

Unit Code:	BCE422	
Unit Titles:	REAL TIME SOFTWARE SYSTEMS	
Program(s):	Bachelor of Science in Information Technology	
Lecturer Name:	M/s. Josephine Magu	
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Contact	Tuesday: 11.00-14.00	

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

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

3.	Exception handling	Exception handling
4.	Real time scheduling theory and algorithms	Real time scheduling 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

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, Instock ISBN-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, 3rd Edition, 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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