



Name:

ID:

**Q2. (8 points)** For the tree network in question **Q1.**, assume that the MTBF and MTTR of any link are respectively 100 days and 1 day, and the MTBF and MTTR of any switch are respectively 100 days and 2 days.

- a. Find  $P_l$  and  $P_s$ , the links and switches reliabilities.
  
  
  
  
  
  
  
  
  
  
- b. Find the overall network reliability, that is, the probability that the network is connected.
  
  
  
  
  
  
  
  
  
  
- c. Find  $E(A)$ , the expected number of nodes communicating with the root node  $A$ . Recall that, for any node  $i$ :

$$E(i) = P_i \times (1 + \sum_{k \in \text{Succ}(i)} P_{j_k} E(k))$$

where  $j_k$  is the link between node  $i$  and its successor node  $k$ .

- d. Find  $EPR(A)$ , the expected number of node pairs communicating through the root node  $A$ . Recall that,

$$EPR(A) = \sum_{\substack{i, k \in \text{Succ}(A) \\ i \neq k}} P_A P_{j_i} E(i) P_{j_k} E(k) + \sum_{i \in \text{Succ}(A)} P_A P_{j_i} E(i)$$

where  $P_{j_i}$  and  $P_{j_k}$  are respectively the reliabilities of the links between nodes  $i$  and  $k$  and the root  $A$ .  $P_A$  is the reliability of switch  $A$ , and  $E(i)$ ,  $E(k)$  are as defined above.

**Q3. (2 points)** List the four models defined by the OSI network management standard.