NATIONAL UNIVERSITY HO CHI MINH CITY

UNIVERSITY OF INFORMATION TECHNOLOGY

COURSE OUTLINE

CE224 – EMBEDDED SYSTEM DESIGN

1. GENERAL INFORMATION

Subject Name (Vietnamese):	Thiết Kế Hệ Thống Nhúng
Subject Name (English):	Embedded System Design
Course code:	CE224
Belong to the knowledge block:	General course ☐; Basic IT course ☐; Junior CE core course ☑; Senior CE core course ☐; Graduating course ☐
Faculty, Department in charge:	Computer Engineering Faculty Department of Embedded Systems and Robots
Lecturer:	Tran Ngoc Duc Email: ductn@uit.edu.vn
Number of credit:	4
Theory:	3
Practice:	1
Self learning:	0
Prerequisite:	
Previous course:	Microprocessor and Microcontroller

2. COURSE DESCRIPTION

(State Positions of subjects in the curriculum, purpose and main content of the subject; about 3 to 5 lines)

Introduce concepts, principles of system design from simple to complex. The study consists of 3 main knowledge blocks presented as system modeling, design and analysis. Three blocks this end is mixed into 12 main chapters relative n Dissociations g. The end of the theory part of each knowledge block will be lab exercises to have a more realistic view of the concepts and algorithms introduced.

3. COURSE GOALS

After completing this course, students can:

Table 1.

Symbol	**Course objectives** *[1]*	**Output standard in curriculum** *[2]*

G1	Having skills in analyzing problems and solving problems	*3*
G2	Have skills to learn and research to solve scientific problems	*4.1*
G3	Having skills of system thinking and learning ability to develop in the Computer Engineering industry	*5*
G4	Having professional ethics	*6*
G5	Equipped with the ability to read professional documents in foreign languages	*9.2*

4. COURSE LEARNING OUTCOMES

(Course learning outcome (CLO) corresponds to the course objectives in Section 3. The CLO are coded G1 to Gn. There should be no more than 10 CLO.)

Table 2.

CĐRMH *[1]*	**Mô tả CĐRMH (Mục tiêu cụ thể)** *[2]*	**Mức độ giảng dạy***[3]*
G1 (3.1.1)	Understand and analyze common problems from simple to complex.	*ITU*
G2 (3.2.1)	Applicable to solving common problems from simple to complex	*ITU*
G3 (4.1.1)	Applying skills to learn and research to solve scientific problems	*ITU*
G4 (5.2)	Applying learning to stream life in the Computer Engineering industry	*IT*
G5 (6.1.1)	Understanding and applying the requirements of professional ethics	*ITU*
G6 (9.2)	Applying reading comprehension of professional documents in foreign languages	*ITU*

5. COURSE CONTENT, LESSON PLAN

(List the content of teaching theory and practice, showing the correlation with CLO)

a. Theory

Table 3.

Lesson	**Content** *[2]*	**CLO***[3]*	**Teaching and learning activities** *[4]*	**Evaluation**

(2.25 hour each) *[1]*				**component** *[5]*
Less on 1	**Chapter 1. Introduction to embedded computing system concept** 1.1 Overview Embedded System Computing 1.2 Introduction to the Cyber Physical system concept 1.3 Overview of applying embedded systems for cyber physical systems	*G1, G2, G3, G5*	Teachers: Popularize class rules, introduce subject syllabus, provide learning materials for students. Teaching about the introduction of Design of Embedded System Student in class: Listening to lectures by faculty members and questioned to lecturer, discussed issues of Design of Embedded System. Answer the questions at the end of the class. Students study at home: Review the lesson and answer the questions discussed at the end of the week 1 slide in the notebook.	*A1, A2*
Less on 2	**Chapter 2. Design based on model** 2.1 The predetermined model 2.2 The relevance of the predetermined model with the design of today's cyber physic systems 2.3 Continuous dynamics model	*G1, G2, G3, G6*	Students prepare at home: Read the slide of week 2 provided by teachers Lecturer: Review knowledge of chapter 1, reiterate the embedded system knowledge chain. Teaching about embedded system design by building the model. Students in class: Listen to lectures by lecturers, compare them with previous knowledge and ask questions if needed, discuss issues of embedded system models. Answer the last questions of study Students learn at home: Review lesson and answer the discussion questions at the end of the slide of week 2 into the notebook.	*A1, A2*
Less on 3	**Chapter 3. Discrete dynamics model** 3.1 Basic concepts 3.2 Sample models 3.3 Languages and frameworks to design models 3.4 Some examples of design models Fig	*G1, G2, G3, G6*	Students prepare at home: Read the slide of week 3 provided by teachers Lecturer: Review the chapter 2, recall about the embedded system knowledge chain. Lecture about the contents of discrete system model Students in class: Listen to lectures, compare them with previous knowledge and ask questions if needed, discuss issues about Discrete model. Answer questions at the end of the class Students study at home: Check out the lesson and answer the discussed questions at the bottom of the slide week 3 in the notebook.	*A1, A2*
Less on 4	**Chapter 4. Extended state machine model**	*G1, G2, G3, G6*	Students prepare at home: Read the slide of week 4 provided by teachers .	*A1, A2*

	4.1 Machine model expanded state 4.1.1 Model over time 4.1.2 mixed model 4.2 Examples		Lecturer: Review knowledge of chapter 3, reiterate the embedded system knowledge chain. Lecture on the content of state machine models over time and mixed models. Students in class: Listen to lectures by lecturers, compare them with previous knowledge and ask questions if needed, discuss issues about status machine models and related knowledge. Reply to questions and do the end of the lesson Student study at home: Review lesson and answered the discussed questions and do the exercise at the end of the week 4 slide in the notebook.	
Lesson 5	**Chapter 5. The synthesis of state machine models** 5.1 Sequential state machine model 5.2 Simultaneous state machine model 5.2.1 The synthesis of asynchronous states 5.2.2 The synthesis of synchronization states 5.3 Split state machines in programming 5.4 Examples	*G1, G2, G3, G6*	Students prepare at home: Read the slide of week 5 provided by the teacher. Refer to the knowledge about models of extended state-of-the-art machine design and mixed models. Lecturer: Review knowledge of state machine model over time and mixed model in the previous lesson, check students' assignments, Recall the embedded system knowledge chain. Teaching on the content required to synthesize the asynchronous state and synchronous state, students do exercises on the division of the state into the C programming. Students in class: Listen to the lecture, compare it with the previous knowledge and ask the questions if needed, discuss issues of asynchronous and synchronous state machines. Answer the questions and do the end of the lesson Students study at home: Review the lesson, answer discussion questions and do homework at the end of the slide week 5 in the notebook.	*A1, A2*
Lesson 6	**Chapter 6. Sensors and actuators** 6.1 Introduce the principle of several types of sensors: accelerometer, shaft sensor 6.2 Calibration principle of sensor 6.3 Errors occur when working with sensors and the way to deal with 6.4 Example	*G1, G2, G3, G6*	Students prepare at home: Read the slide of week 6 provided by the teacher. Refer to the knowledge of sensors, actuators and solutions to solve problems when using sensors. Lecturer: Review knowledge of synchronous and asynchronous state machines, examine student assignments, and recall about embedded system knowledge. Teaching on problems using sensors, ways to calibrate and solving errors when using it. Students in class: Listen to lectures by lecturers, compare with previously read	*A1, A2*

			knowledge and ask teachers questions, discuss sensor issues and related knowledge. Answer the questions and do the end-of-class exercises Students study at home: Review the lesson, answer the questions discussed at the end of the week 6 slide in the notebook.	
Less on 7	**Chapter 7. Memory architecture in embedded systems** 7.1 Types of memory 7.2 Memory map 7.3 Organize memory: stack, static french level, heaps 7.4 Memory usage model in C 7.5 Memory hierarchy: cached, virtual memory 7.6 Example	*G1, G2, G3, G6*	Students prepare at home: Read the slide week 7 provided by the teacher. Refer to the knowledge about busy waiting solutions. Lecturer: Review the knowledge of sensors, recall the embedded system knowledge chain. Teaching on the organization of memory in embedded systems, instructing students to do exercises on using C programming language in memory distribution. Students in class: Listen to lecture, compare with previously knowledge and ask questions if needed, discuss memory organization issues and related knowledge. Answer the questions and do the end-of-class exercises Students study at home: Review the lesson, answer the discussion questions and do the exercises at the end of the week 7 slide in the notebook.	*A1, A2*
Less on 8	Mid-term semester review	*G1, G2, G3, G4, G5*	Students prepare at home: Read slide of week 8 provided by teachers, review all chapters 1, 2, 3, 4, 5, 6, 7 and lectures slides from week 1 to week 7 and review all the previous exercise. Teachers: Give students a 30-minute test to test students' knowledge. Review the knowledge of chapters 1, 2, 3, 4 and remind the exercises that have done, paying special attention to the exercises and knowledge that students have not mastered in the test. Answer students' questions Students studying in class: Take tests, monitor and listen to lecturers, record review contents and necessary exercises Students studying at home: Review knowledge and exercises.	*A1, A2*

Less on 9	**Chapter 8. Input/Output system on embedded system** 9.1 In/Out principles (digital or analog, wired or wireless, serial or parallel) 9.2 Serial input/output 9.3 Parallel input/output 9.4 UART Transmission 9.5 Handling input with Polling and Interrupt 9.6 Example	*G1, G2, G3, G5, G6*	Students prepare at home: Reading slide of week 9 provided by teachers. Refer to the knowledge of the principles of input and output on embedded systems. Lecturer: Review knowledge of memory organization, reiterate the embedded system knowledge chain. Lecture on input/output principles, guide students to do exercises on dispute resolution. Students in class: Listen to the lecture, compare it with the previous knowledge and ask the teacher questions, discuss serial and parallel input/output issues, handle polling and interrupt and related knowledge. Answer the questions and do the end-of-class exercises Students study at home: Review the lesson, answer the discussion questions and do the exercises at the end of the week 9 slide in the notebook.	*A1, A4*
Less on 10	**Chapter 9. Multitasking** 10.1 Simultaneous programming principle 10.2 POSIX application in concurrent programming 10.3 Program C patterns apply concurrent programming 10.4 Example	*G1, G2, G3, G6*	Students prepare at home: Read the slide of week 10 provided by the teacher. Consult more about multitasking knowledge. Lecturer: Review knowledge of input/output systems, reiterate the embedded system knowledge chain. Lecture on multitasking issues, programming applications with POSIX, guide students to do exercises on using C to program simultaneously. Students in class: Listen to lecturers, compare them with previous knowledge and ask teachers questions, discuss deadlock issues and related knowledge. Answer the questions and do the end-of-class exercises Students study at home: Review the lesson, answer the discussion questions and do the exercises at the end of the week 10 slide in the notebook.	*A1, A4*
Less on 11	**Chapter 10. Embedded operating system** 10.1 Basic concepts and functions of embedded operating systems 10.2 RMS timing algorithm 10.3 EDF timing algorithm	*G1, G2, G3, G6*	Students prepare at home: Read the slide of week 11 provided by the teacher. Refer to the embedded operating system knowledge. Lecturer: Review knowledge of multitasking and programming related issues simultaneously, recalling the embedded system knowledge chain. Lecture on the functional principles of	*A1, A4*

			embedded operating systems, guide students to do exercises on RMS and EDF timing algorithms. Students in class: Listen to lecturers, compare with previously knowledge and ask teachers questions, discuss operating system issues and related knowledge. Answer the questions and do the end-of-class exercises Students study at home: Review the lesson, answer the discussion questions and do the exercises at the end of the week 11 slide into the notebook.	
Less on 12	**Chapter 10. Embedded operating system (continued)** 10.4 Compare RMS and EDF 10.5 LDF algorithm 10.6 Example	*G1, G2, G3, G6*	Students prepare at home: Read the slide of week 12 set provided by the teacher. Refer to the knowledge about the operating system. Lecturer: Review knowledge of RMS and EDF in the operating system and some deadlock solutions, reiterating the embedded system knowledge chain. Lecture on LDF algorithm in the operating system, instructing students to do the operating system exercises. Classroom students: Listen to lectures, compare with previously knowledge and ask teachers questions, discuss LDF issues and related knowledge. Answer the questions and do the end-of-class exercises Students study at home: Review the lesson, answer the discussion questions and do the exercises at the end of the week 12 slide in the notebook.	*A1, A4*
Less on 13	**Chapter 11. Timing of unusual cases** 11.1 Simultaneous and mutual exclusion programming 11.2 Priority and inheritance 11.3 Deadlock 11.4 Example	*G1, G2, G3, G6*	Students prepare at home: Read the slide of week 13 provided by the teacher. Refer to knowledge about unusual timing cases in embedded systems. Lecturer: Review knowledge of embedded operating systems, reiterate the embedded system knowledge chain. Lecture on unusual cases in operating system timing, instructing students to do programming exercises on handling unusual cases. Students in class: Listen to the lecture, compare it with the previous knowledge and ask the teacher questions, discuss unusual handling issues and related knowledge. Answer the questions and do the end-of-class exercises.	*A1, A4*

			Students study at home: Review the lesson, answer the discussion questions and do the exercise at the end of the week 13 slide in the notebook.	
Lesson 14	**Chapter 12. Analyzing and checking system efficiency** 12.1 Quantify system performance parameters (worst execution time, program operating thresholds ...) 12.2 Examples of quantitative system analysis	*G1, G2, G3, G6*	Students prepare at home: Read the weekly slide set provided by the teacher. Refer to knowledge about analyzing and checking system efficiency. Lecturer: Review knowledge of abnormal processing in embedded operating system timing, reiterate the embedded system knowledge chain. Teaching on analyzing and checking system efficiency, instructing students to do system analysis and test exercises. Students in class: Listen to lecture, compare with previously knowledge and ask teachers questions, discuss issues of test analysis and related knowledge. Answer the questions and do the end-of-class exercises Students study at home: Review the lesson, answer the discussion questions and do the exercises at the end of the week week 14 in the notebook.	*A1, A4*
Lesson 15	Final semester review	*G1, G2, G3, G4, G5*	Students prepare in advance: Read slide of week 15 provided by the teacher, review all chapters 7, 8, 9, 10, 11, 12 and lecture slides from week 9 to week 14 and review the Previous exercise. Teachers: Give students a 30-minute test to test students' knowledge. Review the knowledge of chapters 7, 8, 9, 10, 11, 12 and repeat the exercises done, paying special attention to the exercises and knowledge that students have not mastered in the test. Answer students' questions Students studying in class: Take tests, monitor and listen to lecturers, record review contents and necessary exercises Students studying at home: Review the knowledge and exercises (in the review exercise file, and the exercises in the slide week 15)	*A1, A4*

b. Practice

Table 4.

Lesson (3.75 hours	**Content** *[2]*	**CLO***[3]*	**Teaching and learning activities** *[4]*	**Evaluation**

each) *[1]*				**component** *[5]*
Lesson 1	*Exercise 1: Instructions for installing LabView and Eclipse software and running the sample*	*G1, G2, G3, G6*	Students prepare at home: Read lesson # 1 in the embedded system practice guide and prepare software to practice as instructed Teachers: Disseminate practice rules, guide students step by step to install the program and instruct students how to perform basic commands in practice, guide how to write reports and submit practice reports Students in class: Install the program, follow the instructions of the instructor, perform practical exercises, write and submit the practice report according to regulations. Students studying at home: Do additional exercises and submit assignments as prescribed	*A3*
Lesson 2	*Exercise 2: Model design on Labview*	*G1, G2, G3, G6*	Students prepare at home: Read lesson # 2 in the embedded system practice guide and learn about using Labview to design embedded system models Lecturer: Teach students how to design models in labview, set parameters, test and collect feedback from the system. Students in class: Listen and follow the instructor's steps, perform practical exercises on system design on Labview, write and submit practice reports according to regulations. Students studying at home: Do additional exercises and submit assignments as prescribed	*A3*
Lesson 3	*Exercise 3: Reading signal and motor controlling programming*	*G1, G2, G3, G6*	Students prepare at home: Read lesson # 3 in the embedded system practice guide and learn thoroughly C programming in Eclipse to read and handle sensors and motors. Teachers: Guide students to write programs related to reading sensor and motor control. Students in class: Listen and follow the instructor's steps, perform practical exercises on reading sensor, write and submit practice reports according to regulations.	*A3*

			Students studying at home: Do additional exercises and submit assignments as prescribed	
Lesson 4	*Exercise 4: Applying Operating system into task synchronization*	*G1, G2, G3, G6*	Students prepare at home: Read lesson # 4 in the embedded system practice guide and learn more about operating systems and synchronize processing tasks Teachers: Recall operating system principles and instruct students to embed operating systems and control tasks. Students in class: Listen and follow the instructor's steps, perform practical exercises on the operating system, write and submit practice reports according to regulations. Students studying at home: Do additional exercises and submit assignments as prescribed	*A3*
Lesson 5	*Exercise 5: Complete assembly of hardware and software models*	*G1, G2, G3, G6*	Students prepare at home: Read lesson # 5 in the embedded system practice guide and learn the knowledge to unite the hardware and software components Teachers: Recall the knowledge of operating system applications in task synchronization. Orientation helps students incorporate accurate hardware and software models. Students in class: Listen and follow the instructor's steps, perform practical exercises on combining hardware and software models, write and submit practice reports according to regulations. Students studying at home: Do additional exercises and submit assignments as prescribed	*A3*
Lesson 6	*Exercise 6: Analyze and evaluate the effectiveness of the complete system*	*G1, G2, G3, G6*	Students prepare at home: Read lesson # 6 in the embedded system practice guide Teachers: Recall knowledge of system analysis and evaluation, orientation to help students fully implement system analysis and evaluation. Students in class: Listen and follow the instructor's steps, perform practical exercises on analyzing and evaluating, writing and submitting practice reports according to regulations.	*A3*

			Students studying at home: Do additional exercises and submit assignments as prescribed	

[1]: Thông tin về tuần/buổi học. [2]: Nội dung giảng dạy trong buổi học. [3]: Liệt kê các CĐRMH. [4]: Mô tả hoạt động dạy và học (ở lớp, ở nhà). [5]: Thành phần đánh giá liên quan đến nội dung buổi học, thành phần đánh giá phải nằm trong danh sách các thành phần đánh giá ở Bảng 5, Mục 6.

6. COURSE ASSESSMENT

Table 5.

Evaluation component *[1]*	**CLO** *[2]*	**Rate (%)** *[3]*
A1. Learning Process (Test on class, assignments)	*G1, G2, G3, G6*	*15%*
A2. Mid-term Semester	*G1, G2, G3, G4, G5, G6*	*15%*
A3. Practice	*G1, G2, G3, G6*	*20%*
A4. Final Semester Test	*G1, G2, G3, G4, G5, G6*	*50%*

[1]: Evaluation components of the subject. [2]: List the corresponding course learning outcome evaluated by the evaluation component. [3]: Scores of assessments on the total subject score.

Rubric of each component evaluated in Table 5

a. Rubric of A1 rating components

Examination in class	***Excellence (8-10đ)***	***Good (6-7đ)***	***Average(5đ)***	***Weak(3-4đ)***	***Bad(0-3đ)***
Ask for old lessons, new lessons and do class work (test self-studying ability of college students in G2)	*Volunteer to answer exercise 4 - 5 times*	*Volunteer to answer or board the exercise 3 times*	*Volunteer to answer or go to the board to do the exercise 2 times*	*Volunteer to answer or board the exercise 1 time*	*Volunteer to answer or board the exercise 0 times*
Attendance is completed	*Attend full attendance at 100% attendance sessions*	*Attend school 75 % attendance sessions*	*Attend 50% of attendance sessions*	*Attend 25% of attendance sessions*	*Not going to school*
15-minute test	***Excellence (8-10đ)***	***Good (6-7đ)***	***Average(5đ)***	***Weak(3-4đ)***	***Bad(0-3đ)***
Test No. 1 on synchronous and asynchronous embedded system design models (Check knowledge of Embedded System in CLO G1, G2, G6)	*Fully present and solve exercises on synchronous and asynchronous embedded system design models*	*Present properly and solve part of the exercises on synchronous and asynchronous embedded system design models*	*Correct presentation of synchronous and asynchronous embedded system design models*	*Present the principle of synchronous and asynchronous embedded system design models*	*Wrongly presented and failed to solve the exercises of synchronous and asynchronous embedded system design models*
Test No. 2 on embedded system design models over time or mixed (Check knowledge of operating system in CLO G1, G2, G6)	*Fully present and solve exercises on embedded system design models over time or mixed*	*Present properly and solve part of the exercises on embedded system design models over time or mixed*	*Correct presentation of embedded system design models over time or mixed*	*Present the principle of embedded system design models over time or mixed*	*Misrepresentation and failure to solve exercises for embedded system design models over time or mixed*

b. Rubric of A2 rating component

Quiz section	*Excellence (8-10đ)*	*Good (6-7đ)*	*Average(5đ)*	*Weak(3-4đ)*	*Bad(0-3đ)*
Embedded system design definitions, concepts and principles	*Correctly identify 80 to 100% of definitions, concepts and general knowledge related to embedded systems*	*Identify exactly 60 to 80% of the definitions, concepts and knowledge related to the embedded system*	*Correctly identify 50 to 60% of the definitions, concepts and knowledge related to the embedded system*	*Correctly identify 30 to 50% of the definitions, concepts and knowledge related to the embedded system*	*Correctly identify under 30% of definitions, concepts and knowledge related to the overview of embedded systems*
Models in embedded system design	*Correctly identify 80 to 100% of definitions, concepts and knowledge related to models in embedded system design*	*Identify exactly 60 to 80% of definitions, concepts and knowledge related to models in embedded system design*	*Identify exactly 50 to 60% of definitions, concepts and knowledge related to models in embedded system design*	*Identify exactly 30 to 50% of definitions, concepts and knowledge related to models in embedded system design*	*Identify below 30% of definitions, concepts and knowledge related to models in embedded system design*
Knowledge of using sensors, solving problems when using sensors	*Correctly identify 80 to 100% of definitions, concepts and knowledge related to the use of sensors, solve problems when using sensors*	*Identify exactly 60 to 80% of definitions, concepts and knowledge related to the use of sensors, solve problems when using sensors*	*Correctly identify 50 to 60% of definitions, concepts and knowledge related to the use of sensors, solve problems using sensors*	*Correctly identify 30 to 50% of definitions, concepts and knowledge related to the use of sensors, solve problems using sensors*	*Identify below 30% of definitions, concepts and knowledge related to the use of sensors, solve problems when using sensors*
Concepts, principles of memory usage in embedded systems	*Correctly identify 80 to 100% of definitions, concepts and knowledge related to memory usage in embedded systems*	*Correctly identify 60 to 80% of definitions, concepts and knowledge related to memory usage in embedded systems*	*Correctly identify 50 to 60% of definitions, concepts and knowledge related to memory usage in embedded systems*	*Correctly identify 30 to 50% of definitions, concepts and knowledge related to memory usage in embedded systems*	*Identify well below 30% of definitions, concepts and knowledge related to memory usage in embedded systems*
The essay section	***Excellence (8-10đ)***	***Good (6-7đ)***	***Average(5đ)***	***Weak(3-4đ)***	***Bad(0-3đ)***

The synchronous and asynchronous design model, time and mixed design model	*Present properly and fully the synchronous and asynchronous design model, time and mixed model and correctly draw state machine models*	*Present properly and fully the synchronous and asynchronous design model, time and mixed model*	*Correctly present the synchronous and asynchronous design model, time and mixed model*	*Presenting the model of synchronous and asynchronous, time and mixed design but having errors in drawing state machine models*	*Misrepresentation of synchronous and asynchronous design models, time and mixed*
Use C language in embedded system memory management	*Properly and fully present the use of C language in embedded system memory management and correct the problems with C*	*The correct and complete presentation of using C language in embedded system memory management*	*Correct presentation of the use of C language in embedded system memory management*	*Presenting the correct principle of using C language in embedded system memory management, but having errors in properly addressing problems with C*	*Wrong presentation of the use of C language in embedded system memory management*

c. Rubric of A3 evaluation components

Report the exercises	***Excellence (8-10đ)***	***Good (6-7đ)***	***Average(5đ)***	***Weak(3-4đ)***	***Bad(0-3đ)***
Report to install and use Labview and Eclipse .	*Fully complete orders and carry out a full range of all files carried h publication only*	*Complete all the commands and perform 4/7 practical exercises*	*Complete the orders and execute 2/7 practical exercises*	*Complete orders or perform 3/7 practical exercises*	*Do not complete the comm ands and do not complete the exercises*
Report de sign of programs in Labview	*Complete the examples and fully implement practical exercises*	*Complete the examples and implement 3/4 practical exercises*	*Complete the examples and perform 2/4 practical exercises*	*Complete the ex amples or perform 2/4 practical exercises*	*Do not complete the examples and do not complete the exercises*
Practical report on program ming sensor reading and motor controllin g	*Complete the examples and fully implement practical exercises*	*Complete all ex amples and perform 4/6 practical exercises*	*Complete the examples and perform 2/6 practical exercises*	*Complete the examples or perform 3/6 practical exercises*	*Do not complete the exam ples and do not complete the exercises*
Report applying operating system on multitask program ming	*Complete the examples and fully implement practical exercises*	*Complete the examples and implement 3/4 practical exercises*	*Complete the examples and perform 2/4 practical exercises*	*Complete full e nough examples or make 2/4 of practical exercises*	*Do not complete the examples and do not complete the exercises*

Report of a complete assembly exercise of hardware and software models	*Complete the examples and fully implement the practical exercises*	*Complete the examples and perform 4/6 practical exercises*	*Complete the examples and perform 2/6 practical exercises*	*Complete the examples or perform 3/6 practical exercises*	*No complete examples and not complete c evil b anyone practicin g*
Report on practice of system design analysis	*Complete the examples and fully implement practical exercises*	*Complete the examples and implement 3/4 practical exercises*	*Complete the examples and perform 2/4 practical ex ercises*	*Complete the examples or perform 2/4 practical exercises*	*Do not complete the examples and do not complete the exercises*

d. Rubric of A4 evaluation components

Quiz section	*Excellence (8-10đ)*	*Good (6-7đ)*	*Average(5đ)*	*Weak(3-4đ)*	*Bad(0-3đ)*
The definition, concepts, solutions of the input/output system in embedded systems	*Correctly identify 80 to 100% of the definitions, concepts, solutions of the input/output system in embedded systems*	*Identify exactly 60 to 80% of the definitions, concepts, solutions of the input/output system in embedded systems*	*Correctly identify 50 to 60% of the input/output system definition, concepts, solutions in embedded systems*	*Identify exactly 30 to 50% of the definitions, concepts, solutions of the input/output system in embedded systems*	*Correctly identify less than 30% of definitions, concepts, solutions of input/output systems in embedded systems*
Multitasking problems, usage principles, multitasking programming	*Correctly identify 80 to 100% of multitasking issues, usage principles, multitasking programming*	*Correctly identify 60 to 80% of multitasking issues, usage principles, multitasking programming*	*Correctly identify 50 to 60% of multitasking issues, usage principles, multitasking programming*	*Correctly identify 30 to 50% of multitasking issues, usage principles, multitasking programming*	*Correctly identify less than 30% of multitasking issues, usage principles, multitasking programming*
Concepts, principles, methods using embedded operating systems	*Correctly identify 80 to 100% of embedded operating system definitions, principles, and methods*	*Correctly identify 60 to 80% of embedded operating system definitions, principles, and methods*	*Correctly identify 50 to 60% of embedded operating system definitions, principles, and methods*	*Correctly identify 30 to 50% of embedded operating system definitions, principles, and methods*	*Correctly identify less than 30% of embedded operating system definitions, principles, and methods*
Defining virtual memory, analysis techniques to evaluate system efficiency	*Correctly identify 80 to 100% of virtual memory definitions, analysis techniques to evaluate system performance*	*Correctly identify 60 to 80% of virtual memory definitions, analysis techniques to evaluate system performance*	*Correctly identify 50 to 60% of virtual memory definitions, analysis techniques to evaluate system performance*	*Correctly identify 30 to 50% of virtual memory definitions, analysis techniques to evaluate system performance*	*Identify below 30% of virtual memory definitions, analysis techniques to evaluate system performance*
The essay section	***Excellence (8-10đ)***	***Good (6-7đ)***	***Average(5đ)***	***Weak(3-4đ)***	***Bad(0-3đ)***

Algorithm for multitask programming with POSIX and application into the operating system	*Proper and complete presentation of using POSIX multitasking programmin g and applications into the operating system*	*Present 60 to 70% of the correct use of POSIX multitasking programming and applications into the operating system*	*Present exactly 50 to 60% of using POSIX multitasking programming and applications into the operating system*	*Present exactly 30 to 50% of using POSIX multitasking programming and applications to the operating system*	*Presented below 30% correctly for using POSIX multitasking programmin g and applications into the operating system*
Quantitative and quantitative analysis of system efficiency	*Proper and complete presentation of algorithms to evaluate and evaluate the effectiveness of the system*	*Present 60 to 70% of the algorithms to evaluate and evaluate the effectiveness of the system*	*Present exactly 50 to 60% of algorithms to evaluate and evaluate the effectiveness of the system*	*Present exactly 40 to 50% of the algorithms to evaluate and evaluate the effectiveness of the system*	*Present properly below 30% of the algorithm of quantitative analysis and evaluation of the effectiveness of the system*

7. COURSE REQUIREMENTS AND EXPECTATIONS

(State other courses regulation, if any, example: students who do not submit assignments or report on will be consider as not submitting; Students who miss practice 2 session will not be allowed to take a final exam, ...)

- Attendance: according to school regulations.
- Theory class:
  - Students need to print lecture slides and read in advance at home before class.
  - In the class, student aren't allowed to make noise, or sleep-in class, attentive listening and full notes.
  - Proactively answer questions from teachers and volunteer on the worksheet, ask when having questions.
  - Review the lesson at home after each lesson, if student still don't understand what knowledge content you can send an email to ask or ask in the next lesson.
- Practical class:
  - Students must not miss more than 3 lesson in the total number of practice exercise. There will be 0 points for practice.
  - Students who miss any practical lesson without first obtaining permission for acceptable reason will receive a zero for that practice session.
  - Read the instruction manual before each practice session. Pay attention to the instructor for practice. Ask questions when you have questions.

- Focus on doing practice, not surfing the web, reading Facebook, playing games, chatting on the Internet ... However, you can discuss with each other in class about the exercise you are doing.
- When submitting the exercise, students should note that each copy of each copy will get a score of 0.

- Theoretical test: do not cheat, ask other students when taking the exam. If the supervisor finds out, the answer sheet will be marked and depending on the extent of the violation the score may be deducted or given a score of 0 for the test.

8. LEARNING MATERIAL, REFERENCE

(The number of textbooks does not exceed 3 documents, the number of reference documents does not exceed 10 documents, in the process of teaching, lecturers can provide additional reference material other than this category.)

Curriculum

1. Vu Duc Lung, Tran Ngoc Duc (2014). *Embedded System syllabus*. Place of publication: HO CHI MINH CITY NATIONAL UNIVERSITY.

References

1. Edward Lee, Sanjit Seshia , Gagne. Introduction to Embedded System A Cyber-Physical System Approach, 2nd edition, MIT Press, 2017
2. Jeff C. Jensen, Edward A. Lee, and Sanjit A. Seshia, An Introductory Lab print Embedded and Cyber-Physical Systems , http://LeeSeshia.org/lab, First Edition v1.70, 2015 .

9. SOFTWARE OR TOOLS SUPPORTING PRACTICE

1. Eclipse.
2. Labview

Tp.HCM, ngày 29 tháng 04 năm 2019

Head of department / subject	Lecturer
(Sign and write full name)	(Sign and write full name)