NAZARBAYEV UNIVERSITY
SCHOOL OF SCIENCE AND TECHNOLOGY

Course Syllabus

ROBT305 EMBEDDED SYSTEMS

Fall Semester 2015

Class Times: Tuesdays, Thursdays 12.00 – 1.15 pm, 1.30 – 2.45 pm

INSTRUCTOR

Almas Shintemirov, Assistant Professor
Office Location: 7.205
Office Hours: Mondays 10.00 am – 12.00 pm, Tuesdays, Thursdays 11.00 am – 12.00 pm
Office Phone Number: +7-(7172)-70-61-55
Email addresses: ashintemirov@nu.edu.kz

TEACHING ASSISTANTS

Ainur Begalinova
Nazgul Tazhigaliyeva
Birzhan Nurimbetov
Office Location: 7.321, 7.402
Office Hours: Fridays 9.00 am – 12.00 pm
Email addresses:
ainur.begalinova@nu.edu.kz , nazgul.tazhigaliyeva@nu.edu.kz , birzhan.nurimbetov@nu.edu.kz

PREREQUISITIES

ROBT206 – Microcontrollers with Lab

COURSE OVERVIEW

Embedded systems control everything from space robot rovers to home electronics. Any system that responds at the pace of relevant events has real-time requirements and constraints whether the timescale is short like the airbag controls for an automobile or longer like the flight scheduling system for an airline. This course introduces underlying scientific and engineering principles behind embedded real-time systems. The course covers the software aspects of embedded processor architectures, along with advanced topics such as real-time operating system design and analysis. Students can expect to learn how to program with the embedded architecture and apply real-time principles that are used to drive critical embedded systems like robotics, automobiles, avionics, medical equipment, etc. Topics covered include embedded architectures; concurrency; real-time principles (multi-tasking, scheduling, synchronization), etc. Through a series of practical exercises with state-of-the-art system-in-chip

microprocessor boards students will acquire skills in the design/implementation of core embedded functionality using Linux based C programming tools and libraries.

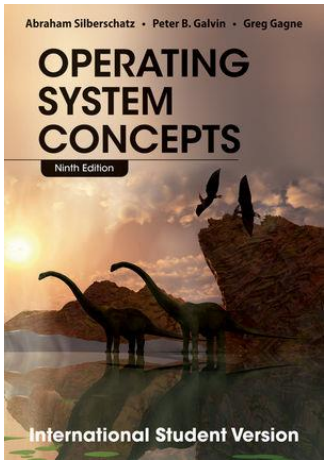
COURSE OBJECTIVES

The main learning outcome for the course is to acquire basic embedded systems design skills. Specifically, upon completing this course, you should be able to:

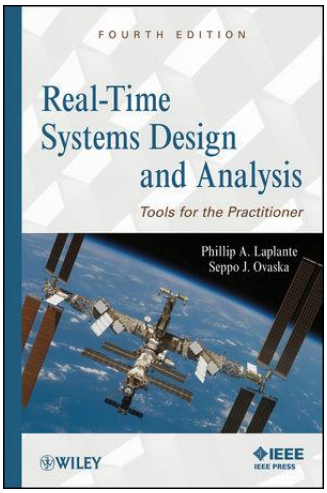
- Understand specific aspects of embedded systems and its practical applications
- Learn main elements of creating specifications for designing embedded systems
- Have a practical experience with embedded systems in robotic/mechatronic systems
- Work in Linux operating system and program multitasking applications in C/C++ environment
- Work in a part of the team on an embedded system design developing creative thinking and communicative skills
- Self-study and work independently on projects
- Work on future research projects

COURSE MATERIALS

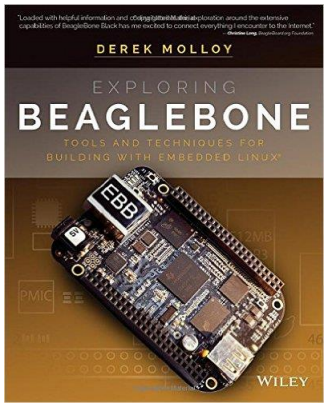
Course textbooks:



Operating System Concepts. 9th edition, International Student Edition
by A. Silberschatz, P. Baer Galvin and G. Gagne, 9th edition, 2012



Real-Time Systems Design and Analysis: Tools for the Practitioner,
by P. A. Laplante and S. J. Ovaska, 4th edition, 2012



Exploring BeagleBone: Tools and Techniques for Building with Embedded Linux by Derek Molloy, 2014

COURSE ASSESSMENT

Activity	Quantity	Weight
Quizzes	~5 (drop 1)	20%
Homework Assignments	~5	25%
Project	1	15%
Mid Semester Exam	1	15%
Final Exam	1	20%
Class Attendance and Participation		5%

Letter Grading Policy

Grade	Percentage
A	95-100
A-	90-94.9
B+	85-89.9
B	80-84.9
B-	75-79.9
C+	70-74.9
C	65-69.9
C-	60-64.9
D+	55-59.9
D	50-54.9
F	0-49.9

COURSE POLICIES

Classroom decorum

Respect the learning environment:

- Come to class on time and be prepared to discuss the assigned reading.
- Do not distract the class with excessive private conversations.
- Turn off all mobile devices.
- Use the lab computers in the room for exercises only.
- Bring paper and pens/pencils.

Class rules

Different classes have different rules about collaboration. These are the standards you will be held to for this class. Unless otherwise noted on the assignment, we expect you to know and follow these rules.

You may only get help on graded assignments from designated people. You are always welcome to get

help on an assignment from your professors, teaching assistants. They may help you at the computer, on paper, or any way they believe will be effective.

The severity of sanctions imposed for an academic integrity violation will depend on the transgression and ascertained intent of the student. Penalties for a first offense may range from failing the assignment to failing the course and referral to an academic review board. You can find more information about the consequences of academic integrity violations from Student Affairs**.**

Electronic resources

You are expected to regularly check your Nazarbayev University email for updates and announcements about the course. You are also required to use Moodle as determined by the instructor.

We live in a time when a vast amount of information is available online, and I have no doubt you can easily find source code or answers to questions on assignments. Before using this information, ask yourself if you are misrepresenting others' work as your own. If you're ever unsure about whether an action is permissible, ask before you do it.

Due Dates and Times

Readings are due before the class period on the day the topic is covered. You will be expected to demonstrate your understanding of the material during the discussions and exercises.

Homework Assignments are due at 11.59 pm on the date specified in the course schedule. **Assignment projects will lose 10% off the top for each day the assignment is submitted late.** For example, a perfect paper submitted two days late would earn a grade of just 80%. The time of submission is determined by the time stamp the course Moodle assigns when the homework is submitted. Start early and get your work done ahead of schedule and you will not have to worry!

Each of you is granted exactly **one "I had a real bad day" 24-hour extension**. You must inform your professor when you want to use this by sending me an email, with the subject "ROBT305 - I had a real bad day," which specifies which assignment is to be given this extension.

You may use USB flash drive sticks to store you class exercises and project, so you can complete them at home on your computers or during the open lab sessions.

Quizzes are given periodically every last class of the week at the start of class. You will receive an advance notice prior to the quiz. There is no way to make up a Quiz. **The worst quiz is dropped**.

In-class attendance and participation require you to be present at the start of class and be actively involved in class activities such as in-class exercises, discussions, etc. Attendance will be collected at every class and lab session.

Missed Classes	**Attendance Grade**
[0 4]	100%
(4 6]	80%
(6 8]	60%
(8 10]	40%
(10 12]	20%
More than 12	0%

A student needs to attend the class regularly in order to pass this course. A student will be considered as missed the class, even if the student did not attend a class due to a medical condition. If the instructor

notes, that you were not participating in the class (not answering questions, using lab computer for surfing web, etc…), the above attendance policy will not be executed and your attendance grade will be lower.

Submitting Work

Your name **must be** prominently displayed at an every document you submit, including each and every drawing. All homework assignments must be submitted via the Moodle. All submissions must be named properly. The name must start with your school ID. It then must be followed by a blank. That blank must then be followed by *assignmentN*, where the *N* is a digit. For example, Peter Parker's school ID is *pparker*, so upon submitting assignment 1, he would name his submission *pparker*_assignment1. If you are required to submit several files, please place them to the properly named folder. Before uploading the assignment, you will need to compress the folder into an archive file. It is this compressed (zipped) archive that you will upload to the Moodle.

Syllabus changes

Occasionally, changes to the syllabus may be necessary. Students will be notified of any changes to the syllabus in writing, if deemed significant.

How to contact us?

Email is the best way for contacting us. The subject of each email should start with "ROBT305". This way, we will filter the message related to this course. For instance, the subject of an email can be: ROBT305 – Homework 3 Question

COURSE OUTLINE (SUBJECT TO CHANGE)

Week	Dates	Topics	Quizzes	Homework assignment
1	18 Aug	Introduction to Course What is Embedded Systems		
	20 Aug	Operating systems, Multithreading		
2	25 Aug	Linux Practice		
	27 Aug	Linux C Programming Practice		
3	1 Sep	POSIX Pthreads Library, Intertask Communication and Process Synchronization: Mutexes		Out: Assignment #1
	3 Sep	Process Synchronization: Mutexes, POSIX Threads Practice		
4	8 Sep	Process Synchronization: Semaphores	Quiz #1	
	10 Sep	Real-time Systems Definitions		Due: Assignment #1
5	15 Sep	Task Scheduling		Out: Assignment #2
	17 Sep	Introduction to course hardware. BeagleBone Black boards	Quiz #2	

6	**22 Sep**	Clock Driven and Rate Monotonic Scheduling		Due: Assignment #2 Out: Assignment #3
	24 Sep	BeagleBone Black practice		
7	**29 Sep**	EDF Scheduling		
	1 Oct	BeagleBone Black practice	Quiz #3	Due: Assignment #3
8	**6 Oct**	Deadlocks		
	8 Oct	Mid Term Exam		
	12 – 16 Oct	FALL BREAK		
9	**20 Oct**	Projects Overview and Selection		Out: Assignment #4
	22 Oct	Practice/Project work		
10	**27 Oct**	Priority Inversion		
	29 Oct	Practice/Project work	Quiz #4	
11	**3 Nov**	Pseudokernels		
	5 Nov	Practice/Project work		Due: Assignment #4 Out: Assignment #5
12	**10 Nov**	Embedded Systems Hardware		
	12 Nov	Practice/Project work		
13	**17 Nov**	Analog-Digital Conversion		
	19 Nov	Practice/Project work	Quiz #5	Due: Assignment #5
14	**24 Nov**	Practice/Project work		
	26 Nov	Practice/Project work		
15	**1 Dec**	Student Group Project demonstrations		
	3 Dec	Exam Review		
	6-15 Dec	Final Exam		