EEL 712 Optical Communication Systems
Major Exam

May 1,2009
10.30-12.30AM
Max Marks 20

Q1 An optical receiver with photodiode of capacitance of 5 pF is operated at a temperature of 300 deg K. The diode bias resistor is 4 M Ohms. It is operated in two possible modes as follows:

i) Low input resistance amplifier having input resistance of 100 ohms.
ii) Trans impedance amplifier of Gain 500 and feedback resistance 100 K Ohms.

a) For both cases find the maximum bandwidth and mean square value of thermal noise current per unit bandwidth. Compare the thermal noise values so obtained in dB.
b) Can you suggest a suitable filter after the Low Input Resistance Amplifier to increase BW. With suitable assumption find the new BW.

Q2 A Si APD has following parameters: Responsivity 0.3 A/W, Surface dark current 1000 nA, Operating temperature 300 K, Load resistance 1000 ohms, Bulk dark current 1 nA, Receiver Bandwidth 10 MHz, x = 0.4.

a) Calculate the optical power that must be incident on the detector to make the optimum gain of the APD have a value of 80.
b) For the desired gain of 80, calculate the ration in dB of the mean square noise current due to shot noise and thermal noise.

Q3 a) Discuss the relationship between Optical Bandwidth and Electrical Bandwidth. Estimate the Electrical BW corresponding to Optical BW of 100 MHz.

b) The operating life time of an LD with an activation energy of 0.6 eV is estimated as 10 years. The operating temperature is 50 deg C. By how much should the temperature be reduced so that the life time is doubled?

Q4 A fiber optic link is to be designed to operate at a BER of 10**-9 at 155 MB/sec. Estimate the power required at the detector if the APD as given above is used. State and justify any assumptions made by you.

Q5 A Fiber optic link has transmitter and receiver with the following performance:

i) Received power less than -20 dBm is a logical 0.
ii) Received power between -20dBm and -12 dBm is a logical 1.
iii) Transmitter has power range of -8 dBm to -15 dBm.
iv) These transmitter and receiver are to be used with a fiber that has an attenuation specified as being between a minimum 3dB/Km and a maximum of 4dB/Km. Calculate the dynamic range of a 2Km link neglecting all other losses except fiber attenuation. What is the maximum distance over which the link can be operated?

Q6 A cascade of optical amplifiers are used in a link where the gain for each amplifier is 30 dB. The total power output of each amplifier is 10 mW. The optical bandwidth is 125X 10**9 Hz and the optical amplifier has a spectral width of 25 nm and wavelength of 1550 nm. The constant η_{SP} for the optical amplifier is 1.25. The product LGo of the amplifier = 3. The fiber attenuation is 0.3 dB/km. It is desired to transmit at a data rate of 2.5 Gb/s and the BER required is 10**-9. calculate after how many stages of optical amplifiers the signal power is sufficiently large compared to ASE noise power to achieve the desired BER. State any assumptions that you make.

Q 7 a) How the basic rate of SDH is calculated?
b) Explain FWM and how many side bands are generated for 32 channel DWDM system?

Q 8 a) Draw a diagram for 8 channel Optical multiplexer using 3 db couplers?
b) Draw a diagram for single wavelength channel drop from 4 channel multiplexed optical signal using FBG?