NATIONAL INSTITUTE OF TECHNOLOGY ANDHRA PRADESH

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Minor-II

Program/course: B. Tech ECE **Semester – V**I

Subject: Optical Communication **Code:** EC317

Max. Marks: 10

Instructions:

- Attempt all questions in order.
- Assume any data if required and indicate the same clearly. Unless otherwise indicated symbols and notations have their usual meanings.

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1. A *p–i–n* photodiode on average generates one electron–hole pair per three incident photons at a wavelength of 0.8 μm. Assuming all the electrons are collected calculate: (a) the quantum efficiency of the device; (b) its maximum possible bandgap energy; (c) the mean output photocurrent when the received optical power is 10^{-7} W.
2. A silicon *p–i–n* photodiode with an area of 1.5 mm^2 is to be used in conjunction with a load resistor of 100 Ω. If the requirement for the device is a fast response time, estimate the thickness of the intrinsic region that should be provided. It may be assumed that the permittivity for silicon is 1.04×10^{-10} F m^{-1} and that the electron saturation velocity is 10^7 m s^{-1}.
3. The incoming signal power to an ASK optical heterodyne receiver operating at its shot noise limit is 1.28 nW for a received SNR of 9 dB. Determine the transmission wavelength of the ASK system if the quantum efficiency of the photodetector is 75% at this wavelength and the transmission bandwidth is 400 MHz.
4. A digital single-mode optical fiber system is designed for operation at a wavelength of 1.5 μm and a transmission rate of 560 Mbps over a distance of 50 km without repeaters. The single-mode injection laser is capable of launching a mean optical power of −13 dBm into the fiber cable which exhibits a loss of 0.25 dB/km. In addition, average splice losses are 0.1 dB at 1 km intervals. The connector loss at the receiver is 0.5 dB and the receiver sensitivity is −39 dBm. Finally, an extinction ratio penalty of 1 dB is predicted for the system. Perform an optical power budget for the system and determine the safety margin.
5. Today, millions of citizens in the country are interested in using telephony, mobile, and broadband services. For this, it requires a high-speed internet connection, which is also important for economic growth and global competitiveness. Therefore, the ministry of the

country supported an ambitious PON / FTTH program to cover the whole country and provide high-speed internet. Suppose in a city there are 280 homes for which fiber network service has been requested in a particular area, how can you plan or develop the network to provide the connection to everyone through the FTTH program. Given that the maximum loss planned (link budget) is 23 dB, fiber loss is 0.2 dB/km. Assume that the given area contains 7 streets, and the network model is shown in figure below for one street. (hint: use the amplifiers/repeaters along with splitters and use either 1:32 or less splitter ratio power splitters if it is required according to your plan)