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BIELE-008

B.Tech. – VIEP – ELECTRONICS AND COMMUNICATION ENGINEERING (BTECVI)

00135

Term-End Examination

June, 2014

BIELE-008 : OPTO ELECTRONICS COMMUNICATION SYSTEMS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **seven** questions. All questions carry equal marks. Missing data may be suitably assumed. Use of scientific calculator is permitted.*

1. (a) Define the term Numerical Aperture. Also derive the relationship : $NA = n_1 (2\Delta)^{1/2}$ where n_1 is the refractive index of core and Δ is the relative refractive index difference. *5*

(b) An optical fiber in air has a Numerical Aperture (NA) of 0·4. Compare the acceptance angle for meridional rays with that for skew rays which change direction by 100° at each reflection. *5*

2. (a) What are the causes of attenuation in optical fibers ? *5*

(b) Why could bending losses in single mode fibers be severe ? What can be done to minimize these losses ? *5*

3. (a) Explain in brief the Kerr Non-linearity. *5*

(b) What do you understand by self-phase modulation ? Explain. *5*

4. The mean optical power launched into an 8 km length of fiber is 120 μW, the mean optical power at the fiber output is 3 μW. Determine the following : *4+2+4=10*

(i) The overall signal attenuation or loss in dB through the fiber assuming there are no connectors or splices.

(ii) The signal attenuation per km for the fiber.

(iii) The overall signal attenuation for a 10 km optical link using the same fiber with splices at 1 km intervals, each giving an attenuation of 1 dB.

5. (a) Show that the threshold gain per unit length for laser can be given as

$$\bar{g}_{th} = \bar{\alpha} + \frac{1}{2L} ln \frac{1}{r_1 r_2}$$

where $\bar{\alpha}$ is loss coefficient per unit length. r_1 and r_2 are the reflectivities of the mirror. L is the length of the region between the two mirrors. *5*

(b) What are the various drawbacks associated with Avalanche Photodiode ? *5*

6. Explain the following terms with reference to the Injection Lasers : *4+3+3=10*

(i) Relaxation Oscillations

(ii) Frequency Chirp

(iii) Mode Hopping

7. (a) Explain the following : $2 \times 2\frac{1}{2} = 5$

(i) Quantum Efficiency

(ii) Responsivity

(b) When 3×10^{11} photons each with a wavelength of 0·85 μm are incident on a photodiode, an average $1{\cdot}2 \times 10^{11}$ electrons are collected at the terminals of the device. Determine the quantum efficiency and responsivity of the photodiode at 0·85 μm. *5*

8. Identify the characteristics which are of the greatest interest in the pursuit of High Performance Receivers ? Also discuss the major techniques which have been adopted in order to produce such high performance receiver for use in long-haul optical fiber communication ? *10*

9. (a) Explain the forward and backward pumping capability associated with the fiber Raman Amplifier. *5*

(b) A fiber Raman Amplifier has a length of 2 km. The attenuation coefficients α_s and α_p for signal and pump wavelengths for this fiber are 0·15 and 0·20 dB/km respectively. Assume that the cross-sectional area of the pump beam is 60 μm^2 and Raman gain coefficient is 5×10^{-14} m/W. The amplifier is pumped by a laser of 1 W power. If the input signal power is 1 μW, calculate the output signal power for forward pumping. *5*

10. Write down the features associated with Brillouin Amplifier. Also explain its limitations. *5+5=10*