CpE 5170/ CS 5205: Real-Time Systems

PROFESSOR:	Dr. M. Zawodniok	**SEMESTER:**	**Spring** 2019
OFFICE:	**ERL 114/133** EECH	**OFFICE HOURS:**	**TBA**
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CLASS TIME:	**MWF** 11am-11:50am	**LOCATION:**	**Library G14**

TEXTBOOK: *Real-Time Systems*, 2nd Edition, Jane W. S. LIU, Prentice-Hall, Inc, 2000, ISBN-10: 0-13-099651-3

REFERENCE: Several IEEE Transactions and other international journals.

PREREQUISITES: CpE 3150 or CS 3800;
Basic programming competency (C/C++/Embedded C - preferred compiler IAR ARM compiler).

OBJECTIVES: Introduction to real-time (R-T) systems and R-T kernels, also known as R-T operating systems, with an emphasis on scheduling algorithms. The course also includes specification, analysis, design, and validation techniques for R-T systems. Course includes a team project to design an appropriate R-T operating system (ARM processor).

GRADING:

Mid-Term Examination:	40%
(3 exams, but the best two will be used toward final grade)	
Homework Assignments	15%
Lab Assignments (group)	20%
Mid-Semester Report on Semester Project (survey)	5%
Final Individual Project	20%

Grades will be based on the following percentage guidelines (standards will not be raised!):

>90% = A,   80 - 89% = B,   70 - 79% = C,   60 - 69% = D,   < 70% = F

POLICIES

1. No late homework will be accepted.
2. No make ups will be given for missed exams without a verified medical excuse. A grade of 0 will be assigned to missed exams.
3. Unless otherwise stated, homework and computer assignments must be done individually
4. University policies regarding academic dishonesty will be implemented.
5. Lecture notes for each class will be posted on Blackboard prior to presentation in class. It is advised that you download these notes and bring them to class.
6. You are expected to read appropriate sections of the textbook before presentation in class. The textbook sections corresponding to each lecture can be found on the class schedule.
7. Assignments are due at the beginning of the class.

ASSIGNMENTS

You may work together to solve the homework problems, but the write-up should be done individually. Copying from anyone else's solution, as well as being dishonest, will deprive you of the opportunity to learn and to find out how much you know about the subject. If homework from two students is found to be effectively identical, both students will receive zero as the grade. If you cannot explain your answer for solutions at a later date, no credit will be given, even if the solution was correct.

If you cite from other works, for example textbook, internet sources, professional articles, you have to reference it properly (see standard IEEE reference guidelines – e.g. in conference or transaction papers).

COURSE OUTLINE: (SUBJECT TO CHANGE!!!)

The following subjects will be covered in the course; the phrase in [brackets] indicates reading assignment. NOTE: each reading assignment is for discussion on the following week. Reading is not expected prior to the class for which it is listed.

1. Introduction to Real-Time (RT) Systems – Hard vs Soft RT [Chapter 1 &2]
2. RT System Modeling [Chapter 3]
3. RT Scheduling [Chapter 4-7]
   a. Clock Scheduling [Chapter 5]
   b. Priority-driven Scheduling [Chapter 6]
4. Resource Management in RTOS [8]
5. Multiprocessor RTOS: Scheduling, Resource Management, and Synchronization [Chapter 9]
6. RT Communication – in particular USB standard [Chapter 10 and additional references]
7. RTOS – Linux/Embedded RTOS Examples [Chapter 11 and additional references]

COURSE UPDATES AND CHANGES ON CANVAS

The CANVAS (http://mst.instructure.edu or from the CANVAS link on the Missouri S&T homepage at www.mst.edu) will be used to post course materials including syllabus, class slides, assignments, and grades. Additionally, announcements and alerts will be sent by email (done through CANVAS) when applicable including class schedule changes, new assignment being posted on CANVAS.

All students are being assigned to following course on the CANVAS:

mst.instructure.com

Please check that you are able to access the materials for the course.

REPORTS REQUIREMENTS
1. Submission of reports is expected in electronic format (PDF, Word files) via email or Digital DropBox at Blackboard. In special cases hardcopies will be accepted – please contact instructor.

2. The assignment reports should be submitted using provided template (see Blackboard). It is not necessary to use all sections from the template.

3. **The assignment reports should not exceed 6 pages**. Penalty of 10% will be given for each page over 8 pages. For example, 9 page report will result in reduction of grade by 10%, the 13 page report will result in reduction of grade by 50%, for **18 page and longer report - 0 points! The appendixes (e.g. C/C++ code) will not be counted toward the limit!**

4. The students are required to discuss the results and explain the observed phenomena and changes in the results – simple description of the plots is not sufficient. The report with only

results shown will receive maximum 50%. Please talk to the instructor in advance if you have questions or doubts.

5. The detailed requirements for project report will be given in separate document. The project will have mandatory sections and separate page limits.

ATTENDANCE POLICY

The students are required to attend the lectures. If you must miss a class, you are responsible for procuring any material, information, handouts, or announcements that you missed. The attendance will be verified through in-class quizzes and exercises.

EXAMINATIONS

Tests will cover material from the lectures, text, homework and labs, with a slight emphasis on homework. Tests will primarily cover material presented since the last exam, though the nature of the course dictates knowledge of some material from earlier tests.

Unless there is a valid excuse, failure to show up at an exam will result in a grade zero. If there is a scheduling conflict wherein an examination from another course overlaps in time with any of these times, you should notify the instructor in writing (preferably by email) at least two weeks ahead of time. Students are expected to provide evidence of scheduling conflicts or other excuses before permission for a makeup exam can be granted. According to the Student Academic Regulations, all requests to change the final schedule because of conflicts or having three or more examinations schedule on one day are to be made in the Registrar's Office at least one week before the beginning of the final examination week.

Students needing special accommodations for exams should notify the instructor at least one week prior to the exam.

DISABILITY SUPPORT SERVICES: HTTP://DSS.MST.EDU

Any student inquiring about academic accommodations because of a disability should be referred to Disability Support Services so that appropriate and reasonable accommodative services can be determined and recommended. Disability Support Services is located in 204 Norwood Hall. Their phone number is 341-4211 and their email is dss@mst.edu. Instructors may consider including the following statement on their course syllabus as a means of informing students about the services offered:

"If you have a documented disability and anticipate needing accommodations in this course, you are strongly encouraged to meet with me early in the semester. You will need to request that the Disability Services staff send a letter to me verifying your disability and specifying the accommodation you will need before I can arrange your accommodation."

ACADEMIC DISHONESTY: HTTP://REGISTRAR.MST.EDU/ACADEMICREGS/INDEX.HTML

Page 30 of the Student Academic Regulations handbook describes the student standard of conduct relative to the System's Collected Rules and Regulations section 200.010, and offers descriptions of academic dishonesty including cheating, plagiarism or sabotage. Additional guidance for faculty, including a description of the process for dealing with issues related to academic dishonesty, is available on-line at http://ugs.mst.edu .

We expected every member of the Missouri S&T community to practice honorable and ethical behavior inside and outside of the classroom. Any action that might unfairly improve a student's score on homework, quizzes, or examinations will be considered cheating, and will not be tolerated.

A few examples of cheating are:

- Submitting homework that is not your own work. While we encourage you to work together, your work

should not be a copy of any other student's work.
- Sharing results or notes during quizzes or exams.
- Bringing notes, in hard copy or electronic form, to an exam where they are not allowed. This includes improper use of a programmable calculator.
- Counting work on your exam after we have called for papers.
- Requesting a re-grad on an exam or homework problem that has been altered after grading.
- Copying entire paragraphs/sentences from past publications without proper citation ("" and reference)

If you are unsure whether a certain act is considered cheating, please ask the instructor. **Cheating on assignments or exams can result in a zero score for the assignment or exam, and lead to a reduced or failing grade for the course. Instances of cheating will be reported to university administrative officials for further action and possible suspension or expulsion from the university.**

ACADEMIC ALERT SYSTEM: HTTP://ACADEMICALERT.MST.EDU
The purpose of the Academic Alert System is to improve the overall academic success of students by improving communication among students, instructors and advisors; reducing the time required for students to be informed of their academic status; and informing students of actions necessary by them in order to meet the academic requirements in their courses.

The AAC will be utilized when a particular student's performance is below minimum level for passing the course. This also includes attendance in class

CLASSROOM EGRESS MAPS:
In case of emergency, everyone should leave the building in orderly fashion by following exit routes. Students should familiarize themselves with the classroom egress maps posted on-line at: http://registrar.mst.edu/links/egress.html .