Question 1

Draw a $(2, 2, 2)$ Clos switch, with inputs I_n, $n = 1, 2, \cdots, N$ and outputs O_m, $m = 1, 2, \cdots, M$. What are the possible numbers of inputs and outputs of the overall switch?
The following connections exist;

- $I_1 \Rightarrow O_2$ via intermediate stage #2
- $I_4 \Rightarrow O_3$ via intermediate stage #1

A new connection $I_2 \Rightarrow O_4$ is requested. Can such connection be achieved immediately? What do you propose the switch do in order to fulfill the new request?

Question 2

Draw the $(2, 2, 4)$ Clos switch in the lecture notes, with inputs I_n, $n = 1, 2, \cdots, 8$ and outputs O_m, $m = 1, 2, \cdots, 8$.
Show how the following connections can be achieved, assuming ordered arrivals:

- $I_1 \Rightarrow O_7$
- $I_2 \Rightarrow O_1$
- $I_3 \Rightarrow O_4$
- $I_4 \Rightarrow O_2$
- $I_5 \Rightarrow O_5$
- $I_6 \Rightarrow O_3$
- $I_7 \Rightarrow O_8$
- $I_8 \Rightarrow O_6$

What do you observe?

Question 3

Redesign and draw the 8×8 three-stage Clos switch of the previous problem such that to be strictly non-blocking.
Show if the list of connections in the previous problem can be achieved simultaneously.
Comment on your findings.

Question 4

Redesign and draw the 8×8 Clos switch of the previous problem assuming that only $n \times m$ switches are available, where, $n = 2, 3$ and $m = 2, 3$. You still need your switch to be strictly non-blocking

Question 5

It is required to design an ADSL system over an existing PSTN with overall system bandwidth of 1.1 MHz. The twisted pair links have a bandwidth efficiency of 1 symbol/sec/Hz. Design considerations are such that:

- A single baseband voice channel is included.
- A band gap exists between voice and data channels. This gap is at least four times the width of the voice channel.
- The downstream data rate is 10 times the upstream data rate.
- A band gap exists between upstream channels and downstream channels
- The downstream data rate is at least 5.76 Mbps.

Design your ADSL system by finding:

- The bandwidth of each sub-channel
- The total number of channels in the system
- How many channels are allocated for voice, band gaps, upstream and downstream
- The QAM scheme used. Assume it is the same for all sub-channels, in both upstream and downstream.

Instructions

- This is an individual assignment
- No late assignments are accepted
- Both soft-copies and hard-copies are required
- Questions $1 - 4$ are worth 15% each, and question 5 is worth 40% of the assignment grade.