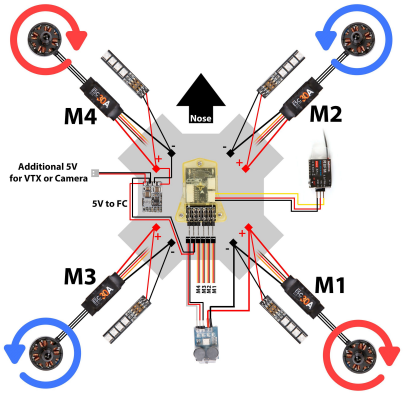



# What is this course about?

Kizito NKURIKIYEYEZU, Ph.D.

## What is ECS6264 —IoT OS?

Learn the fundamental concepts for operating system (OS) that manages hardware and software resources and provides common services for IoT systems. The course gives foundational materials on RTOS for embedded applications, including task scheduling, memory allocation and resource management.

## What you will learn?

- Fundamental concepts of RTOS used in IoT systems
- Basic concepts of RTOS, task and threads
- Task scheduling, predictable scheduling algorithms and memory allocation
- Topics: uniprocessor scheduling, multicore scheduling, synchronization, parallel task scheduling, mixed criticality
- I designed this course to teach you the theoretical and



## By the end of the course, you will:

- Understand the fundamentals of RTOS from pseudo-kernels to OS and memory management.
- Be able to analyze and implement fundamental scheduling algorithms for IoT scheduling and synchronization
- Be able to determine requirements for a real-time embedded system problem and be able to choose the proper algorithm to solve the problem.
- Be able to develop an time-constrained IoT system from scratch



# Expectations in you

- Prerequisites—you are expected to have the necessary background. Important topic will be revised very quickly but it is your responsibility to catch up.
- Time commitment—Expect to spend more time self-learning and code debugging
- Professionalism—You are adults and I will treat you as such
- Content —The course involves much more reading, deeper analysis, self-studies and research than undergraduate classes
- Evaluation —The quality of your work is expected to reflect a graduate level-course.
- Cheating—Anyone found cheating on an exam or any assignment will receive an automatic F on the evaluation and will be reported to the management of the University. Cheating/plagiarism detection software might be used at the sole discretion of the instructors

# What to expect in me

- I want you to succeed —both in this course but also, and most importantly, in life after you graduate
- I am prepared to help you understand the course material and help you pass your homework, quizzes and exams. My job is to help you, so let me know what I can do to help you succeed. If there is something that you would like me to do differently, please, let me know. I am happy to work with you to make class the best it can be.
- The Government of Rwanda is spending billions on your education and expect you to transform the future of this nation. I will make sure that such an investment does not go to waste.
- Fairness—I am a fair man. And fairness obliges me not to give preferential treatment to anyone.



# Prerequisite knowledge

- General knowledge—Ability to read and understand electronic schematics, ability to read and understand unfamiliar topics, competency in C/C++
- Computer architecture —CPU Registers, memory addressing, data paths, memory allocation, page fault, DMA
- Algorithms& data structures—understanding of “Big O” notation and its mathematical definition, stacks, queues, and linked lists
- Mathematics—logic symbols, proof techniques (e.g., induction and contradiction), probability, recurrence relations, basic algebra
- Sound knowledge of C/C++—Computer programming will be integral part of this module. It is assumed that students have a sound knowledge of programming in C/C++ to successfully carry out laboratory exercises.
- Note: Due to time limitation, I will not attempt to teach any



# Evaluation

- There will be daily online quizzes over any material taught in the class to date.
- Exams —UR’s policy will be applied
- Programming assignments
  - There will be several programming assignments
  - Each assignment expects design and debug some hardware simulation
  - They expect strong programming and problem solving skills.
  - ADVICE: Please try to work on this assignment early and ask questions if needed.
- Design project—Express your design in oral and written forms

**NOTE** If you do not complete your programming projects, odds are you will fail the exams and ultimately fail this class.



# Course materials


- Laplante (2021). Real-Time Systems Design and Analysis: Tools for the Practitioner (4th edition) Wiley-IEEE Press.
- Buttazzo, G. C. (2011). Hard Real-Time Computing Systems: Predictable Scheduling Algorithms and Applications (3rd edition). Springer.
- Walls, C. (2020). Embedded RTOS Design: Insights and Implementation (1st ed.). Newnes.
- Bertolotti, I. C., & Manduchi, G. (2017). Real-Time Embedded Systems: Open-Source Operating Systems Perspective (1st ed.). CRC Press.

**TAB 1.** Allocation of study & Teaching hours according to ACEIoT

| DESCRIPTION | STUDENT HOURS | STAFF HOURS |
|---|---|---|
| LECTURES | 24 | 48 |
| SEMINARS/ WORKSHOPS | | |
| PRACTICAL CLASSES/ LABORATORY | 18 | 36 |
| STRUCTURED EXERCISES | 6 | 12 |
| SET READING ETC. | | |
| SELF – DIRECTED STUDY | 42 | 42 |
| ASSIGNMENTS – PREPARATION & WRITING | 60 | 30 |
| EXAMINATION – REVISION & ATTENDANCE | | 44 |
| OTHER: INVIGILATION END OF MODULE | | 4 |
| **TOTAL** | 150 | 216 |



# Course organization

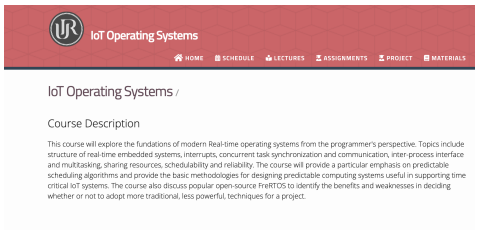
- Lecture—Monday, Wednesday and Friday from 9:00AM-1PM
- Quiz—Monday, Wednesday and Friday.
- Independent study and review Tuesday, Thursday 7:00AM-12PM
- Lab assignments Tuesday, Thursday 1:00PM-6:00PM
- Unfortunately, the University does not have enough material to conduct a proper lab.—Thus, we will only use simulations.
- I will not attend the lab session since I have other course to teach but if you need help, you can schedule an appointment or call me if you need help
- **Notes**—This is a graduate level course:
  - You're expected to do lots of independent learning
  - You're expected to produce graduate-level outcome (lab and exams)
  - No sloppy lab reports
- Submission of Course Work Policy



# Course website

The course has two websites where I host all the materials

- The UR e-learning platform
  - This is the official website. When in doubt, consult this first
  - Everyone must register here
  - All quizzes will be conducted on this platform
  - https://elearning.ur.ac.rw/
- Personal website
  - https://qiriro.com/ecs6264/
  - It should be used as a






# The end