

PGT302 - Embedded Software Technology

This course is *Embedded Software Technology*, offered by the Department of Electronics Engineering Technology.

Announcements

[20201018] Welcome to PGT302 202021S1!

[20201018] Please try to setup development environment required for this course on your own personal laptops. Video guides for this course are [available on YouTube](#).

Lecture Slides

- Lecture Part 0 - [Course Introduction](#)
- Lecture Part 1 - [Introduction to the Embedded World](#)
- Lecture Part 2 - [Hardware Platform 1](#)
- Lecture Part 3 - [Bare-metal Programming](#)
- Lecture Part 4 - [Hardware Platform 2](#)

Lab Notes

- Lab Work 1 - [Tools and Platform](#)
- Lab Work 2 - [Bare-metal Programming](#)
- Lab Work 3 - [Peripherals and Interfacing](#)
- Lab Work 4 - [Using Embedded OS](#)

Downloads

- Datasheet: [Broadcom BCM2835](#)
- Datasheet: [NXP's P89V51](#)

Assignments

- Assignment 1:

[pgt302_202021s1_assign1.txt](#)

assigned in Google Classroom...

- Assignment 2:

[pgt302_202021s1_assign2.txt](#)

assigned in Google Classroom...

Lab Project

- Lab Project Description:

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Lab Project  
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Note: This is a group project!  
  
Develop an application that utilizes any of the available modules  
at the  
laboratory (e.g. GPS/GSM module, Bluetooth module,  
Temperature/Humidity Sensor,  
RF transceiver) AND one other module that you have to purchase on  
your own.  
  
The developed application must be presented as a commercial  
product. Overall  
evaluation will be based on two main components: technical  
evaluation and  
product evaluation.  
  
Technical Evaluation will be based on the number of module  
interfacing and its  
complexity. So, applications with more complex interfacing (e.g.  
protocols,  
external interface circuit) will be considered for extra marks.  
  
Product evaluation will be based on product brochure and a  
practical  
demonstration of the application. Having aesthetic features in  
your  
application/product will assist towards getting better grades.  
  
Requirement:  
  
- submission of a product brochure  
- demonstration of a working application (product)
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- individual AND group Q/A for technical competency

DUE: WK14/14 (Respective Lab Sessions)

- Lab Project (CAA Supplement 1):

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Lab Project  
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[CAA Supplement] Technical Report 1 (Group Report)  
  
- analyze future enhancement(s) that can be applied to your  
product  
- for each feature (can be more than one), specify  
  = advantage of having that feature  
  = additional component needed  
  = sketch interfacing required (more detail = more marks)  
  = additional costs involved  
  
Requirement:  
  
- submission of technical report (MAX 5 pages)  
- short presentation (15 minutes)  
  
DUE: WK14/14 (Respective Lab Sessions)
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- Lab Project (CAA Supplement 2):

[pgt302_202021s1_lab_project_tr2.txt](#)

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Lab Project  
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[CAA Supplement] Technical Report 2 (Individual Report)  
  
- analyze alternative options redesign your product  
- assuming you can use any components to implement THE SAME  
product  
- provide overall schematic with interface details  
- also, provide (for each component use)  
  = distinctive technical info  
  = reason(s) this component is selected  
- provide estimate cost for this product  
  
Requirement:
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- submission of technical report (MAX 10 pages)
- short Q&A (10 minutes)

DUE: WK14/14 (Respective Lab Sessions)

Course Synopsis

This course introduces contemporary software technology for embedded systems. Students will be exposed to the requirements of embedded systems that frequently impose time and/or memory constraints. Among the topics that will be discussed are embedded systems, platform hardware, cross-compilations, barebone systems, peripheral interfacing and embedded operating system. Knowledge in this subject is important for electronics engineers who are interested in system development and integration.

Course Outcome

1. Able to DESCRIBE the concept of embedded software.
2. Able to EVALUATE embedded software implementations.
3. Able to DEVELOP embedded software for specific applications.

Course Assessment

	Examinations		Course Work		
Total Contribution	60%		40%		
Assessment	Final Exam	Mid-Term	Assignments	Lab Assessments	Lab Project
Contribution	40%	20%	10%	20%	10%
CMCO-Revised Assessment (Session 2020/21 S1)					
	Examinations		Course Work		
Revised Contribution	0%		100%		
Assessment	Exam	Test	Assignments	Lab Assessments	Lab Project
Contribution	0%	20%	20%	30%	30%

Course Syllabus

Week	Lecture	Laboratory	Notes
Week 01	• Course Introduction (Lecture Part 0) • Introduction to Embedded World (Lecture Part 1) ◦ embedded systems ◦ embedded software ◦ hardware platform ◦ software development	• Lab Work 1 • [DEVELOPMENT WORK] • my1barepi: t00_intro4u • my1barepi: t01_gpio	• [VIDEO GUIDES] • install xcompiler • install code editor • install scm software • prepare my1barepi • prepare sd card • workflow demo • scm basics (git)
Week 02	• Hardware Platform 1 (Lecture Part 2) ◦ Board (Raspberry Pi) specifications ◦ Microcontroller (BCM2835) details	• Lab Work 2 • [DEVELOPMENT WORK] • my1barepi: t02_timer • my1barepi: t03_interrupt	
Week 03	• Hardware Platform 1 (cont.) (Lecture Part 2) ◦ Features: I/O, Timer, Interrupt	• Lab Work 2 (cont.) • [DEVELOPMENT WORK] • my1barepi: t04_textlcd • my1barepi: t05_senstemp • my1barepi: t06_framebuffer • my1barepi: t07_video	Assignment 1 Queue
Week 04	• Bare-metal Programming (Lecture Part 3) ◦ single task, multi-tasking ◦ event triggered	• Lab Work 2 (cont.) • [DEVELOPMENT WORK] • my1barepi: t08_uart • my1barepi: t09_bluetooth ◦ needs bluetooth terminal app	

Week	Lecture	Laboratory	Notes
Week 05	- Bare-metal on Raspberry Pi (Lecture Part 3) - Timer access - Interrupt Access	Lab Work 2 (cont.) [DEVELOPMENT WORK] - my1barepi: t10_gsm - my1barepi: t11_gps - my1barepi: t12_rtc	Assignment 1 Due (5%)
Week 06	- Simple Applications - traffic light control - temperature control - input signal detection/measurement	Lab Work 3 [DEVELOPMENT WORK] - practical programming: - detect edges - measure pulse width - measure frequency - generate pwm (single/periodic)	Lab Assessment 1 (10%)
Week 07	- Hardware Platform 2 (Lecture Part 4) - Board (GTUC51B001) specifications - Mirocontroller (NXP P89V51RD2) details	Lab Work 3 (cont.) [DEVELOPMENT WORK] - system integration	Mid-term Examination (20%)
Week 08	- Hardware Platform 2 (cont.) (Lecture Part 4) - Features: I/O, Timer, Interrupt	Lab Work 3 (cont.) [DEVELOPMENT WORK] - system integration	Assignment 2 Queue
Week 09	- Embedded OS on Raspberry Pi - running Raspbian Linux - basic I/O access	Lab Work 4 [PREPARATION WORK] - prepare raspbian (pgt302pi image) - change hostname (make unique) [DEVELOPMENT WORK] - my1linuxpi: gpio	

Week	Lecture	Laboratory	Notes
Week 10	- Embedded OS on Raspberry Pi - running Raspbian Linux - basic peripheral interface	- Lab Work 4 (cont.) [PREPARATION WORK] - make sure avahi/mdns is running on pi - make sure bonjour/avahi/mdns is available on host [DEVELOPMENT WORK] - remote access using putty - my1codelib: run custom server - my1linuxpi: run gpio http server	Assignment 2 Due (5%)
Week 11	- Setup/running simple data server - server side programming (C @ PHP)	Lab Project	Lab Assessment 2 (10%)
Week 12	- Setup/running simple data server - client side programming (C @ HTML/CSS/JAVASCRIPT)	Lab Project (cont.)	
Week 13	- Practical Applications - requirements and considerations	Lab Project (cont.)	
Week 14	- Practical Applications (cont.) - requirements and considerations	Lab Project (cont.)	Lab Project Due (10%)

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