Description of Course CSE 423

PART A: General Information

1	**Course Title**	: FAULT TOLERANT SYSTEMS
2	**Type of Course**	: THEORY
3	**Offered to**	: DEPARTMENT OF CSE
4	**Pre-requisite Course(s)**	: NONE

PART B: Course Details

1. Course Content (As approved by the Academic Council)

Introduction: background and motivation, dependability attributes, probability distributions; Reliability modeling: combinational modeling, state-space modeling; System view of high availability design; Defects: defect avoidance, shielding and hardening, defect circumvention, yield enhancement; Faults: fault testing, design for testability, fault masking, replication with voting; Errors: error detection, self-checking modules, error correction, redundant disk arrays; Hardware redundancy: basic approaches, static and dynamic, voting, fault tolerant interconnection networks; Software redundancy: software reliability models, software aging, N-version programming; Degradation allowance: performability of a fail-soft system, checkpointing and rollback.

2. Course Objectives

The students are expected to:

i. Analyze different notions of fault tolerance.
ii. Investigate reliability of different types of systems.
iii. Distinguish and design methodologies to overcome defects and to harden systems.

3. Knowledge required

Technical

- System design and development

Analytical

- Probability theory

4. Course Outcomes (COs)

CO No.	CO Statement After undergoing this course, students should be able to:	Corresponding PO(s)*	Domains and Taxonomy level(s)**	Delivery Method(s) and Activity(-ies)	Assessment Tool(s)
CO 1	**Analyze** different notions of fault tolerance.	PO1, PO2, and PO7	C4	Lecture and Demonstration	Class Tests or Assignments or Projects, and Final Exam
CO 2	**Investigate** reliability of different types of systems.	PO4 and PO6	A5	Lecture, Demonstration, and hands-on	Class Tests or Assignments or Projects, and Final Exam
CO 3	**Distinguish** and **design** methodologies to overcome defects and to harden systems.	PO3 and PO5	C6	Lecture and Demonstration	Class Tests or Assignments or Projects, and Final Exam

***Program Outcomes (POs)**

PO1: Engineering knowledge; PO2: Problem analysis; PO3: Design/development of solutions; PO4: Investigation; PO5: Modern tool usage; PO6: The engineer and society; PO7: Environment and sustainability; PO8: Ethics; PO9: Individual work and teamwork; PO10: Communication; PO11: Project management and finance; PO12: Life-long learning.

****Domains**

C-Cognitive: C1: Knowledge; C2: Comprehension; C3: Application; C4: Analysis; C5: Synthesis; C6: Evaluation
A-Affective: A1: Receiving; A2: Responding; A3: Valuing; A4: Organizing; A5: Characterizing
P-Psychomotor: P1: Perception; P2: Set; P3: Guided Response; P4: Mechanism; P5: Complex Overt Response; P6: Adaptation; P7: Organization

5. Mapping of Knowledge Profile, Complex Engineering Problem Solving and Complex Engineering Activities

COs	K1	K2	K3	K4	K5	K6	K7	K8	P1	P2	P3	P4	P5	P6	P7	A1	A2	A3	A4	A5
CO1		√	√	√	√	√			√	√					√				√	
CO2		√	√	√	√	√			√	√				√		√	√			
CO3		√	√	√	√	√			√		√	√			√			√		√

K-Knowledge Profile:

K1: A systematic, theory-based understanding of the natural sciences applicable to the discipline; **K2:** Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline; **K3:** A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline; **K4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline; **K5:** Knowledge that supports engineering design in a practice area; **K6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline; **K7:** Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability; **K8:** Engagement with selected knowledge in the research literature of the discipline

P-Range of Complex Engineering Problem Solving:

P1: Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach; **P2:** Involve wide-ranging or conflicting technical, engineering and other issues; **P3:** Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models; **P4:** Involve infrequently encountered issues; **P5:** Are outside problems encompassed by standards and codes of practice for professional engineering; **P6:** Involve diverse groups of stakeholders with widely varying needs; **P7:** Are high level problems including many component parts or sub-problems

A-Range of Complex Engineering Activities:

A1: Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies); **A2:** Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues; **A3:** Involve creative use of engineering principles and research-based knowledge in novel ways; **A4:** Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation; **A5:** Can extend beyond previous experiences by applying principles-based approaches

6. Lecture/ Activity Plan

Week	Lecture Topics	Corresponding CO(s)
Week 1	Introduction and terminologies	CO1
Week 2	Fault models	CO1
Week 3	Probability theory	CO1
Week 4	Reliability modeling using probability theory	CO1 and CO2

Week	Lecture Topics	Corresponding CO(s)
Week 5	Reliability modeling using probability theory	CO2
Week 6	Different modeling approaches	CO2
Week 7	Different modeling approaches	CO2
Week 8	Reliability modeling different types of systems	CO2
Week 9	Defect avoidance	CO3
Week 10	Defect circumvention	CO3
Week 11	Shielding and hardening	CO3
Week 12	Yield enhancement	CO3
Week 13	Degradation allowance	CO3
Week 14	Revision	CO1, CO2, and CO3

7. Assessment Strategy

- Class Attendance: Class attendance will be recorded in every class.
- Class Tests/Assignments/Projects: There will be a minimum of 4 (four) Class Tests/Assignments/Projects, out of which the best 3 (three) will be considered in final evaluation.
- Final exam: A comprehensive Final exam will be held at the end of the semester as per the institutional ordinance.

8. Distribution of Marks

Attendance:	10 %
Class Tests/Assignments/Projects:	20%
Final Exam:	70%
Total:	100%

9. Textbook/ Reference

a. Dependable Computing: A Multilevel Approach (by Behrooz Parhami) [http://www.ece.ucsb.edu/~parhami/text_dep_comp.htm#text]

10. Student Code and Policies

A student at BUET campus is a member of a University community of which all members have at least the rights and responsibilities common to all citizens, free from institutional censorship. Affiliation with the University as a student does not diminish the rights or responsibilities held by a student or any other community member as a citizen of larger communities of the state, the nation, and the world. All the students must adhere to the rights or responsibilities.

11. Academic Integrity

All students are expected to abide by the campus regulations on academic integrity. These standards will be enforced and infractions of these rules will not be tolerated in this course. Sharing, copying, or providing any part of a homework solution or code is an infraction of the University's rules on academic integrity. We will be actively looking for violations of this policy in homework and project submissions. Any violation will be punished as severely as possible with sanctions and penalties typically ranging from a failing grade on this assignment up to a failing grade in the course, including a letter of the offending infraction kept in the student's permanent university record. Again, a good rule of thumb: Keep every typed word and piece of code your own. If you think you are operating in a gray area, you probably are. If you would like clarification on specifics, please contact the course instructor(s).

12. Disability Accommodations

Students with learning, physical, or other disabilities requiring assistance should contact the instructor(s) as soon as possible. If you are unsure if this applies to you or think it may, please contact the instructor(s) as soon as possible.

Course Teacher(s):

Name:	Office/Room:	E-mail and Telephone:
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