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 μA.

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 wave length of 1300 nm: I_D = 4 nA, η = 0.90, R_L = 1000Ω, 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 $P_1 = 0.51$ mW and the power level with the optical filter in the link is $P_2 = 0.43$ mW. What is the insertion loss of the device? **[5]**

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