British Columbia Institute of Technology   https://www.bcit.ca/study/outlines/20173043410

Programs & Courses

ELEX 7820 - Real-Time Embedded Systems

School:	School of Energy
Program:	Electrical Engineering
Course Credits:	4
Minimum Passing Grade:	50%
Start Date:	September 05, 2017
End Date:	December 15, 2017
Total Hours:	60
Total Weeks:	15
Hours/Weeks:	4
Delivery Type:	Lecture
Prerequisites:	ELEX 4618
CRN:	43410

Instructor Details

Name: David Romalo
Email: David_Romalo@bcit.ca
Location: SW02-359
Office Hours:

As posted at office door. Also, can be by appointment.

Course description

This course covers software and hardware design for real-time embedded systems. Topics include real-time implementation of DSP algorithms, code and hardware optimization for speed and power, real-time operating systems, reliable operation, and overall system architecture. In the laboratory, students will apply selected concepts learned in the lectures by implementing them on a development board centered around a DSP-oriented microcontroller. This course uses C as the programming language. There is some interaction with assembly code.

Course learning outcomes / competencies

Upon successful completion of the course, the student will be able to:

- Select a processor or other implementation platform for the real-time embedded task at hand. [1,2]
- Design and implement hardware interfaces, including the related software. [4,5]
- Understand real-time operating system concepts including scheduling, interrupt handling, context switching, task synchronization, and resource sharing. [1,2]
- Predict and measure real-time performance. [3]
- Design and implement a real-time system in the lab. [2,3,4,5,6,7]
- Consider all aspects, including software and hardware, and technical and non-technical concepts, in the design of real-time embedded systems. [4,12]

Engineering accreditation

The Canadian Engineering Accreditation Board (CEAB) oversees the accreditation of engineering programs across Canada. To measure the effectiveness of an engineering program the CEAB has identified twelve specific attributes that the graduate is expected to possess and use as the foundation to developing and advancing an engineering career. To ensure that the overall curriculum of the Bachelor of Engineering in Electrical program covers these attributes sufficiently, the learning outcomes for each course have been mapped to applicable CEAB graduate attributes.

1. A knowledge base for engineering: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.

2. Problem analysis: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.

3. Investigation: An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.

4. Design: An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.

5. Use of engineering tools: An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.

6. Individual and team work: An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.

7. Communication skills: An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.

8. Professionalism: An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.

9. Impact of engineering on society and the environment: An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.

10. Ethics and equity: An ability to apply professional ethics, accountability, and equity.

11. Economics and project management: An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.

12. Life-long learning: An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge.

Evaluation criteria

Criteria	%	Comments
Assignments and Quizzes	20	
Midterm	15	
Final Exam	30	
Laboratory	35	

Notes:

- Successful completion of both the lab component and the theory component of this course is also required for a passing grade. Section 3.4 of BCIT policy 5103-PR1 states that when one component is successfully completed and the other is not, but the average mark of the two components is a passing grade; a failing grade of U (unsatisfactory) is awarded.

Learning resources

Reference Texts (Books in Item 1 on Reserve Shelf in BCIT Library, Do Not Need to be Purchased) and Equipment:

1. R. Oshana, *DSP Software Development Techniques for Embedded and Real-Time Systems*, 2006.

J.W.S. Liu, *Real-Time Systems*, 2000.

A. Burns and A. Wellings, *Real-Time Systems and Programming Languages*, 2009.

2. TI Piccolo LaunchPad development board (purchase at bookstore). (add-ons and other equipment provided in lab)

3. BCIT IEEE Student Toolkit (breadboard, parts, tools, etc) or equivalent.

BCIT policy

The following statements are in accordance with the BCIT Policies 5101, 5102, 5104, and 7507, and their accompanying procedures. To review these policies and procedures please click on the links below.

Attendance/Illness:
In case of illness or other unavoidable cause of absence, the student must communicate as soon as possible with his/her instructor or Program Head or Chief Instructor, indicating the reason for the absence. Students who are seeking accommodation for a medical absence must have a BCIT approved medical certificate submitted to the department, substantiating the reason for absence. For other absences, the student should be prepared to provide appropriate supporting documentation. Unapproved absence in excess of the prescribed regulations within this outline may result in failure or forced withdrawal from the course or program. **Please see Policy 5101 - Student Regulations, and accompanying procedures.** [1]

Academic Integrity:
Violation of academic integrity, including plagiarism, dishonesty in assignments, examinations, or other academic performances are prohibited and will be handled in accordance with **Policy 5104 - Academic Integrity and Appeals, and accompanying procedures.** [2]

Accommodation:
Any student who may require accommodation from BCIT because of a physical or mental disability should refer to BCIT's Policy on Accommodation for Students with Disabilities (Policy #4501), and contact BCIT's Disability Resource Centre (SW1 2360, 604-451-6963) at the earliest possible time. Requests for accommodation must be made to the Disability Resource Centre, and should not be made to a course instructor or Program area.

Any student who needs special assistance in the event of a medical emergency or building evacuation (either because of a disability or for any other reason) should promptly inform their course instructor(s) and the Disability Resource Centre of their personal circumstances.

Human Rights, Harassment and Discrimination:
The BCIT community is made up of individuals from every ability, background, experience and identity, each contributing uniquely to the richness and diversity of the BCIT community as a whole. In recognition of this, and the intrinsic value of our diversity, BCIT seeks to foster a climate of collaboration, understanding and mutual respect between all members of the community and ensure an inclusive accessible working and learning environment where everyone can succeed.

Campus Mediation Services is a supportive resource for both students and employees of BCIT, to foster a respectful learning and working environment. Any student who feels that they are experiencing discrimination or harassment (personal or human rights-related) can confidentially access this resource for advice and support. Please see **Policy 7507 – Harassment and Discrimination and accompanying procedure.** [3]

Students should make themselves aware of additional Education, Administration, Safety and other BCIT policies listed at **http://www.bcit.ca/about/administration/policies.shtml** [4]

Policy for School of Energy

Attempts:Students must successfully complete a course within a maximum of three (3) attempts at the course. Students with two attempts in a single course will be allowed to repeat the course only upon special written permission from the Associate Dean. Students who have not successfully completed a course within three attempts will not be eligible to graduate from their respective program.

Approved

I verify that the content of this course outline is current.
David Romalo, Instructor
September 03, 2017

I verify that this course outline has been reviewed.
Neil Cox, Program Head Electrical Engineering
September 05, 2017

I verify that this course outline has been reviewed and complies with BCIT policy.
Craig Cowan, Associate Dean
September 05, 2017

Note: Should changes be required to the content of this course outline, students will be given reasonable notice.

Links

1. bcit.ca/files/pdf/policies/5101.pdf
2. bcit.ca/files/pdf/policies/5104.pdf
3. bcit.ca/files/pdf/policies/7507.pdf
4. bcit.ca/about/administration/policies.shtml