Computer Systems Reliability

Midterm – Short answers

April 29, 2015

I declare that during this Exam I will not provide or use any illegal help and will not use illegal resources. Such acts are serious violations of the University Codex and can lead to consequences of expulsion from the Faculty of Electrical Engineering and Computing. Also I declare that my health condition is allowing me in taking this Exam.

_____   _____   _____
Student ID   *Name and Surname*   *Hand-written signature*

Note: This Exam contributes 20% to overall course score. In multiple-choice questions there is only one correct answer.

1. /1 point/ *Availability* is defined as:

   a) $A = MTBF$,

   b) $A = \dfrac{MTBF}{MTTF}$,

   c) $A = \dfrac{MTBF - MTTF}{MTBF}$,

   d) $A = \dfrac{MTTF}{MTTF + MTTR}$,

   e) $A = MTTF - MTTR$.

2. /1 point/ Function that is constant and equal to failure rate in case of exponential failures distribution is:

   a) cumulative distribution function,

   b) probability density function,

   c) hazard function,

   d) reliability function,

   e) none of the above (*a-d*).

3. /1 point/ Conditional probability that the system will recover in case of fault existence describes the term of:

   a) availability,

   b) coverage,

   c) fault tolerance,

   d) redundancy,

   e) reliability.

4. /1 point/ Self-purging redundancy system is an example of:

   a) passive hardware redundancy,

   b) active hardware redundancy,

   c) hybrid (passive + active) hardware redundancy.

5. /1 point/ Which fault detection technique is based on nonexistence of predefined action?

   a) circuits with spare components,

   b) fail-safe logic,

   c) self-checking circuits,

   d) watchdog timers.

6. /1 point/ The claim „the system is weaker than the weakest module" is true for:

   a) *M-of-N* model,

   b) nonserial-nonparallel model,

   c) parallel system,

   d) serial system.

7. /1 point/ The failure rate formula

   $$\lambda = \pi_L \pi_Q \left(C_1 \pi_T \pi_V + C_2 \pi_E \right)$$

   is characteristic of reliability model named:

   _____ MIL-HDBK-217E _____ .

8. /1 point/ Which assumption for *stuck-at* fault model is false?

   a) The circuit consequently behaves as one of inputs or outputs is fixed to 0 or 1.

   b) The fault is not permanent.

   c) The fundamental functionality is unaffected.

9. /1 point/ „Avoiding service failures in the presence of faults" describes a category of means to attain dependability and security:

   a) fault forecasting,

   b) fault prevention,

   c) fault removal,

   d) fault tolerance.

10. /1 point/ Complete the fundamental chain of dependability and security threats (*fill with correct answers*):

_ fault _ →activation→ ___ error ___ → propagation→ _ failure _ → causation → ___ fault _

11. /3 points/ In three *Monte Carlo simulation* iterations estimate MTTF for serial-parallel system in the figure. It is assumed exponential distribution of failures for all system modules with following parameter values: $\lambda_a = 0.003$, $\lambda_b = 0.002$, $\lambda_c = 0.0025$. Assume randomly generated values: *0.305, 0.941, 0.267, 0.623, 0.167, 0.085, 0.337, 0.899, 0.133, 0.079, …*
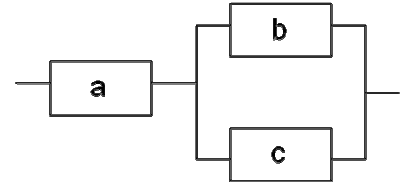
12. /3 points/ For nonserial-nonparallel system in the figure derive the reliability expression and its upper bound value. For components' reliabilities assume R_A, R_B, R_C, R_D, R_E and R_F values are identical (=R).
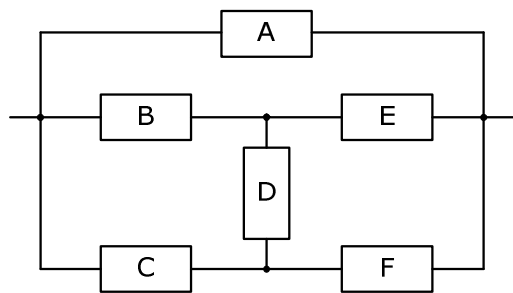
13. /2 points/ For circuit in the figure assume *stuck-at* faults appearances, analyze fault equivalence, find maximum collapsing ratio and checkpoints.
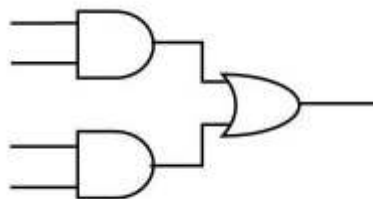
14. /2 points/ Discuss possibilities of permanent faults detection using time redundancy.