

Total No. of Questions : 8]

SEAT No. :

P-607

[Total No. of Pages : 3

[6004]-556

B.E. (E & TC)

Fiber Optic Communication

(2019 Pattern) (Semester - VIII) (404190)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Assume suitable data, if necessary.

Q1) a) A photodiode has a quantum efficiency of 65% when photons of energy 1.5×10^{-19} J are incident upon it. [6]

- i) at what wavelength is the photodiode operating?
 - ii) Calculate the incident optical power required to obtain a photocurrent of 2.5 μ A.
- b) Define the quantum efficiency and the responsivity of a photodetector. Give the mathematical equations for the same. [6]
- c) Compare PIN diode with APD (any 3 points). [6]

OR

Q2) a) An InGaAs PIN photodiode has the following parameters at a wavelength of 1300 nm: $I_D = 4$ nA, $\eta = 0.90$, $R_L = 1000\Omega$, and the surface leakage current is negligible. The incident optical power is 300 nW (−35 dBm) and the receiver bandwidth is 20 MHz. Find the following noise terms of the receiver. [6]

- i) The mean-square dark current
 - ii) The mean-square thermal noise current
- b) What is a photodetector? Discuss various requirements of a photodetector to be used in optical communication. [6]
- c) With the help of diagram explain working of p - n photodiode. Draw its output characteristics. [6]

P.T.O.

- Q3)** a) A 1550-nm single-mode digital fiber optic link needs to operate at 622 Mb/s over 80 km without amplifiers. A single-mode InGaAsP laser launches an average optical power of 13 dBm into the fiber. The fiber has a loss of 0.35 dB/km and there is a splice with a loss of 0.1 dB every kilometer. The coupling loss at the receiver is 0.5 dB and the receiver uses an InGaAs APD with a sensitivity of -39 dBm. Excess-noise penalties are predicted to be 1.5 dB. Setup an optical power budget for this link and find the system margin. [6]
- b) Draw and explain simplex point to point optical link. [6]
- c) Illustrate the working of optical amplifier. Enlist the semiconductor materials used for active medium in DFAs. [6]

OR

- Q4)** a) Sketch and explain implementation of a typical WDM network. Enlist some of the active WDM components. [6]
- b) A digital optical fiber system uses an RZ pulse format. An optical fiber link is required to operate over a distance of 10 km without repeaters. The fiber available exhibits a rise time due to intramodal dispersion of 0.2 ns/km. In addition the APD detector has a rise time of 1 ns. Estimate the maximum rise time allowable for the system, if the source has a rise time of 4 ns in order for the link to be successfully operated at a transmission rate of 40 Mbps. [6]
- c) Describe Optical power loss model. Draw a neat diagram for the same. [6]
- Q5)** a) With the help of diagram explain various elements used in optical networks. Explain the modularity and scalability features of an optical network. [6]
- b) What are the corresponding levels and bit rates for SDH and SONET? Draw and explain STS-1 frame structure. [6]
- c) i) Calculate how many 64-kb/s voice channels can be carried by an STS-3, STS-48, and STS-192 system.
- ii) How many 20-Mb/s digitized video channels can be transported over STS-3 systems? [5]

OR

- Q6)** a) Draw and explain general structure of a passive optical network (PON). [5]
b) Compare EPON, APON and GPON (any 3 points). [6]
c) Explain the following w.r.t. SONET. [6]
i) Structure
ii) Operation
iii) Advantages
- Q7)** a) Enlist widely used optical system test instruments and explain their functions. [6]
b) Draw Schematic experimental setup for determining fiber attenuation by the cutback technique. Explain the same. [6]
c) Draw representative trace of backscattered and reflected optical power as displayed on an OTDR screen and explain the meanings of various trace features. [5]

OR

- Q8)** a) Illustrate Operational principle of an OTDR using an optical circulator. Draw the corresponding diagram. [6]
b) Explain Eye diagram test. Define fundamental measurement parameter. [6]
c) Consider the case when the power at the photodetector prior to inserting the filter is $P_1 = 0.51 \text{ mW}$ and the power level with the optical filter in the link is $P_2 = 0.43 \text{ mW}$. What is the insertion loss of the device? [5]
