UNIVERSITY of NICOSIA

Course Code	Course Title	ECTS Credits
ECE-521	Fault Tolerant Computing	8
Department	**Semester**	**Prerequisites**
Engineering	Fall or Spring	ECE-220, ECE-322, ECE-324
Type of Course	**Field**	**Language of Instruction**
Elective	Engineering	English
Level of Course	**Year of Study**	**Lecturer(s)**
2nd Cycle	1st	Dr Stelios Neophytou
Mode of Delivery	**Work Placement**	**Co-requisites**
Face-to-face	N/A	None

Objectives of the Course:

The main objectives of this course are to:

- Introduce the main concepts regarding fault occurrences, fault modeling and fault simulation in real systems and networks.
- Provide techniques for detection and correction of hardware errors in digital circuits and computer systems both at the IC production stage and during the operational life of the computer system.
- Overview the main approaches used in real systems to improve their dependability, availability and reliability.
- Train the students in independent or team research and help them recognize the need for life-long learning through lab assignments and a term project.

Learning Outcomes:

After completion of the course students are expected to be able to:

- Discuss the main concepts and the relationship between defect, fault and error and the main issues of fault modeling and simulation.
- Analyze and design fault tolerant systems and fault tolerant schemes/architectures in hardware and software.
- Demonstrate the operation the most popular fault tolerant approaches use in digital systems and computer networks.
- Discuss the concepts of availability, dependability and reliability and use them in the analysis and/or design of a fault tolerant system.

Course Contents:

- Fault Classification, types of Redundancy and the basic measures of Fault Tolerance. Introduce the traditional measures as well as the measures used for networks.
- Hardware Fault Tolerance. The rate of hardware failures, reliability, and mean time to failure.
- Canonical and Resilient Structures. Series and parallel systems, M-of-N Systems, voters and variations on N-Modular Redundancy.
- Fault-Tolerance processor-level techniques. Watchdog Processor and simultaneous multithreading for fault tolerance.
- Byzantine Failures and the Byzantine Agreement with message authentication

approach.

- Information Redundancy. Coding techniques and architectures. Resilient disk systems (RAID). Data Replication and Voting. Algorithm-Based Fault Tolerance.
- Fault-Tolerant Networks. Measures of Resilience. Common Network Topologies and Their Resilience. Fault-Tolerant Routing.
- Software Fault Tolerance. Acceptance tests. N-Version programming. Recovery Block Approach. Exception-Handling. Software Reliability Models.
- Checkpointing. An Analytical Model for optimal Checkpointing. Cache-Aided Rollback Error Recovery (CARER). Checkpointing in Distributed systems and in Shared-Memory Systems. Checkpointing in Real-Time systems.
- Case Studies: NonStop Systems and their architecture. Stratus systems. The Cassini Command and Data Subsystem. IBM G5, IBM Sysplex and Intel Itanium.

Learning Activities and Teaching Methods:

Lectures, Project. Homework Assignments. Research literature review and presentation.

Assessment Methods:

Homework, Mid-Term, Project, Final Exam, Presentation.

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
I. Koren, C. Mani Krishna	Fault-Tolerant Systems	Morgan Kaufmann	2007	978-0120885251

Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Barry W. Johnson	The Design and Analysis of Fault Tolerant Digital Systems	Addison-Wesley	1989	978-0201075700
Dhiraj K. Pradhan	Fault-Tolerant Computer System Design	Prentice Hall	1996	978-0130578877
D. P. Siewiorek, R. S. Swarz	Reliable Computer Systems: Design and Evaluation	A K Peters/ CRC Press	1998	978-1568810928