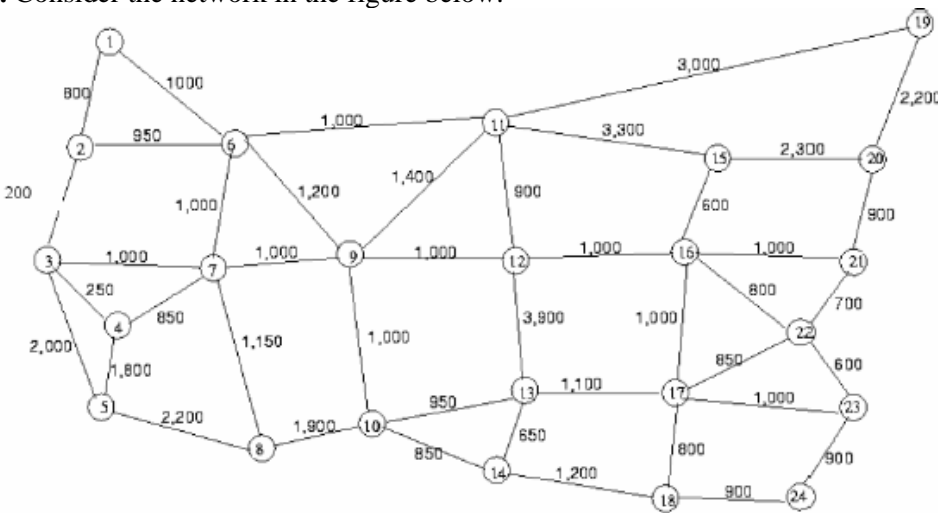


1. Explain the wavelength continuity constraint in WDM networks. How can this constraint be eliminated?
2. Explain the operation principles of EPON in downstream and upstream directions. Why is the timeslot assignment to ONU important in EPON?
3. Assume a metro network of six nodes connected as a single-hop ring topology. There are 3 wavelengths in the system, and the grooming ratio is 2. We want to establish a connection between each pair of nodes in the network (a total of 15 connections forming a fully connected virtual topology). Draw the connection graph so that minimum number of ADM are used in total.  
note: Draw a separate graph for each wavelength.
4. Explain fixed routing, fixed-alternate routing, and adaptive routing schemes in WDM networks. Which one do you expect to have a better performance in terms of connection acceptance?
5. What are the subproblems in virtual topology design problem. Is it possible to optimally solve the problem by solving its subproblems separately? Elaborate your answer.
6. Consider the network in the figure below.



- a. Find the shortest primary path from source node 3 to destination node 21.
- b. Find the shortest backup path from node 3 to node 21 for the path found in part (a).
- c. Find the primary and backup paths for the connection from node 5 to node 15, assuming dedicated path protection.
- d. Find the primary and backup paths for the connection from node 5 to node 15, allowing it to share links with the backup path of the connection between nodes 3 and 21. In a WDM network, when can two connections not share their backup paths?
- e. Suppose that we wish to use dedicated link protection for the primary path between nodes 3 and 21. Show the backup routes. What is the total cost of this dedicated-link-protection method?