DEPARTMENT OF ELECTRICAL ENGINEERING

EEL712 -OPTICAL COMMUNICATION SYSTEM

MAJOR TEST **28th April 2008**

1. For a step index fiber with a core radius of 4 μ m and a eladding refraetive index of 1.45, determine the range of core refraetive index for whieh the fiber will be single moded for all wavelengths in the 1310 to 1550 nm range?
(2 marks)

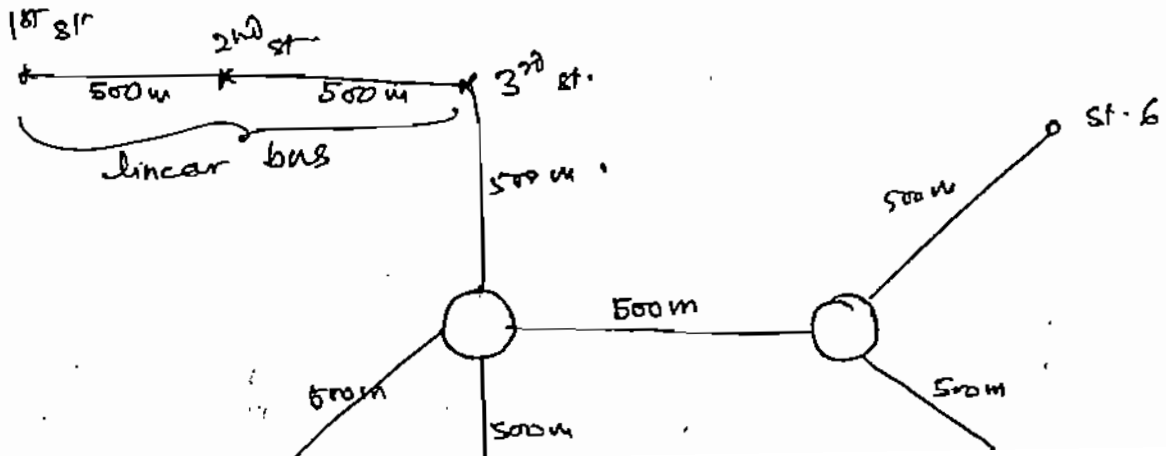
2. (a) Consider a pin direct detection receiver where the thermal noise is the main noise component. What is the receiver sensitivity expressed in photons per bit at a bit rate of 100 Mb/s for a BER of 10^{-9}? Assume that the operating wavelength is 1550 nm and the reponsitivity of 1.25 A/W, load resistance of 50 ohms and T=300 ^{0}K. Assume the electrical bandwidth is half the bit rate.

   (b) How will the receiver sensitivity be improved with an optically preamplified receiver with gain of 20 dB, $n_{sp} = 2$ and for a $B_{opt} = 2B_{elec}$, assuming noise to be signal-ASE beat noise limited?

   (5+5 marks)

3. For a network the 7 nodes are connected as shown in the figure. The parameters of the network components are:
   - Fiber attenuation constant: 0.4 db/km
   - Each STAR coupler excess loss: 1 dB
   - Connector loss: 1 dB
   - Passive coupler used in linear bus : Intrinsic transmission loss: 0.5 dB
   - C_T = 10% for the passive coupler

   All the nodes have a transmitter with a LD of 3 dBm. Calculate the minimum sensitivity of the receiver connected to a node in order to communicate with each other?
(6 marks)



4. Calculate the SNR at the output of two easeaded EDFA with a fiber of 10 km and $\alpha = 0.2dB/km$ connected between the two. Each amplifier has a gain of 30-dB, B_{opt} to be 30-nm spectrum at 1550nm. The input to the first amplifier is -20dBm and $n_{sp} = 2$. Pump wavelength and power for each amplifier is 980nm and 30mW, respectively.
(6 marks)

5. Consider a WDM system of 4 channels in the ITU-T G.694.1 with 100 GHz spacing starting from 1569.59 nm (191.00 THz). The system uses PIN diodes and uses no optical amplifiers in the link length of 100 km. Each channel carries a power of 10 mW. Calculate the power penalty due to cross talk due to (i) FWM in the 2nd and 3rd channel taking only into account the $f_i + f_j - f_k$ terms and (ii) Raman scattering in the system. Take:
$\alpha = 0.2dB/km, \bar{n} = 3x10^{-8}\,\mu m^2/W, d_{ijk} = 4, A_e = 50\mu m^2, g_R = 6x10^{-14}\,m/W,$
Raman gain bandwidth is 125 nm.
(5+5 marks)

6. (i) Discuss two application of Fiber Bragg Gratings
(ii) Difference between the modal noise and the mode-partition noise in the fiber systems.

(3+3 marks)

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

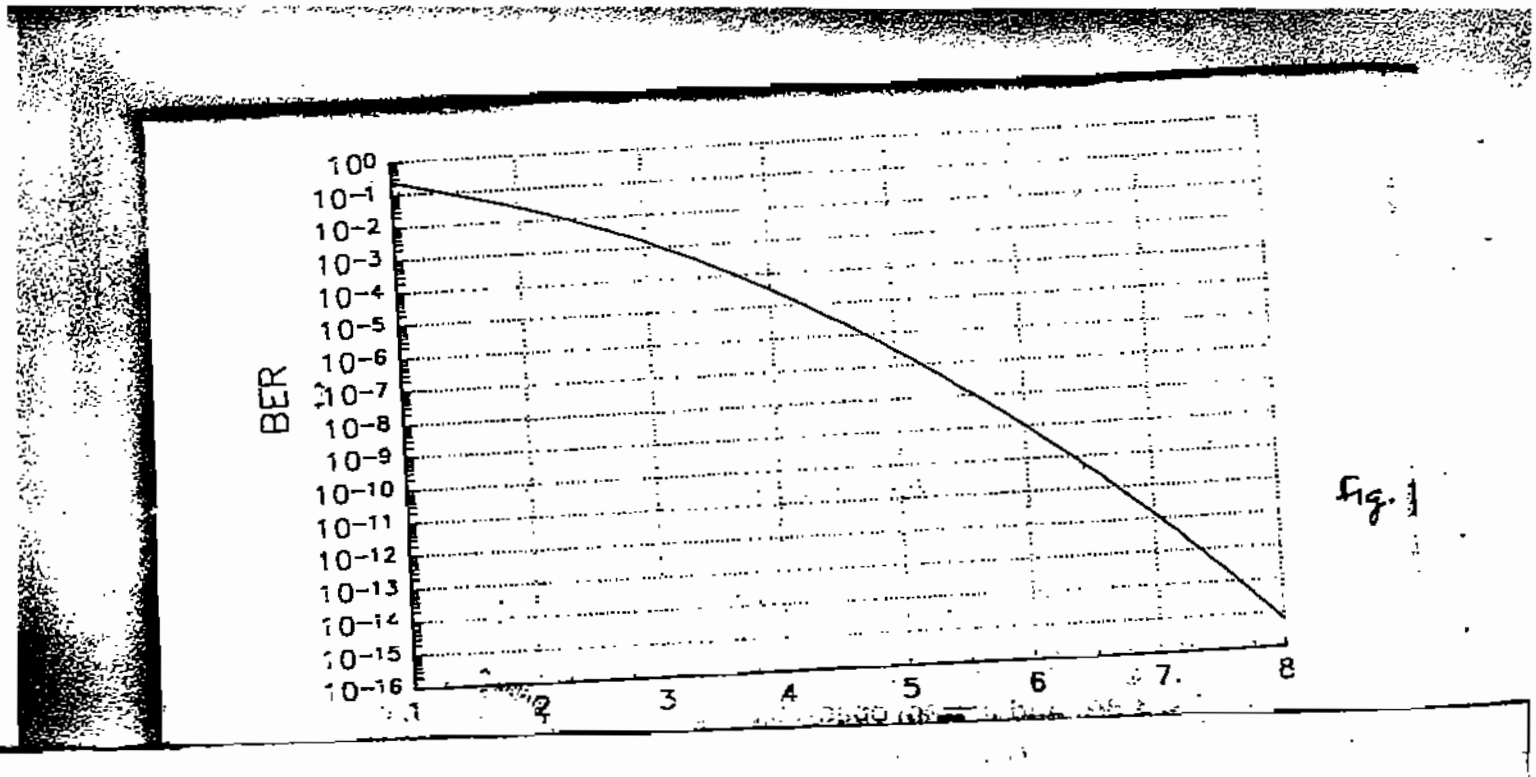


Fig. 1