

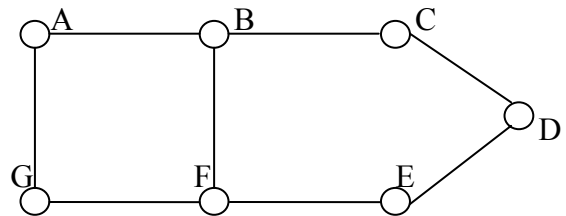
1. Short questions:

- What is OC-1? How do you calculate OC-n?
- What is the highest data rate in today's optical networks?
- What is an ISP?
- Why do we need to use WDM technology in optical networks? Elaborate your answer.
- Name two of the international bodies that set the standards in optical networks?
- Which refractive index is smaller in a fiber: core or cladding?
- What is the difference between an opaque and transparent switch?

2. Consider the PON architecture. What is the burst-mode transceiver? Explain its use and how it helps to set up an PON network? Which site of the network do we need burst-mode transceiver?

3. Suppose we are given the network in the figure and have 2 wavelengths available. The following directional lightpaths have already been set up:

- A-B-C on λ_1
- C-B-A-G on λ_2
- B-F-E on λ_1
- C-D on λ_2



We wish to set up the following lightpaths in addition:

- C-B-F-G
- E-F-G-A
- A-G-F-E-D
- A-B-C-D

Draw the lightpaths, preferably in color. At which nodes are wavelength converters required, and how many conversions are required at these nodes?

4. Give the names of three wavelength assignment schemes and explain how they work.

5. The virtual topology design formulation includes also the seven set of equations shown on the right.

- C is the capacity of a wavelength channel.
- T_i is the number of transmitters at node n .
- R_i is the number of receivers at node n .
- $V_{ij} = 1$ if there is a lightpath between nodes i and j , and 0 otherwise.
- λ_{sd} is the amount of average traffic between nodes s and d .
- λ_{ij}^{sd} denotes the traffic flowing from s to d and employing V_{ij} as an intermediate lightpath.

$$\sum_j V_{ij} \leq T_i \quad \forall i$$

$$\sum_i V_{ij} \leq R_j \quad \forall j$$

$$\lambda_{ij}^{sd} \geq 0$$

$$\sum_j \lambda_{sj}^{sd} = \lambda_{sd}$$

$$\sum_i \lambda_{id}^{sd} = \lambda_{sd}$$

$$\sum_i \lambda_{ik}^{sd} = \sum_j \lambda_{kj}^{sd} \quad \text{if } k \neq s, d$$

$$\sum_{s,d} \lambda_{ij}^{sd} \leq V_{ij} * C$$

Explain each of the equations.