Embedded Systems-- Design Verification and Test

Computer Science and Engineering

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Course Intro: : An embedded system (ES) can be described as a computing system which is part of a larger physical system. Examples of ESs range from a simple elevator controller to a complex avionics control system. Unlike a general purpose computer system, ESs are typically designed for specific functionalities, often with stringent performance objectives and constraints related to real-time accuracy, area, power, cost etc. Their implementations may include both software and hardware components and may necessitate integration with sensors and actuators. The increase in complexity of modern ESs mandates automation in their design. Given a system which we intend to implement, the design process majorly evolves through distinct but often overlapping and iterative phases which include,i. modeling of the intended system behavior, ii. design of appropriate structural representations and implementation methodologies, corresponding to the specified behavior, iii. verification and validation of the correctness and performance related properties that the designed system should satisfy, and iv. testing whether the prototyped / manufactured implementation actually performs the required behaviour. The proposed course will systematically cover all these topics so that the student gains an end-to-end understanding of the overall ES design process.

Pre Requisites: : Digital Design and Computer Architecture
Core/Elective: : Elective
UG/PG: : Both
Industry Support : All Embedded System design/application industries like Intel, Samsung etc. and CAD industries like Cadence, Synopsys, Agilent etc.

Reference : 1. Peter Marwedel, P. Marwedel, â€œEmbedded System Designâ€•, Springer, 2011 2. Wayne Wolf, Components, 2 nd Kaufmann Computers as Edition, Morgan 3. Abhik Roychoudhury, Embedded Systems and Software Validation, 1 st Edition, Morgan Kaufmann 4. M. Huth and M. Ryan, Logic in Computer Science modeling and reasoning about systems, Cambridge University Press, 2nd Edition, 2004 5. Bushnell and Agrawal, Essentials of Electronic Testing for Digital, Memory & Mixed-Signal Circuits, Kluwer Academic Publishers, 2000

About Instructor: Dr. Arnab Sarkar is an Asst. Professor in the Dept. of CSE IIT Guwahati. He has an experience of 3 years in teaching and about 2 years in industry. His research interests Real-Time and Embedded Systems, Computer Architecture, Algorithms.

COURSE PLAN

SL.NO	Week	Module Name
1	1	Module 1: Introduction and Modeling Lec 1: Introduction to Embedded Systems Design Flow Lec 2: Formal specification and Modeling Strategies - I Lec 3: Formal specification and Modeling Strategies - II
2	2	Hardware-Software Co-Design principles and details of hardware design Lec 1: Hardware Software Co-Design Lec 2: Architectural Design of Hardware - I Lec 3: Architectural Design of Hardware - II
3	3	Introduction to Scheduling in embedded systems Lec 1: System and Task level Timing Analysis
4	4	Lec 2,3: Uni-processor Real-time Scheduling Lec 4,5: Multiprocessor Real-time Scheduling
5	5	Lec 2,3: Resource Allocation Strategies in Automotive Systems Lec 4: Energy-aware and Fault-tolerant Real-time Scheduling
6	6	Introduction to Formal Verification Lec 1 Introduction and Basic Operations on Temporal Logic Lec 2 Syntax and Semantics of CTL
7	7	Lec 3 Equivalence between CTL Formulas Lec 4,5,6 Model Checking Algorithm (3 lectures)
8	8	Embedded SystemVerification for Embedded Systems Lec 1,2: Software Verification Lec 3: Verification of real time systems hardware Testing
9	9	Test: Introduction to Digital Testing Lec 1. Introduction to Digital VLSI Testing Lec 2 Automatic Test Pattern Generation (ATPG) Lec 3. Scan Chain based Sequential Circuit Testing
10	10	Embedded System hardware Testing Lec 1. Software-Hardware Co-validation Fault Models and High Level Testing for Complex Embedded Systems Lec 2. Testing for embedded cores Lec 3. Bus and Memory Testing

11	11	Advances in Embedded System hardware Testing Lec 1. Testing for advanced faults in Real time Embedded Systems Lect 3. BIST for Embedded Systems
12	12	Lec 3,4 Concurrent Testing for Fault tolerant Embedded Systems ,Testing for Embedded Software Systems Lect 1 Interaction Testing between Hardware and Software Lect 2. Software testing for Reprogrammable hardware