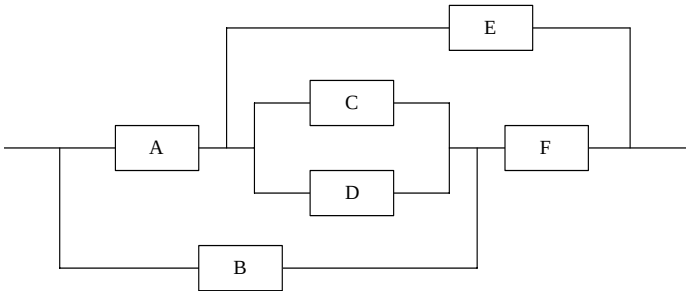
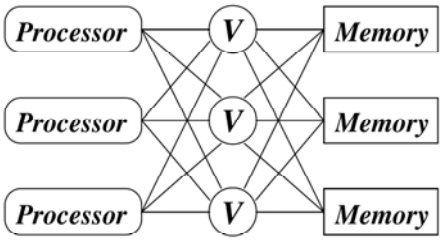
The University of Alabama in Huntsville
Electrical and Computer Engineering
CPE 633 01
Test 1
Spring 2008

Name: _____

1. (30 points) For the system diagram shown:
   (a) Derive the upper bound for system reliability.
   (b) Derive the lower bound for system reliability.
   (c) Derive the exact reliability formula.
   (d) If $R_A = R_B = R_C = R_D = R_E = R_F = R = e^{-\lambda t}$, find the MTTF for the system.



2. (20 points) Consider the processor/memory configuration shown below. List the conditions under which it will fail,and compare them to a straightforward TMR configuration in which each unit consists of a processor and a memory. Denote by Rp, Rm , and Rv, the reliability of a processor, a memory, and a voter, respectively, and write expressions for the reliability of the two TMR configurations.



3. (15 points) Derive all codewords for the separable 6-bit cyclic code based on the generating polynomial $X^3 + X^2 + 1$.

4. (20 points) A communication channel has a probability of 10^{-4} that a bit transmitted is erroneous. The data rate is 6000 bits per second (bps). Data packets contain 148 information bits, a 16-bit CRC for error detection, and 0, 8, or 16 bits for error correction coding (ECC). Assume that if 8 ECC bits are added all single bit errors can be corrected, and if 16 ECC bits are added all double bit errors can be corrected.
   (a) Find the throughput in information bits per second of a scheme consisting of error detection with retransmission of bad packets (i.e., no error correction).
   (b) Find the throughput if 8 ECC check bits are used, so that single bit errors can be corrected. Uncorrectable packets must be retransmitted.
   (c) Finally find the throughput if 16 ECC check bits are appended, so that two bit errors can be corrected. As in (b), uncorrectable packets must be retransmitted. Would you recommend increasing the number of ECC check bits from 8 to 16?

5. (15 points) Consider two computers A and B. Assuming an exponential distribution, what is the probability that at least one will survive 10,000 hours if their failure rate is 1 failure per million hours? What is the probability that both will survive 10,000 hours? What is the probability that A will survive 15,000 hours if it survived 5,000 hours?