DEPARTMENT OF ELECTRICAL ENGINEERING

EEL712 -OPTICAL COMMUNICATION SYSTEM

MAJOR TEST 3rd May 2005

1. Consider a 0.8 μm receiver with silicon p-i-n photodiode. Assume 20 MHz bandwidth, 65% quantum efficiency, 1nA dark current, and 8pF junction capacitance and 3-dB amplifier noise figure. If the receiver is to be used in a digital communication system that requires a SNR of at least 20 dB for satisfactory performance, calculate the minimum received power when the detection is limited by thermal noise. Also calculate the NEP (Noise Equivalent Power).
(6 marks)

2. What method is used to determine the performance of an optical digital system? Give the experimental setup for the same.
(6 marks)

3 Give two methods for making wavelength dependent multiplexers. Give their layout.
(6 marks)

4. Discuss the origin of gain saturation in fiber Raman amplifier. A Raman amplifier is pumped in forward direction using 1W of power. Find the output power and the gain of the amplifier when a 1-μW signal is injected into the 5-km-long amplifier. Assume losses of 0.2 and 0.25 dB/km at the signal and pump wavelengths, respectively, A_{eff} =50 μm^2, and g_R =6X10^{-14} m/W. Neglect gain saturation.
(2+5) marks

5. Suppose a 0.5W, 1550 nm signal is transmitted across a 0.5 km fiber, through an 8X8 passive star coupler, and through another 1.5 km of fiber before reaching its destination. Each connector has a1-dB loss, the excess loss in the star coupler is 2-dB.No amplifiers are used. What is the power of the signal at the destination? $\alpha = 0.22 dB/km$.. Next, a 5-station linear bus is connected to the output fiber (1.5 km) with each station separated by 500m fiber. Assume
$C_T = 10\% and L_{thru} = 0.9 dB, L_t = 0.5 dB, L_c$ = 1.0 dB
Calculate the dynamic range of the network.
(6 marks)

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6. Design a 4-wavelength transmission system operating over dispersion-shifted fiber. The four wavelengths are to be placed in a band from 193.1 THz to 194.1 THz. The possible slots are placed 100 GHz apart in this band. Pick the four wavelengths carefully so that no FWM components fall on any of the chosen wavelengths.
(5 marks)

7. The C and L spectral bands cover a wavelength range from 1.53 to 1.63 μm., how many channels can be transmitted through WDM when the channel spacing is 25 GHz? The transmitter tuning range is from 1450 nm to 1600 nm and the receiver tuning range is from 1500 nm to 1650 nm. What is the effective bit rate-distance product when a WDM signal covering the two bands using 10 Gbps channels is transmitted over 2000 Km.
(4 marks)

$h = 6.6256 \times 10^{-34}$ J.s **$k = 1.38 \times 10^{-23}$ J/K**