School of Electrical, Electronics and Computer Engineering		Course Code and Title CPE160P Embedded System and Design	
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]VISION

The university shall move up and entrench itself in the ranks of the world's best universities. It shall make significant contributions to sustainable socio-economic development nationally and internationally.

MISSION

1. The University shall provide a learning environment in order for its students to acquire the attributes that will make them globally competitive.
2. The University shall engage in publishable and/or economically viable research, development and innovation.
3. The University shall provide state-of-the-art solutions to problems of industries and communities

PROGRAM EDUCATIONAL OBJECTIVES		MISSION		
Within five years after graduation, graduates of the Computer Engineering program should have:		1	2	3
1.	Undertaken, singly or in teams, projects that show ability to solve complex engineering problems.	✓	✓	✓
2.	Had substantial involvement in projects that take into consideration safety, health, environmental concerns and the public welfare, partly through adherence to required codes and laws.	✓	✓	✓
3.	Demonstrated professional success via promotions and/or positions of increasing responsibility.	✓		
4.	Demonstrated life-long learning via progress toward completion of an advanced degree, professional development/continuing education courses, or industrial training courses.	✓	✓	✓
5.	Demonstrated technical expertise, professionalism, and ethics in ICT, computer hardware and software systems development, entrepreneurship or other related fields in the practice of computer engineering for the advancement of industry and society.	✓		✓

ABET Student Outcomes		Program Educational Objectives				
		1	2	3	4	5
1	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	✓			✓	✓
2	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	✓	✓		✓	✓
3	An ability to communicate effectively with a range of audiences	✓	✓			✓
4	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts		✓	✓	✓	✓
5	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	✓	✓	✓	✓	✓
6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	✓	✓		✓	✓
7	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	✓	✓	✓	✓	✓

PTC and CHED Student Outcomes		Program Educational Objectives				
		1	2	3	4	5
A	An ability to apply knowledge of mathematics and science to solve complex engineering problems	✓			✓	✓
B	An ability to design and conduct experiments, as well as to analyze and interpret from data	✓	✓		✓	✓
C	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability, in accordance with standards;	✓	✓		✓	✓
D	An ability to function on multidisciplinary teams	✓	✓	✓	✓	
E	An ability to identify, formulate, and solve complex engineering problems	✓			✓	✓
F	An understanding of professional and ethical responsibility		✓	✓	✓	✓
G	An ability to communicate effectively	✓	✓			✓
H	The broad education necessary to understand the impact of engineering solutions in the global and societal context		✓		✓	✓
I	A recognition of the need for, and an ability to engage in life-long learning				✓	✓

J	A knowledge of contemporary issues	✓	✓		✓	✓
K	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	✓		✓		✓
L	Knowledge and understanding of engineering and management principles as a member and leader in a team, to manage projects in multidisciplinary environments	✓				
M	Understand at least one specialized field of Computer Engineering practice		✓		✓	✓

COURSE SYLLABUS

1. **Course Code: CPE160P**

2. **Course Title: Embedded System and Design**

3. **Pre-requisite: CPE109/CPE109L**

4. **Co-requisite: CPE108L**

5. **Credit: 3 units / 7.5 hours per week**

6. **Course Description:** This course is designed to introduce to the students a unified view of software and hardware in designing embedded systems. The discussions include topics on microcontrollers, memory subsystems and the architecture of embedded systems. The course will also include programming of microcontroller.

7. **Course Outcomes (COs) and Relationship to Program Educational Objectives**

Course Outcomes After completing the course, the student must be able to:	**Student Outcomes* ABET**							**Student Outcomes* PTC and CHED**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**
Module 1																				
1. Apply, analyze, and demonstrate implementation of control to the input/output peripherals.	I				I	I	I	I								I			I	I
Module 2																				
2. Apply, analyze and demonstrate simple application of embedded system using sensors and transducers.	I				I	I	I	I								I			I	I
Module 3																				
3. Design an embedded system application	I				I	I	I	I								I			I	I

- **Level: I – Introduced; R – Reinforced; D – Demonstrate**

8. Outcome-Based Modular Course Design

Course Title	Credit Units	Module Code	Module Title	Lec Hrs.	Lab Hrs.	Weeks	Credit Units	Pre-requisites	May be taken if remedial
Embedded System and Design	3	CPE160PM1	Digital Input and Output Interface	12	18	4	1	CPE109/ CPE109L	Yes
		CPE160PM2	Analog to Digital Converter	12	18	4	1	CPE160PM1	Yes
		CPE160PM3	Design of Embedded System	9	13.5	3	1	CPE160PM2	Yes

9. Course Coverage

Week	Topic	Session	TLA			AT			Learning Objects	CO
			F2F (onsite)	Synchronous Online	Asynchronous Online	F2F (onsite)	Synchronous Online	Asynchronous Online		
Module 1: Fundamentals of Real-Time Systems										
1	Orientation Brief discussion and familiarization with Real-Time Embedded System	1			Lecture/ Discussion/ Laboratory Experiment			EXP1	Syllabus, Course Policy, Schedule, Lecture Notes/PDF/PPT, Laboratory Manual	**CO1**
		2			Lecture/ Discussion			Reading Assignment CW1	MVL, Lecture Notes/PDF/PPT	
2	Introduction to Real-Time Systems	3	Lecture/ Discussion Laboratory Experiment			EXP2			Lecture Notes/PDF/PPT, Laboratory Manual	**CO1**
		4		Lecture/ Discussion			CW2		MVL, Lecture Notes/PDF/PPT	

Week	Topic	Session	TLA			AT			Learning Objects	CO
			F2F (onsite)	Synchronous Online	Asynchronous Online	F2F (onsite)	Synchronous Online	Asynchronous Online		
3	Hardware for Real-time systems	5	Lecture/ Discussion/ Laboratory Experiment			EXP3			Lecture Notes/PDF/PPT, Laboratory Manual	CO1
		6		Lecture/ Discussion			Quiz 1		MVL, Lecture Notes/PDF/PPT	
4	Real-time operating systems	7	Lecture/ Discussion/ Laboratory Experiment			EXP4 ME1			Lecture Notes/PDF/PPT, Laboratory Manual	CO1
		8			Lecture/ Discussion				MVL, Lecture Notes/PDF/PPT	
Module 2: Requirement Engineering										
5	Requirement Engineering for Real-Time Systems	9	Lecture/ Discussion/ Laboratory Experiment			EXP5			Lecture Notes/PDF/PPT, Laboratory Manual	CO2
		10			Lecture/ Discussion			Reading Assignment CW3	MVL, Lecture Notes/PDF/PPT	

Week	Topic	Session	TLA			AT			Learning Objects	CO
			F2F (onsite)	Synchronous Online	Asynchronous Online	F2F (onsite)	Synchronous Online	Asynchronous Online		
6	Formal and Semiformal Methods in System Specification	11	Lecture/ Discussion Laboratory Experiment			EXP6			Lecture Notes/PDF/PPT, Laboratory Manual	CO2
		12		Lecture/ Discussion			Reading Assignment CW4		MVL, Lecture Notes/PDF/PPT	
7	Performance Analysis Techniques Real-Time Performance Analysis	13	Lecture/ Discussion/ Laboratory Experiment			EXP7			Lecture Notes/PDF/PPT, Laboratory Manual	CO2
		14		Lecture/ Discussion			Quiz 2		Lecture Notes/PDF/PPT	
8	Application of Queuing TheoryI/O Performance Analysis of memory requirements	15			Forum/Discussion Board			Project Proposal	MVL, Lecture Notes/PDF/PPT, Laboratory Manual	CO2
		16	Lecture/ Discussion			ME2			Lecture Notes/PDF/PPT	

Week	Topic	Session	TLA			AT			Learning Objects	CO
			F2F	Synchronous Online	Asynchronous Online	F2F	Synchronous Online	Asynchronous Online		
Module 3: Future Vision for the Real-Time Systems										
9	Design for fault tolerance	16		Lecture/Discussion			PR1 (written)		MVL, Lecture Notes/PDF/PPT, Laboratory Manual	**CO3**
		17			Lecture/Discussion Board			PR1 (video demonstration) CW5	MVL, Lecture Notes/PDF/PPT, Laboratory Manual	
10	Software Testing and System Integration	18			Lecture/Discussion			PR2 (written)	MVL, Lecture Notes/PDF/PPT, Laboratory Manual	**CO3**
		19		Lecture/Discussion			PR2 (video demonstration) Quiz 3		MVL, Lecture Notes/PDF/PPT, Laboratory Manual	
11	Performance optimization techniques	20	Defense			Project OE			MVL, Lecture Notes/PDF/PPT, Laboratory Manual	**CO3**
		21	Lecture/ Discussion			ME3			Lecture Notes/PDF/PPT	

10. Lifelong-Learning Opportunities

It will allow students to adapt to the advancement in the basic application and design of the embedded system.

11. Contribution of Course to Meeting the Professional Component

Engineering Topics – 100%

12. Prescribed E-Book and Courseware

Embedded Microcomputer Systems: Real Time Interfacing

13. Other References and Educational Resources

METIS (Mapua E-Text Infinity Solution)

Enoch O. Hwang, Digital Logic and Microprocessor Design with Interfacing, 2nd Edition, CENGAGE Learning US, 2018. ISBN: 978-1-305-85945-6

14. Course Evaluation

Student performance will be rated based on the following:

Module 1

Assessment Tasks		Weight	Minimum Average for Satisfactory Performance
CO 1	Course Work 1	7.00	4.90
	Course Work 2	10.00	7.00
	Quiz 1	15.00	10.50
	Module Exam 1	20.00	14.00
	Experiment 1	12.00	8.40
	Experiment 2	12.00	8.40
	Experiment 3	12.00	8.40
	Experiment 4	12.00	8.40
Total		100%	70%

Module 2:

Assessment Tasks		Weight	Minimum Average for Satisfactory Performance
CO 2	Course Work 3	7.00	4.90
	Course Work 4	7.00	4.90
	Quiz 2	15.00	10.50
	Module Exam 2	25.00	17.50
	Experiment 5	12.00	8.40
	Experiment 6	12.00	8.40
	Experiment 7	12.00	8.40
	Project Proposal	10.00	7.00
Total		100%	70%

Module 3:

Assessment Tasks		Weight	Minimum Average for Satisfactory Performance
CO 3	Course Work 5	5.00	3.50
	Quiz 3	10.00	7.00
	Module Exam 3	20.00	14.00
	Progress Report 1	10.00	7.00
	Progress Report 1	10.00	7.00
	Project	30.00	21.00
	Oral Examination	15.00	10.50
	Total	100%	70%

The module grades will correspond to the weighted average scores shown below

Average	Module Grade	Average	Module Grade
0.00 – 34.99	5.00	82.00 - 84.99	2.00
35.00 – 69.99	IP	85.00 - 87.99	1.75
70.00 - 72.99	3.00	88.00 - 91.99	1.50
73.00 - 75.99	2.75	92.00 - 95.99	1.25
76.00 - 78.99	2.50	96.00 - 100.00	1.00
79.00 - 81.99	2.25	For approved medical reasons only	I

The module grade average will be the weighted average of the module grades based on the credit units of each module:

$$\text{Module Grade Average} = \frac{\sum_{i=1}^{\text{no of modules}} \left(\text{credit unit}\right)_i \left(\text{module grade}\right)_i}{\text{total credit units of the course}}$$

The course grade will be determined from the module grade average using the table below:

Module Grade Average (MGA)	Course Grade
1.0 ≤ MGA ≤ 1.10	1.0
1.10 < MGA ≤ 1.40	1.25
1.40 < MGA ≤ 1.60	1.5
1.60 < MGA ≤ 1.85	1.75
1.85 < MGA ≤ 2.10	2.0
2.10 < MGA ≤ 2.40	2.25
2.40 < MGA ≤ 2.60	2.5
2.60 < MGA ≤ 2.85	2.75
2.85 < MGA ≤ 3.0	3.0
IP	IP
5.00	5.00

15. Other Course Policies

a. Attendance
According to CHED policy, total number of absences by the students should not be more than 20% of the total number of meetings or 9 hrs for a three-unit-course. Students incurring more than 9 hours of unexcused absences automatically gets a failing grade regardless of class standing

b. Guided Learning Output
Guided learning outputs through various worksheets in each clusters of topics are assigned to the students. Problems encountered in the worksheets will be discussed in class.

c. Written Examination
Exams will be given face to face for Tri-X, Bio-X and Blended modes and online for UOX.

d. Course Portfolio
Selected guided learning outputs and examinations are to be compiled and collected before the end of the term. The selection is based on statistical data gathering (lowest, median, highest). Guided learning outputs and examinations with marks lowest, median, and highest must be photocopied and must be given back to the instructor for course portfolio keeping.

e. Language of Instruction
Lectures, discussion, and documentation will be in English. Written and spoken work may receive a lower mark if it is, in the opinion of the instructor, deficient in English.

f. Dress and Grooming Codes
All of us have been instructed on the Dress and Grooming Codes of the University.

g. Academic Integrity Policy
It is the student's responsibility to refrain from infractions of academic integrity, from conduct that may lead to suspicion of such infractions, and from conduct that aids others in such infractions. Any of the following sanctions may be imposed to any student who is found guilty of committing online academic dishonesty:

a. Failed mark in the course.
b. Suspension for a period of less than one term, with or without community service.
c. Suspension for a period of one term or more, with or without community service.
d. Non-readmission to the University.
e. Dismissal from the University.
f. Expulsion.

The following are considered academic dishonesty:

1. Using another MyMapua email address to login to any platform (such as BlackBoard and Coursera) with or without permission.
2. Asking or hiring someone else to do their exams, homework, Coursera course, papers, projects or other academic requirements.
3. Recording and saving copies of exam questions or answers, or answer keys for distribution.
4. Receiving copies of exam questions or answers, or answer keys to an exam from someone who has already taken it.
5. Plagiarizing or the unethical act of stealing the thoughts of another without proper citation or reference, acquiring information from the Internet without acknowledging the author, copying from another student's work without permission and submitting it as own work.

6. Massive, pre-meditated, organized online cheating using instant messaging/email during a quiz or exam.
7. Any form of dishonesty in peer-reviewed assignments/submissions (e.g. Coursera peer-graded submissions).
8. Engaging in any activities that will dishonestly improve results, or dishonestly improve or damage the results of others.
9. Any other form of dishonesty or cheating in any assessment or course requirement.

All students who will violate the Academic Integrity Policy of the university will be given zero mark for the exam or for the activity and will be given a failing grade for the course. He or she will also be referred to the Prefect of Discipline for appropriate sanction.

h. Consultation Schedule
Consultation schedules with the Professor are posted outside the EECE Faculty room and in the School web-page (http://eece.mapua.edu.ph). It is recommended that the student first set an appointment to confirm the instructor's availability.

i. Appeal system
All appeals on student assessment must be made by the concerned student within one week after the return of the assessed student work.

In case the student is not satisfied, no later than one week after the decision of the faculty has been made, he can elevate the appeal to the program chair or dean in case there is no program chair. The decision of the program chair or dean is final. The faculty must abide with the moderated decision of the program chair or dean.

j. Use of generative AI
It is expected that students will adhere to generally accepted standards of academic honesty, including but not limited to refraining from cheating, plagiarizing, misrepresenting one's work, and/or inappropriately collaborating. This includes the use of generative AI tools that have not been cited or documented or authorized. Students will also be expected to adhere to the prescribed professional and ethical standards of the profession/discipline for which the student is preparing. Any student who engages in academic dishonesty or who violates the professional and ethical standards for the profession/discipline for which the students.

16. Course Materials to be Provided to Students

16.1 Syllabus
16.2 Detailed Schedule

17. Committee Members

Carlos Hortinela IV
Cyrel Manlises
Rafael Maramba
Rosemarie Pellegrino
Isagani Villamor
Jocelyn Villaverde