

Optical Communications
Written Examination - June 16th, 2014

1. Discuss the causes of attenuation in optical fibers and specify the typical attenuation values in the three transmission windows.
2. Write the expression of the normalized frequency V for a step-profile fiber. Specify how and why the range of parameter V shall be selected for the fiber to work in the single-mode regime.
3. Briefly describe the features and the principle of operation of an optical fiber coupler. If a minimum order coupler splits the power in a 50-50% ration between the two output ports, how would the power division ratio change if the interaction length were doubled (provide explanation)?
4. A PIN photodiode has a dark current $I_b = 200$ nA and and it is closed on a $1M\Omega$ load resistance. Specify for what input optical signal level this photodiode works in the quantum detection regime.
5. A 100 MHz signal must be distributed using a star network operating at 1300 nm with a maximum users distance of 5 km, using PIN receivers, and having an available power of 0 dBm at the transmitter. A BER of 10^{-9} is required. How many users can be served?
6. Draw a scheme of an optical isolator and comment on it. What are the applications of this device?
7. Describe the principle of operation of an OTDR, specifying its typical performance. If an OTDR uses a pulsed laser with a pulse duration of 1 ns, what is the attainable spatial resolution in the measurement of back-reflected power from a fiber?
8. Discuss modern transmission systems that make use of phase-modulation formats.
9. Sketch the block scheme for a ROADM, and comment on its functionalities.
10. What is a Forward Error Correction Code (FEC)?
11. Discuss the possible effects of Four-Wave Mixing in WDM transmission systems.
12. Briefly compare the EDFA and the SOA according to the following parameters/features: a) use as line amplifier in WDM systems; b) all-optical signal processing; c) photonic integrated circuits

$$h=6.6 \cdot 10^{-34} \text{ J s}$$

$$k=1.38 \cdot 10^{-23} \text{ J/K} \quad c=3 \cdot 10^8 \text{ m/s}$$

$$V_t = 25 \text{ mV @ } 300 \text{ K}$$

$$e= 1.6 \cdot 10^{-19} \text{ C}$$