2h		- Ability to generate the Gerber files - Ability to add text to the Front Silkscreen(“F.SilkS”) and the bottom Silkscreen(“B.SilkS”) - Ability to add a decorative graphic - Ability to upload it to the fabricator	Lecture5: Fabrication	- Lecture - Tutorial - Assignment3	- Taking Note - Presentation	- Attendance - Presentation	- PPT Present - Lecture Note - Computer, LCD, ink markers
8	**2h**	**Final Exam**						

6. References

[1] Peter Dalmaris “*Kicad like a Pro*”. PO Box 22, Berowra, 2081, NSW, Australia.

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

SENSORS AND ACTUATORS

Subject: Sensors and Actuators, Year: 4 Semester: 2 Credit: 2
Lecturer: Mr. CHHORN Sopheaktra, Master degree from CU, Thailand
Tel.: 010 668 465 E-mail: pheaktra@itc.edu.kh

1. Course Description

This subject is to provide the fundamental concept of create and assembly of sensor and actuator by studying its structure, operation, and applications. This subject is also focus on how to use sensors and actuator in industry and its technology.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to have knowledge on operation of sensors and actuators in industrial automation	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to select the best sensors and actuators for industrial application concept	PLO1, PLO2, PLO3, PLO4, PLO5
CLO3	Able to analyze the datasheet of devices	PLO1, PLO2, PLO3, PLO4, PLO5

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Do modeling and make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Assignment (quality reports)	25	CLO2, CLO3
3	Quality oral presentation	25	CLO2
4	Mid-Term exam	20	CLO1, CLO2
5	Final Exam	20	CLO1, CLO2

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	2h/1h		- Ability to understand the application of Sensors and Actuators	Lecture 1: Introduction to Sensors and Actuators	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
1→2	4h/3h		- Ability to understand the variety of components that are interconnected to perform the intended functions. - Ability to determine the power efficiency using Impedance Matching Method - Ability to use Amplifier, Analog filter or Analog circuit in order to build the Sensors and Actuators	Lecture 2: Component Interconnection and Signal Conditioning	- Lecture - Tutorial - Case Study 1	- Note - Q/A	- Attendance - Quiz 1	- PPT Present - Lecture Note - Computer, LCD, ink markers
3	2h/2h		- Ability to understand the Performance Specification and its parameters - Ability to analyze the equivalent equation such as first and second order of the Sensor and Actuator systems - Ability to express Linearity and linearize the Nonlinear systems	Lecture 3: Static and Dynamic Characteristics of Instrumentation	- Lecture - Tutorial - Assignment 1	- Note - Q/A	- Attendance - Quiz 2 - Homework 1	- PPT Present - Lecture Note - Computer, LCD, ink markers

4	2h / 2h		- Ability to determine model error and measurement error which using Least-squares line estimation (regression line). Especially, implemented by Kalman Filter.	Lecture 4: Estimation from Measurements	- Lecture - Tutorial	- Note - Q/A	- Attendance - Quiz 3	- PPT Present - Lecture Note - Computer, LCD, ink markers
5 → 6	4h / 4h		- Ability to understand Sensor/transducer terminology. - Ability to understand concept of Analog Sensors and Transducers - Ability to select the exact sensors to use in real-world applications - Ability to understand Sensor and Actuators Technology	Lecture 5: Analog Sensors and Transducers	- Lecture - Tutorial	- Note - Q/A	- Attendance - Presentation 1	- PPT Present - Lecture Note - Computer, LCD, ink markers
7	2h	**Mid-term**						
8 → 10	4h / 4h		- Ability to understand the concept of digital sensor and its technology - Ability to merge several sensors to get the high performance using sensor fusion	Lecture 6: Digital and Innovative Sensing	- Lecture - Tutorial - Assignment 2	- Note - Q/A	- Attendance - Quiz 3	- PPT Present - Lecture Note - Computer, LCD, ink markers

11	2h/2h		- Ability to understand the mechanical system of actuator - Ability to select an actuator (e.g., motor, hydraulic actuator) to drive a load, for efficient and optimal operation.	Lecture 7: Mechanical Transmission Components	- Lecture - Tutorial - Case study	- Note - Q/A	- Attendance - Homework 2	- PPT Present - Lecture Note - Computer, LCD, ink markers
12	2h /2h		- Ability to understand the structure of Stepper Motors which is the Crucial industrial application	Lecture 8: Stepper Motors	- Lecture - Tutorial - Assignment 3	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
13 → 16	8h / 8h		- Ability to select actuator types and continuous drive actuators for real-world application - Ability to express the Modeling of Actuator such as DC, AC. - Ability to use actuator both Linear actuator and Rotational actuator	Lecture 9: Continuous-Drive Actuators	- Lecture - Tutorial	- Note - Q/A - Final Presentation	- Attendance - Presentation	- PPT Present - Lecture Note Computer, LCD, ink markers
17	**2h**	**Final Exam**						

6. References

[1] Clarence W. De Silva " Sensors and Actuators: Engineering System Instrumentation," Second Edition Book 2016

[2] Jacob Fraden "Handbook of Modern Sensors" Physics, Designs, and Applications Fifth Edition 2016

[3] John G. Webster "The Measurement, Instrumentation, and Sensors Handbook"

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

MOTOR DRIVE

Subject: Motor Drive Year: 4 Semester: 2 Credit: 3
Lecturer: Dr. Kim Bunthern
Tel.: 077 512 157 E-mail:kimbunthern@itc.edu.kh

1. Course Description

This subject provides the basic knowledge and advance skill in motor drive applications/ motor control. It is an interdisciplinary subject of Electrical Machine, mechanical system, Power Electronic and control system.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to understand the basic knowledge of electrical machine and its application	PLO1, PLO2, PLO3
CLO2	Able to analyze the operation of DC and AC motor	PLO5, PLO6, PLO7, PLO8
CLO3	Able to design the motor drives system for both AC and DC motor	PLO5, PLO6, PLO7, PLO8

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Discussion
- Presentation

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Case study/Quiz	20	CLO1, CLO2, CLO3
3	Assignment	20	CLO1, CLO2, CLO3
4	Mid-Term exam	20	CLO1, CLO2, CLO3
5	Final Exam	30	CLO1, CLO2, CLO3

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed LLOs

Weeks		CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	4h/4h		- Ability to understand the notion of electromechanical phenomenon. - Ability to understand the different type of electric motors.	Lecture 1: Introduction to Electric motor and it applications	- Lecture - Tutorial	- Listen/Note - Asking question	- Attendance	- Lecture Note /PPT - LCD
2-4	6h/12h		- Ability to create and analyze the model of a DC motor. - Ability to implement a control system for regulating the speed and position of a brushed DC motor.	Lecture 2: Principle control of dc motors	- Tutorial - Lecture - Simulation - Experimentation	- Participate in modeling dc motor - Do the case studies	- Attendance - Simulation result - Short report of experiments	- Lecture Note/PPT - dc motor - Matlab/PSIM
5-6	4h/8h		- Ability to create and analyze the model of the stepper motor. - Ability to implement a control system for speed control/ position.	Lecture 3: Stepper motor	- Lecture - Tutorial - Simulation	- Participate stepper dc motor - Do the case studies	- Attendance - Simulation result	- Lecture Note/PPT - dc motor - Matlab/PSIM
7-8	4h/8h		- Ability to understand the transformation model abc-dq0 and dq0-abc - Ability to create and analyze the model of an AC induction motor.	Lecture 4: Model of induction machine	- Lecture - Tutorial - Model of induction motor - Build model of AC induction motor in Matlab/PSIM	- Student built the - Do the case studies	- Attendance - Simulation result - Short report of experiments	- Lecture Note/PPT - dc motor - Matlab/PSIM
9	2h	**Midterm**						

10-11	4h/8h		- Ability to implement simple closed loop control systems - Ability to design the controller for induction motor speed control	Lecture 5: Simple control of AC motors	- Lecture - Tutorial - experiment - Assignment	- Participate in experiment set up - Do the case studies	- Attendance - Short report of simple closed loop control	- Lecture Note/PPT - ac motor - power converter - Matlab/PSIM - dspace
12-13	6h/10h		- Ability to understand the notion of field-oriented control (FOC) - Ability to create and analyze the model of AC induction motor in rotating reference frame (dq-frame). - Ability to implement control systems for regulating the speed of the AC induction motor using FOC and direct torque control (DTC).	Lecture 6: Vector control of AC induction motor (IM)	- Lecture - Tutorial - Experiment on FOC, DTC - Assignment	- Participate in experiment set up - Do the case studies on FOC and DTC	- Attendance Short report of simple closed loop control	- Lecture Note/PPT - ac motor - Power converter - Matlab/PSIM - dspace
14-15	3h/6h		- Ability to implement speed control of synchronous motor using FOC and direct torque control (DTC).	Lecture 7: Vector control of AC synchronous motor (PMSM)	- Lecture - Tutorial - Experiment vector control for ac synchronous motor - Case studies of ac motor speed control	- Participate in experiment set up - Student involve Case studies of ac motor speed control	- Attendance - Short report	- Lecture Note/PPT - ac motor - power converter - Matlab/PSIM - dspace
16		Final Exam						

6. References

[1]. DR. P. C. SEN, ‘Principles of Electric Machines and Power Electronics’, Fellow IEEE, Third edition,

[2]. Bin Wu, ‘High-power Converters And AC Drives’, IEEE PRESS, 2006.

INTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION

Course Syllabus

Research Methodology

Subject: Research Methodology Year: 3 Semester: 1 Credit: 2.5
Lecturer: Dr. AM Sok Chea, PhD. from UGA-Grenoble, France
Tel.: 096 34 55 449 / E-mail: sokchea_am@itc.edu.kh

1. Description of Course

Energy Research Project 1 (Research Methodology) provides students the first experience to get to know how research lookalike. Students also will gain knowledge on research pathway which capable to perform research in the future.

2. Course Learning Outcomes (CLOs)

Description of CLOs		Matching PLOs of Program
CLO1	Understand the research pathways and how to collect documents for supporting the research topic.	PLO6, PLO7, PLO8, PLO9,
CLO2	Analyze the collected articles and synthesis the findings in previous research	PLO6, PLO7, PLO8, PLO9,
CLO3	Develop tool for verification the previous finding and future research trend	PLO6, PLO7, PLO8, PLO9,
CLO4	Apply research methodology for their future research work.	PLO6, PLO7, PLO8, PLO9,

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Quality presentation
- Quality of report writing

4. Evaluation Methodology

No	Evaluation Types	Score	Matching CLOs
1	Attendants	10	CLO1, CLO2, CLO3, CLO4
2	Assignments and report	20	CLO1, CLO2, CLO3, CLO4
3	1st Oral Presentation	20	CLO1, CLO2, CLO3, CLO4
4	Report in Journal format with max. 6 pages	20	CLO1, CLO2, CLO3, CLO4
5	2nd Oral presentation	30	CLO1, CLO2, CLO3, CLO4

Passing Score:

- Final Moyenne > 50: score of subjects under 30 must re-do exam
- Final Moyenne < 50: score of subjects under 50 must re-do exam

5. Detailed of content

Weeks		CLOs	LLOs	Content	Teaching met.	Learning met.	Assessment	Equipment
1	2h	CLO1	- Ability to understand what is research. - Ability to define research scope.	Lecture 1: Introduction to Research Methodology	- Tutorial/lecture - Asking key question	- Group discussion - Asking key question	- Attendance	- PPT Present - Lecture Note
2-3	4h	CLO1 CLO2 CLO3 CLO4	- Ability to use web to download valuable articles/journals - Ability to classify types of articles.	Lecture 2: Research Methodology-Tool	- Tutorial/lecture - Demonstrate on how to classify quality article. - Request student to select/propose research topic	- Actively participate in class activities - Select/propose research topic and start to collect data (published articles)	- Attendance	- PPT Present - Lecture Note
4-5	4h	CLO1 CLO2 CLO3 CLO4	- Ability to read article correctly. - Ability to analyze the provided articles.	Lecture 3 : Analyse the articles	- Tutorial/lecture - Demonstrate on how to read article effectively way. - Request student to analyze each section in their selected article.	- Actively participate in class activities - Presentation their result of analyze article	- Attendance - Presentation - Report	- PPT Present - Lecture Note
6-7	4h	CLO1 CLO2 CLO3 CLO4	- Ability to develop simulation model for verification the finding results in previous publications. - Ability to judge the quality of data in previous articles.	Lecture 4: Verification of Finding Results	- Tutorial/lecture - Demonstrate on how to summary the work. - Request student to summary finding in their selected article.	- Actively participate in class activities - Presentation their abstract.	- Attendance - Presentation - Report	- PPT Present - Lecture Note
8-10	6h	CLO1 CLO2 CLO3 CLO4	- Ability to define the up to date technology and future research trend in	Lecture 5: Propose research topic in the relevant field	- Tutorial/lecture - Demonstrate on how to verify the	- Actively participate in class activities	- Attendance - Presentation - Report	- PPT Present - Lecture Note

			the field after analyzing the articles.		finding results in article.	- Presentation their abstract.		
11-12	2h/4h	CLO1 CLO2 CLO3 CLO4	- Ability to define steps for research activities. - Ability to own the research problem and able to perform autonomy research	Lecture 6: Ways to produce quality research results	- Tutorial/lecture - Demonstrate on how to summary the work.	- Actively participate in class activities - Presentation	- Attendance - Presentation - Report	- PPT Present - Lecture Note
13-16	2h/4h	CLO1 CLO2 CLO3	- Ability to produce results in journal format with max. pages	Lecture 7: Technical report in Journal format (6 pages)	- Tutorial/lecture - Demonstrate on how to write technical result in journal format	- Actively participate in class activities - Presentation	- Attendance - Presentation - Report	- PPT Present - Lecture Note

6. References

[1] Prabhat Pandey, Meenu Mishra Pandey “RESEARCH METHODOLOGY: TOOLS AND TECHNIQUES” Bridge Center, 2015

[2] Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers’Distributors

[3] Kothari, C.R.,1985, Research Methodology- Methods and Techniques, New Delhi, Wiley Eastern Limited.

[4] Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners,(2nd.ed.),Singapore, Pearson Education

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

STUDENT PROJECT PART 1

Subject: Student Project Part 1, Year: 4 Semester: 2 Credit: 1
Lecturer: Dr. AM Sok Chea, PhD. from UGA, France
Tel.: 096 34 55 449 E-mail: Sokchea_am@itc.edu.kh

1. Course Description

This subject is to provide the students the first experience in real research project or projects from partner industries.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to do real research projects or industries' projects	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to do simulation for related project	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to increase soft-skill: report + presentation	PLO8, PLO9, PLO11

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Do modeling and make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Assignment (quality reports)	40	CLO1, CLO2, CLO3
3	Quality oral presentation	50	CLO3

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	2h	CLO1	- Ability to define small groups for specific research projects. - Ability to match students with partner industries.	Lec. 1: Small of group of students	- Tutorial/lecture - Asking key question	- Group discussion - Asking key question	- Attendance	- PPT Present - Lecture Note
2-3	4h/4h	CLO1 CLO2 CLO3	- Ability to define technical topic for students to perform research. - Ability to collect documents for defined research topic.	Lec. 2: Small group technical research topics	- Tutorial/lecture - Demonstrate on analysis of article	- Taking note - Download documents and start analysis the articles	- Attendance	- PPT Present - Lecture Note
4-5	4h	CLO1 CLO2 CLO3	- Ability to analyze the sub-section results of read article.	Lec. 3: Analyze the sub-sections	- Tutorial/lecture	- Taking note - Develop simulation	- Attendance	- PPT Present - Lecture Note
6-7	4h	CLO1 CLO2 CLO3	- Ability to do research for answering to the need of society	Lec. 4: Start create similar project + work for industries project	- Tutorial/lecture - Present the industries to students	- Taking note - Make simulation	- Attendance	- PPT Present - Lecture Note
9-10	4h	CLO1 CLO2 CLO3	- Ability to do research for answering to the need of society	Lec. 4: Start create similar project + work for industries project (Cont. 1)	- Tutorial/lecture - Present the industries to students	- Taking note - Make simulation file	- Attendance	- PPT Present - Lecture Note
11-12	4h	CLO1 CLO2 CLO3	- Ability to do research for answering to the need of society	Lec. 4: Start create similar project + work for industries project (Cont. 2)	- Tutorial/lecture - Present the industries to students	- Taking note - Make simulation file	- Attendance	- PPT Present - Lecture Note
13-16	8h	CLO1 CLO2 CLO3	- Ability to do research for answering to the need of society	Lec. 4: Start create similar project + work for industries project (Cont. 3)	- Tutorial/lecture - Present the industries to students	- Taking note - Make simulation file	- Attendance	- PPT Present - Lecture Note -

6. References

[1] ITC, IG Tech Grou “MoU of Coorporation” 2022

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

EMBEDDED ELECTRONICS FPGA

Subject: Embedded Electronics, Year: 5 Semester: 1 Credit: 2
Lecturer: Mr. CHHORN Sopheaktra, Master degree from CU, Thailand
Tel.: 010 668 465 E-mail: pheaktra@itc.edu.kh

1. Course Description

This subject is to provide the students the knowledge on how to develop microcontroller or microprocessor of laptop by using software and hardware, especially coding correctly. This subject is a main part for computer system's design.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to have knowledge on operation, technique and equipment for developing embedded system	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to perform research in the field of embedded electronics	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to build the embedded electronics system	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Making a simulation for each assignment
- Build hardware
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Assignment (quality reports)	25	CLO1, CLO2, CLO3
3	Quality oral presentation	25	CLO3
4	Mid-Term exam	20	CLO1, CLO2
5	Final Exam	20	CLO1, CLO2

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1-2	4h		- Ability to understand the application of embedded electronic systems - Ability to use logic fundamental design	Lecture 1: Introduction embedded electronics	- Lecture - Tutorial	- Note - Q/A	- Attendance - Quiz 1	- PPT Present - Lecture Note - Computer, LCD, ink markers
3	2h		- Ability to use and install the powerful software Quatus Prime and simulation tools - Ability to simulate the digital circuit	Lecture 2: Software and development Tools	- Lecture - Tutorial	- Note - Q/A	Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
4-5	4h		- Ability to use the Combinational logic circuit to build Memory Register - Ability to implement the Boolean equation in software	Lecture 3: Regular Sequential Circuit	- Lecture - Tutorial - Assignment 1	- Note - Q/A	- Attendance - Quiz 2	- PPT Present - Lecture Note - Computer, LCD, ink markers
6-7	4h		- Ability to understand state Machine and real application - Ability to write state machine loop process in VHDL language	Lecture 4: Finite State Machine (FSM)	- Lecture - Tutorial - Assignment 2	- Note - Q/A	- Attendance - Quiz 3	- PPT Present - Lecture Note - Computer, LCD, ink markers
8	2h	**Mid-term**						

9-10	4h		- Ability to understand the component of Nois II processor - Ability to recognize the type of processor unit - Ability to determine the architecture of Nois II processor	Lecture 5: Nois II Processor Overview	- Lecture - Tutorial -	- Note - Q/A	- Attendance - Quiz 3	- PPT Present - Lecture Note - Computer, LCD, ink markers
11-12	4h		- Ability to build components in processor using Quatus Prime Software	Lecture 7: Nois II System Derivation and Low-level Access	- Lecture - Tutorial - Case study	- Note - Q/A	- Attendance - Homework 1	- PPT Present - Lecture Note - Computer, LCD, ink markers
13-14	4h		- Ability to understand System Interconnect Fabric for Avalon MM Interface - Ability to understand SOPC Builder Design Optimizations - Ability to construct SOPC Component - Ability to reduce logic and power utilization	Lecture 8: Avalon Interconnect and SOPC Component	- Lecture - Tutorial - Assignment 3	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
15-16	4h		- Ability to design a system of processor unit that specific with real application	Lecture 9: Project Design	- Lecture - Tutorial	- Note - Q/A	- Attendance - Presentation 1	- PPT Present - Lecture Note Computer, LCD, ink markers
17	**2h**	**Final Exam**						

6. References

[1] Charles H. Roth, Jr. & Lizy Kurian John “Digital Systems Desging Using VHDL” Second Edition
[2] Pong P. Chu “Embedded SOPC Design with NIOS II processor and VHDL examples”

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

INDUSTRIAL AUTOMATION

Subject: Industrial Automation, Year: 5 Semester: 1 Credit: 2
Lecturer: Dr. KIM Bunthern, PhD. from N7-INP, France
Tel.: 077 512 157 E-mail: kimbunthern@itc.edu.kh

1. Course Description

This subject is to provide the students on how to develop automation system - such as PLC, industrial management, industrial network, SCADA system, sensors and actuators, CNC machine, and industrial robotics - for industrial application.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to have basic knowledge on industrial automation such as operation control, industrial controllers, sensors and actuators, robotics system	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to develop industrial network/automation	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to analyze on the operation of SCADA system, PLC system,	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO4	Able to build industrial automation system	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Making a simulation for each assignment
- Build prototype of industrial automation system
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Assignment (quality reports)	25	CLO2, CLO3, CLO4
3	Quality oral presentation	25	CLO4
4	Mid-Term exam	20	CLO1, CLO2, CLO3
5	Final Exam	20	CLO1, CLO2, CLO3

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	2h/2h		- Ability to understand the industrial process control system, type of control, motion control, production automation, real-time control system, distributed control system.	Lecture 1: Introduction to industrial control systems and engineering	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
2-3	4h/4h		- Ability to understand the process of industrial measurement system, sensors, industrial actuators, transducers, and valves. - Ability to identify the type of sensors and actuators used for a given specification.	Lecture 2: Sensors and actuators	- Lecture - Tutorial	- Note - Q/A	- Quiz 1 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
4-8	6h/10h		- Be able to understand the type control for industrial process: PID controller, Batch process control, servo and motion control. - Be able to understand the basic of PLC programing using IEC 61131 standard	Lecture 3: Industrial process control and PLC	- Lecture - Tutorial - TP	- Note - Q/A	- Quiz 2 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers

			language (LD, FBD, ST, SFC, IL). - Ability to setup a PLC control system with I/O devices. - Ability to program a PLC based on the given automatic process.					
9	2h	- **Midterm**						
10-12	4h/6h		- Be able to understand the basic of industrial networks: DCS vs. SCADA, Field interfaces, CAN, Industrial ethernet, networks devices, OPC UA. - Ability to analyze industrial networks based on the configuration and protocols. - Ability to set up HMI and SCADA system,	Lecture 4: Industrial control networks and SCADA	- Lecture - Tutorial - TP	- Note - Q/A	- Homework 1 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
13	2h/2h		- Be able to understand the basic components hydraulic and pneumatic systems. - Ability to analyze the control systems based on Hydraulic and Pneumatic actuator.	Lecture 5: Hydraulic and Pneumatic Control Systems	- Lecture - Tutorial	- Note - Q/A	- Homework 2 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
13-14	2h/4h		- Be able to understand the basic components	Lecture6:	- Lecture - Tutorial	- Note - Q/A	- Quiz 3 - Attendance	- PPT Present - Lecture Note

			CNC machine, and CNC programming. - Ability to program a CNC machine.	CNC (computer numerical control) controllers.	- TP			- Computer, LCD, ink markers
15-16	4h/4h		- Be able to understand the basic of robotics employed in industrial automation, robot manipulator, end-effector position, robot vision and sensors, and robot programming. - Ability to analyze the robot pose and workspace based on the manipulator configuration.	Lecture7: Introduction to Industrial Robotics	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
17	2h	**Final Exam**						

6. References

[1] Stamatios Manesis, George Nikolakopoulos “Introduction to Industrial Automation” CRC Press, 2018.

[2] Peng Zhang “Advanced Industrial Control Technology” 1st edition, Elsevier Inc., 2010.

[3] W. Bolton “Programmable Logic Controllers,” 4th edition, Elsevier Newnes, 2006.

[4] Daniel E. Kandray, P.E “Programmable Automation Technologies: An Introduction to CNC, Robotics and PLCs” Industrial Press, Inc. 2010.

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

POWER ELECTRONICS

Subject: Power Electronics, Year: 5 Semester: 1 Credit: 2
Lecturer: Dr. VAI Vannak, PhD. from UGA, France
Tel.: 012 617 364 E-mail: vannak.vai@itc.edu.kh

1. Course Description

This subject is to provide on how to design ELV system respected to standard. This subject also focused on how to install the ELV system (Access control, Energy Monitoring, Building Automation) correctly.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to understand the architecture, code/standard, and communication of ELV system as well as selecting the equipment	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to use user manual guide	PLO6, PLO7
CLO3	Able to install and config the ELV system in building	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO4	Able to maintenance and repair the ELV system	PLO6, PLO7
CLO5	Able to config HMI for ELV management	PLO8, PLO9, PLO11

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Making a simulation for each assignment and build hardware
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3, CLO4, CLO5
2	Assignment (quality reports)	25	CLO2, CLO3, CLO4
3	Quality oral presentation	25	CLO5
4	Mid-Term exam	20	CLO1, CLO2
5	Final Exam	20	CLO1, CLO2

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	2h		- Ability to understand the concept and the use of Extra Low Voltage system	Lecture 1: Introduction to Extra Low Voltage System	- Lecture	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
2-4	6h/6h		- Ability to choose component for CCTV system - Ability to install and config the CCTV system	Lecture 2: CCTV System	- Lecture - Tutorial	- Note - Presentation - Q/A	- Attendance - Presentation 1	- PPT Present - Lecture Note - User manual - Video - Computer, LCD, ink markers
5-7	6h/6h		- Ability to choose component for Fire Alarm system - Ability to install and config the Fire Alarm system - Ability to understand the standard used in Fire Alarm system	Lecture 3, Fire Alarm System	- Lecture - Tutorial	- Note - Presentation - Q/A	- Attendance - Presentation 2	- PPT Present - Lecture Note - User manual - Video - Computer, LCD, ink markers
8	2h	**Midterm**						
9-11	6h/6h		- Ability to choose component for Access Control system - Ability to install and config the Access Control system - Ability to design HMI for Access Control system	Lecture 5, Access Control	- Lecture - Tutorial	- Note - Presentation - Q/A	- Attendance - Presentation 3	- PPT Present - Lecture Note - User manual - Video - Computer, LCD, ink markers

12-14	6h/6h		- Ability to choose component for Building Automation system - Ability to choose communication network for Building Automation system - Ability to install and config the Building Automation system	Lecture6, Building Automation	- Lecture - Tutorial	- Note - Presentation - Q/A	- Attendance - Presentation 4	- PPT Present - Lecture Note - User manual - Video - Computer, LCD, ink markers
15-16	4h/4h		- Ability to choose component for Energy Monitoring system - Ability to install and config Energy Monitoring system - Ability to design HMI for Energy Monitoring system	Lecture7, Energy Monitoring	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - User manual - Video - Computer, LCD, ink markers
17		**Final Exam**						

6. References

[1] S. N. Manias, “Power Electronics and Motor Drive Systems,” Elsevier Inc., 2017

[2] D. W. Hart, “Power Electronics,” McGraw-Hill, 2011

INTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY DEPARTMENT

OPTION: ELECTRONICS AND AUTOMATION/ ELECTRICAL ENERGY

Course Syllabus

PROJECT MANAGEMENT

Detailed Course Syllabus

Subject: Project Management Subject code: ……

Year: 5… Semester: …1 Credit: 2.5

Responsible Lecturer: Dr. AM Sok Chea, PhD. from UGA-Grenoble, France

Tel.: …096 34 55 449 / E-mail: sokchea_am@itc.edu.kh

1. Description of Course

This subject is proposed to provide student the basic knowledge on Project Management and tool for project implementation.

2. Course Learning Outcomes (CLOs)

Description of CLOs		Matching PLOs of Program
CLO1	Basic knowledge on Project Planning (Workplan, Budget Plan, Action Plan)	PLO1, PLO2, PLO3
CLO2	Able to monitor and evaluation project progress (Project implementation, PDM tool, evaluation	PLO1 PLO2 PLO3 PLO4
CLO3	Able to produce evaluation report and problem-solving technique for project's progress	PLO4, PLO11

3. Teaching Methodology

- Tutorial, and active learning system: more activities from students with clear guideline from lecturer
- Assignments in group
- Oral presentation of assignment

4. Evaluation Methodology

No	Evaluation Types	Score	Matching CLOs
1	Attendants	10	
2	Assignments and report	20	CLO1, CLO2, CLO3, CLO4
3	1st Oral Presentation	20	CLO1, CLO2, CLO3, CLO4
4	Monitoring and Evaluation Report	20	CLO1, CLO2, CLO3, CLO4
5	2nd Oral presentation	30	CLO1, CLO2, CLO3, CLO4

Passing Score:

- Final Moyenne > 50: score of subjects under 30 must re-do exam
- Final Moyenne < 50: score of subjects under 50 must re-do exam

5. Detailed of content

Weeks		CLOs	LLOs	Content	Teaching met.	Learning met.	Assessment	Equipment
1	2h/2h		- Ability to understand what is Project. - Ability to define definition of project management.	Lecture 1: Introduction to Project Management	- Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
2-3	4h/4h		- Ability to develop PDM for project planning - Ability to plan activities to achieve project outputs/outcomes.	Lecture 2: Project Design Matrix (PDM)	- Tutorial	- Note - Searching - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
4-5	4h/5h		- Ability to develop PDM for project planning - Ability to plan activities to achieve project outputs/outcomes.	Lecture 3, Project Design Matrix (PDM) – Cont.	- Lecture - Tutorial	- Note - Q/A	- Quiz 2 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
6-7	4h/5h		- Ability to develop workplan from PDM - Ability to develop Action plan and budget plan.	Lecture 4: Project planning: Workplan, Action plan, Budget plan	- Lecture - Tutorial	- Note - Q/A	- Homework 1 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
8	2h	**Midterm**						
9-10	2h/4h		- Ability to develop project planning with Microsoft Project.	Lecture 5, Project Planning with Software	- Lecture - Tutorial	- Discussion - Q/A	- Homework 2 - Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
11-12	2h/4h		- Ability to monitor and evaluate project progress and problem-solving skill	Lecture6, Project Implementation	- Lecture - Tutorial	- Discussion - Q/A	- Quiz 3 - Attendance	- PPT Present - Lecture Note
13-16	2h/4h		- Ability to produce quality report and oral presentation.	Lecture7, Report and oral presentaiotn	- Lecture - Tutorial	- Presentation	- Attendance	- PPT Present - Lecture Note
17		**Final Exam**						

5. References

[1] JOSEPH HEAGNEY “Fundamentals of Project Management” 4th Edition Amacon, 2011

[2] Xia Qin, “Project Management and Project Action Plan” Asean QA, 2009

INTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY DEPARTMENT

OPTION: ELECTRONICS AND AUTOMATION/ ELECTRICAL ENERGY

DETAILED COURSE SYLLABUS

TECHNOENTREPRENEUSHIP

Subject: Techno-Entrepreneurship Year: 5… Semester: …1Credit: 1

Responsible Lecturer: Dr. AM Sok Chea, PhD. from UGA-Grenoble, France

Tel.: …096 34 55 449 / E-mail: sokchea_am@itc.edu.kh

1. Description of Course

This subject is proposed to provide student the basic knowledge and experiences from success khmer entrepreneur in the field of engineering.

2. Course Learning Outcomes (CLOs)

Description of CLOs		Matching PLOs of Program
CLO1	Basic knowledge on Technology and Entrepreneurship	PLO6, PLO7, PLO8
CLO2	Understand the ways to do business from successful and unsuccessful entrepreneur	PLO6, PLO7, PLO8
CLO3	Able to self-prepare for being a future entrepreneur in the field of engineering	PLO6, PLO7, PLO8

3. Teaching Methodology

- Tutorial, and active learning system: more activities from students with clear guideline from lecturer
- Assignments in group
- Oral presentation of assignment

4. Evaluation Methodology

No	Evaluation Types	Score	Matching CLOs
1	Attendants	10	CLO1, CLO2, CLO3
2	Assignments and report	30	CLO1, CLO2, CLO3
3	1st Oral Presentation	30	CLO1, CLO2, CLO3
5	2nd Oral presentation	30	CLO1, CLO2, CLO3

Passing Score:

- Final Moyenne > 50: score of subjects under 30 must re-do exam
- Final Moyenne < 50: score of subjects under 50 must re-do exam

5. Detailed of content

Weeks		CLOs	LLOs	Content	Teaching met.	Learning met.	Assessment	Equipment
1	2h/2h		- Ability to understand what is Entrepreneurship in the field of engineering	Lecture 1: Introduction to Entrepreneurship	- Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note
2-3	4h/4h		- Ability to understand the successful and unsuccessfully story of IG Tech Group Company. - Ability to understand the market need of the field of embedded electronics in Cambodia	Lecture 2: Sharing knowledge on Entrepreneurship from IG Group Tech	- Tutorial	- Note - Searching - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
4-5	4h/5h		- Ability to understand the successful and unsuccessfully story of BSI Company. - Ability to understand the market need of the field of electrical lab requirement in Cambodia	Lecture 3: Sharing knowledge on Entrepreneurship from BSI Company	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
6-7	4h/5h		- Ability to understand the successful and unsuccessfully story of MAUSSO Company. - Ability to understand the market need of the field of electrical panel requirement in Cambodia	Lecture 4: Sharing knowledge on Entrepreneurship from MAUSSO Company	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers
9-10	2h/4h		- Ability to understand the successful and unsuccessfully story of OBEN Company. - Ability to understand the market need of the field of	Lecture 5: Sharing knowledge on Entrepreneurship from OBEN Elevator Co. Ltd.	- Lecture - Tutorial	- Discussion - Q/A	- Attendance	- PPT Present - Lecture Note - Computer, LCD, ink markers

			elevator requirement in Cambodia					
11-12	2h/4h		- Ability to understand the successful and unsuccessfully story of LeGrand Company. - Ability to understand the market need of the field of Electrical Device requirement in Cambodia	Lecture 6: Sharing knowledge on Entrepreneurship from LeGrand	- Lecture - Tutorial	- Discussion - Q/A	- Attendance	- PPT Present - Lecture Note
13-16	2h/4h		- Ability to understand the successful and unsuccessfully story of EnergyLab. - Ability to understand the market need of the field of Energy in Cambodia	Lecture7: Sharing knowledge on Entrepreneurship from EnergyLab	- Lecture - Tutorial	- Presentation	- Attendance	- PPT Present - Lecture Note
17		**Final Exam**						

5. References

[1] JOSEPH HEAGNEY “Fundamentals of Project Management” 4th Edition Amacon, 2011

[2] Xia Qin, “Project Management and Project Action Plan” Asean QA, 2009

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

WORK-LIFE AND SOCIAL PSYCHOLOGY

Subject: Work-life and psychology, Year: 5 Semester: 1 Credit: 1
Lecturer: Dr. BUN Long, PhD. Degree from UGA, France
Tel.: 095 222 776 E-mail: bunlong@itc.edu.kh

1. Course Description

This subject is to provide the students the different between the work-life and student-life. This subject is to teach students to prepare for real-job after graduation.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to understand the work pressure	PLO6, PLO7, PLO8
CLO2	Able to tolerance with work	PLO6, PLO7, PLO8
CLO3	Able to prepare for real-job	PLO6, PLO7, PLO8

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Assignment (quality reports)	45	CLO1, CLO2, CLO3
3	Quality oral presentation	45	CLO3

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1-3	6h		- Ability to understand the student life and ready for work-life	Lecture 1: Re-call of student life	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note
4-6	6h		- Ability to know how to face big pressure from work load	Lecture 2: Confort zoon come to end	- Lecture - Tutorial	- Note - Q/A	Attendance	- PPT Present - Lecture Note
7-8	4h		- Ability to well planning activities for completing the teamwork project	Lecture 3: Planning for achieving	- Lecture - Tutorial - Assignment 1	- Note - Q/A	- Attendance - Quiz 2	- PPT Present - Lecture Note
9-11	4h		- Ability to complete on time with sharing load in team	Lecture 4: Work-pressure	- Lecture - Tutorial - Assignment 2	- Note - Q/A	- Attendance	- PPT Present - Lecture Note
12-16	10h		- Ability to understand the difficulty at work.	Lecture 5: Sharing experience on real-work	- Lecture - Tutorial	- Note - Q/A	- Attendance	- PPT Present - Lecture Note
17								

6. References

[1] Oyedele O. Ola, Willoughby O. John, Olaniyi A. Simeon and Oyero A. Mutiu, "Impact of Work Life Balance on the Social Life of Workers Living in Lagos Metropolitan Borders"

[2] K.D.H Sarawaty, "Psychological Well-Being: The Impact of Work-Life Balance and Work Pressure" Published by Atlantis Press SARL, 2020

INSTITUTE OF TECHNOLOGY OF CAMBODIA

FACULTY: ELECTRICITY

DEPARTMENT: ELECTRICAL AND ENERGY

ENGINEERING DEGREE: ELECTRONICS AND AUTOMATION - EA

DETAILED COURSE SYLLABUS

STUDENT PROJECT PART 2

Subject: Student Project Part 2, Year: 5 Semester: 1 Credit: 1

Lecturer: Dr. AM Sok Chea, PhD. from UGA, France
Tel.: 096 34 55 449 E-mail: Sokchea_am@itc.edu.kh

1. Course Description

This subject is to provide the students the continuation on real research project or projects from partner industries linked from Student Project Part 1.

2. Course Learning Outcomes - CLOs

Description of course learning outcomes - CLOs		Matching PLOs
CLO1	Able to do real research projects or industries' projects	PLO1, PLO2, PLO3, PLO4, PLO5
CLO2	Able to do simulation for related project	PLO1, PLO2, PLO3, PLO4, PLO5, PLO10
CLO3	Able to increase soft-skill: report + presentation	PLO8, PLO9, PLO11

3. Teaching Methodology

In this lecture, we use active learning methodology where student is engaged in more activities than just listening.

- Participate actively in lectures
- Do modeling and make a simulation for each assignment
- Quality presentation
- Quality of report writing

4. Assessment Methodology

No.	Evaluation	% of score	Matching CLOs
1	Attendant	10	CLO1, CLO2, CLO3
2	Assignment (quality reports)	40	CLO1, CLO2, CLO3
3	Quality oral presentation	50	CLO3

Passing score:

- If overall average is over 50, subjects with score lower than 30 have to re-sit
- If overall average is under 50, subjects with score lower than 50 have to re-sit.

5. Detailed Contents

Weeks	N. of hours	CLOs	LLOs	Lecture	Teaching Methodology	Learning Methodology	Assessment	Material
1	2h	CLO1	- Ability to define small groups for specific research projects. - Ability to match students with partner industries.	Lec. 1: Continue working on project from Student Project Part 1	- Tutorial/lecture - Asking key question	- Group discussion - Asking key question	- Attendance	- PPT Present - Lecture Note
2-3	4h/4h	CLO1 CLO2 CLO3	- Ability to present research results. - Ability to prototype the findings	Lec. 2: Continue working on project from Student Project Part 1 (Cont. 1)	- Tutorial/lecture - Demonstrate on how to prototype	- Taking note	- Attendance - Presentation	- PPT Present - Lecture Note
4-5	4h	CLO1 CLO2 CLO3	- Ability to present research results. - Ability to prototype the findings	Lec. 3: Continue working on project from Student Project Part 1 (Cont. 1)	- Tutorial/lecture Demonstrate on how to prototype	- Taking note -	- Attendance - Presentation	- PPT Present - Lecture Note -
6-7	4h	CLO1 CLO2 CLO3	- Ability to present research results. - Ability to prototype the findings	Lec. 4: Continue working on project from Student Project Part 1 (Cont. 1)	- Tutorial/lecture - Demonstrate on how to prototype	- Taking note	- Attendance - Presentation	- PPT Present - Lecture Note
9-10	4h	CLO1 CLO2 CLO3	- Ability to present research results. - Ability to prototype the findings	Lec. 5: Continue working on project from Student Project Part 1 (Cont. 1)	- Tutorial/lecture - Demonstrate on how to prototype	- Taking note -	- Attendance - Presentation	- PPT Present - Lecture Note -
11-12	4h	CLO1 CLO2 CLO3	- Ability to present research results. - Ability to prototype the findings	Lec. 6: Continue working on project from Student Project Part 1 (Cont. 1)	- Tutorial/lecture - Demonstrate on how to prototype	- Taking note -	- Attendance - Presentation	- PPT Present - Lecture Note
13-16	8h	CLO1 CLO2 CLO3	- Ability to present research results. - Ability to prototype the findings	Lec. 7: Continue working on project from Student Project Part 1 (Cont. 1)	- Tutorial/lecture - Demonstrate on how to prototype	- Taking note -	- Attendance - Presentation	- PPT Present - Lecture Note -

6. References

[1] ITC, IG Tech Grou “MoU of Coorporation” 2022