

# GUJARAT TECHNOLOGICAL UNIVERSITY

## ELECTRONICS & COMMUNICATION (VLSI SYSTEM DESIGN) (42)

HARDWARE SOFTWARE CO-DESIGN

**SUBJECT CODE: 2724207**

SEMESTER: II

**Type of course:** Major Elective\_3 (mixed software-hardware systems)

**Prerequisite:** Basic knowledge in the following areas: computer architecture, digital design, software design, and embedded systems.

**Rationale:** The students will learn various design steps starting from system specifications to Hardware/software implementation and will experience process optimization while considering

### Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	0	4	70	30	30	0	10	10	150

### Content:

Sr. No.	Content	Total Hrs	% Weight age
1	<b>SYSTEM SPECIFICATION AND MODELLING</b> Embedded Systems , Hardware/Software Co-Design , Co-Design for System Specification and Modeling , Co-Design for Heterogeneous Implementation - Processor Synthesis , Single-Processor Architectures with one ASIC , Single-Processor Architectures with many asics, Multi-Processor Architectures , Comparison of Co-Design Approaches , Models of Computation ,Requirements for Embedded System Specification .	12	25
2	<b>HARDWARE/SOFTWARE PARTITIONING</b> The Hardware/Software Partitioning Problem, Hardware-Software Cost Estimation, Generation of the Partitioning Graph, Formulation of the HW/SW Partitioning Problem, Optimization, HW/SW Partitioning based on Heuristic Scheduling, HW/SW Partitioning based on Genetic Algorithms.	10	20
3	<b>HARDWARE/SOFTWARE CO-SYNTHESIS</b> The Co-Synthesis Problem, State-Transition Graph, Refinement and Controller Generation, Distributed System Co-Synthesis	6	15
4	<b>PROTOTYPING AND EMULATION</b> Introduction, Prototyping and Emulation Techniques , Prototyping and Emulation Environments, Future Developments in Emulation and Prototyping ,Target Architecture- Architecture Specialization Techniques ,System Communication Infrastructure, Target Architectures and Application System	10	20

	Classes, Architectures for Control-Dominated Systems, Architectures for Data-Dominated Systems, Mixed Systems and Less Specialized Systems		
5	<b>DESIGN SPECIFICATION AND VERIFICATION</b> Concurrency, Coordinating Concurrent Computations, Interfacing Components, Verification, Languages for System-Level Specification and Design System-Level Specification ,Design Representation for System Level Synthesis, System Level Specification Languages, Heterogeneous Specification and Multi-Language Co-simulation	10	20

### Reference Books:

1. Ralf Niemann , “Hardware/Software Co-Design for Data Flow Dominated Embedded Systems”, Kluwer Academic Pub, 1998.
2. Jorgen Staunstrup , Wayne Wolf ,”Hardware/Software Co-Design: Principles and Practice” , Kluwer Academic Pub, 1997.
3. Giovanni De Micheli , Rolf Ernst Morgon,” Reading in Hardware/Software Co-Design “ Kaufmann Publishers,2001.

### Course Outcome:

On completion of the course, a student should be able:

1. To understand and to apply design methodologies
2. To appreciate the fundamental building blocks of the using hardware and software co-design and related implementation and testing environments and techniques and their interrelationships.
3. To be familiar with modern hardware/software tools for building prototypes.
4. To demonstrate practical competence in these areas.

### List of Open Source Software/learning website:

<http://www.tik.ee.ethz.ch/education/lectures/hswcd/>  
<http://embedded.eecs.berkeley.edu/Research/hsc/abstract.html>  
<http://rijndael.ece.vt.edu/gezel2/book.html>  
<http://courses.cs.tamu.edu/cpsc489/rabi/syllabus.shtml>  
<http://www.ece.vt.edu/schaum/teachcodesign.html>  
<http://technav.ieee.org/tag/864/hardware-software-co-design>  
[https://www.annauniv.edu/academic\\_courses/WS/04.%20I%20&%20C/04.%20M.E.VLSI.pdf](https://www.annauniv.edu/academic_courses/WS/04.%20I%20&%20C/04.%20M.E.VLSI.pdf)  
<http://engineering.iit.edu/courses/ece587>  
<http://www.satishkashyap.com/p/video-lectures.html>

**Students will choose one of the topics from below list and prepare presentation on it.**

- Hardware/Software Co-design Systems
- Languages for hardware Software Co-Design
- Current Hardware/Software Design Process
- Issues and Directions in Hardware/Software Co-design
- Hardware software partitioning and scheduling
- Hardware/Software Synthesis
- Architectural exploration tools
- Co-simulation based validation
- Fundamental issues in co-design
- SW, HW and interface Synthesis

- Models and methodologies of HSCD system design
- Co simulation, synthesis and verifications
- System on chip
- Application specific processors (DSP)
- Processor ASIP or ASSP
- Multiple processors
- RTOS (real-time programming OS)
- Code generation tools etc.

**Review Presentation (RP):** The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website