

# F-7-16

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| Unit Code: | BCE422 |
| Unit Titles: | **REAL TIME SOFTWARE SYSTEMS** |
| Program(s): | Bachelor of Science in Information Technology |
| Lecturer Name: | M/s. Josephine Magu |
| Lecturer Contacts: | [Josephine.magu@gmail.com](mailto:Josephine.magu@gmail.com) Phone No.:0721513140 |
| Contact | Thursday: 11.00-14.00p.m |

## Course Description

This course discusses the principles and applications for real-time computing. The course focuses on complexities of embedded system and the fundamental challenges in embedded computing, together with design methodologies and models of computation. It also provides an in-depth and advanced treatment of all the components of embedded systems with discussions of the current developments in the field and numerous examples of real-world applications. Topics include system architecture; D/A and A/D conversion; synchronous data acquisition and analysis; computers in real time control; asynchronous monitoring and control; resource scheduling; interfacing issues.

### Learning Outcomes

On completion of the course, the students should:

1. Demonstrate the techniques that can be used to construct reliable and timely real-time systems,
2. Be able to explain different models of concurrency and how they can be used to facilitate the programming of real-time systems,
3. Realize different approaches to programming fault tolerance in real-time embedded systems,
4. Understand how to undertake scheduling analysis of real-time systems,

## Course Content

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| **WEEK** | **TOPIC** | **SUB-TOPIC** |
| **1.** | **Introduction:** | **Introduction:**Concept of real-time design, Time scales for real-time system, Definition of embedded system, Constraints on embedded systems vs. standalone systems, Applications: Localization, Data Dissemination, Mobility, Distributed Control |
| **2.** | **Hardware/software functional partitioning** | **Hardware/software functional partitioning** Relevant hardware technologies: Discrete logic, CPLDs, FPGAs, ASICs, Software environments: HLL vs. assembly coding, DSP vs. general purpose computer vs. RISC, Component Technologies: Sensors, Sensor Platforms |

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| **3.** | **Exception handling** | **Exception handling** |
| **4.** | **Real time sheduling theory and algorithms** | **Real time sheduling theory and algorithms** Real-Time Operating Systems**,** Fixed Priority and Dynamic Scheduling**,** Aperiodic and Sporadic Task Scheduling |
| **5.** | **Shared Variable-Based Synchronization and Communication** | **Shared Variable-Based Synchronization and Communication:** Priority Inversion and Task Synchronization**;** Timing, Clocks, Delays and Timing Constraints. |
| **6.** | CAT1- ASSIGNMENT 1 | |
| **7.** | **System Infrastructure and Development:**  **System architectures:** | **System Infrastructure and Development:** Clock Synchronization**,** Programming Abstractions**,** Storage. **System architectures:**reactive, real-time and safety-critical systems - examples and problems. |
| **8.** | **Reliability and fault- tolerance in safety critical systems** | **Reliability and fault-tolerance in safety critical systems**. Efficiency and performance analysis. |
| **9.** | **Interacting with embedded systems:** | **Interacting with embedded systems:**polling and interrupt handling: the engineering of reactive systems.(using device drivers & interrupt handlers), Interacting with hardware, Pipelining, |
| **10.** | **Software engineering for embedded systems & real-time systems:** | **Software engineering for embedded systems & real-time systems:**Debugging low-level systems, firmware programming, Soft real-time in distributed systems, Real-time in embedded systems, |
| **11.** | CAT2 – ASSIGNMENT 2 | |
| **12.** | Software structures: | Software structures:ISRs, Polling and interrupt handling, semaphores, Quality of Service in the OS and isochronous systems |
| 13. | REVISION |  |

**Teaching and learning Methodologies:** Lectures, Presentations by members of the class, Case discussions, Tutorials, Assignments, Continuous assessment tests, Practical, Library, appropriate software, manual/notes,

**ASSESSMENT CRITERIA**

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| **Assessment Type** | **Frequency** | **Percentage** |
| Assignment | 2 | 10% |
| CATs | 2 | 20% |
| Final Examination | 1 | 70% |
| Total |  | 100% |

# Instructional Materials/Equipment

* + Course text, Handouts, White board, Presentation slides, Journals
  + C/C++ or Java is required
  + Matlab Kit

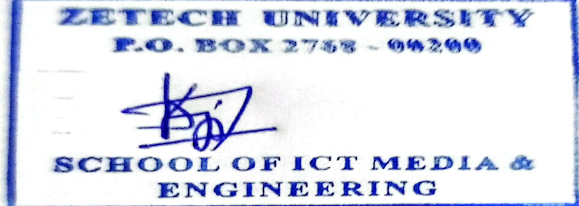
### Main Textbooks-journals

1. Burns & Wellings**,** *Real-Time Systems and Programming Languages: Ada, Real-Time Java and C/Real-Time POSIX*, 4/e**,** 2009**,** Addison-Wesley, InstockISBN-10: 0321417453, ISBN-13: 9780321417459.
2. HermannKopetz, Real-Time Systems: Design Principles for Distributed Embedded Applications, 2nd Edition., 2011

### Recommended Textbooks

1. Shashi Phoha, Thomas F. La Porta, Christopher Griffin (Editors) *Sensor Network Operations,* June 2006, Addison-Wiley Publishers.
2. Oshama, *DSP Software Development Techniques for Embedded and Real-Time Systems,* 1st Edition, ISBN: 9780080491196
3. Tim Wilmshurst*, Designing Embedded Systems with PIC Microcontrollers*, ***Principles and Applications***, 2nd Edition, Published: 03 Dec 2009, Elsevier, ISBN: 9781856177504.
4. Jonathan W. Valvano, Embedded Microcomputer Systems: Real Time Interfacing, 3rd, © 2012,3rdEdition, ISBN-13: 9781111426255.
5. Meikang Qiu, *Real-Time Embedded Systems: Optimization, Synthesis, and Networking* June 01, 2011, CRC Press

***Approval for circulation by:***





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