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10EC/TE72

Seventh Semester B.E. Degree Examination, June/July 2018
Optical Fiber Communication

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Using Snell's law, derive an expression for numerical aperture of a fiber optic cable. **(08 Marks)**

b. Explain total internal reflection and photonic crystal fibers. **(06 Marks)**

c. A graded index fiber has a core with a parabolic refractive index profile which has a diameter of 50 μm. The fiber has a numerical aperature of 0.2. Find total number of guided modes propagating in the fiber when it is operating at a wavelength of 1 μm. **(06 Marks)**

2 a. Derive an expression for pulse spreading due to material dispersion. **(08 Marks)**

b. Explain fiber bending loss with neat diagram. **(08 Marks)**

c. A 6 km optical link consists of multimode step index fiber with a core refractive index of 1.5 and a relative refractive index difference of 1%. Estimate the delay between the slowest and fastest modes at the fiber output and also find the rms pulse broadening due to intermodal dispersion on the link. **(04 Marks)**

3 a. A double-heterojunction InGaAsP LED emitting at a peak wavelength of 1310 nm has radioactive and non radioactive recombination times of 30 and 100 ns, the derive current is 40 mA. Find the recombination life time and internal power generated. **(06 Marks)**

b. Explain the GaAs homojunction injection laser with fabry-perot cavity and also derive its quantum efficiency of the above laser. **(08 Marks)**

c. A photodiode has a quantum efficiency of 65% when photons of energy 1.5×10^{-19} J are incident upon it. At what wavelength is photo diode operating and also calculate the incident power required to obtain a photo current of 2.5 μA (Assume e = 1.602×10^{-19}). **(06 Marks)**

4 a. Explain the three types of misalignment which occur when joining optical fibers. **(08 Marks)**

b. Discuss about star coupler and also give its splitting and excess loss. **(06 Marks)**

c. An optical fiber has a core refractive index of 1.5. Two lengths of the fiber with smooth and perpendicular end faces are butted together. Assuming fiber axes are perfectly aligned, calculate optical loss in decibels at the joint. When there is a small air gap between the fiber end faces. **(06 Marks)**

PART – B

5 a. Derive SNR for Analog receiver. **(08 Marks)**

b. Explain the term receiver sensitivity. Derive an equation for receiver sensitivity interms of photodetector noise. **(08 Marks)**

c. Explain the basic sections of an optical receiver with neat diagram. **(04 Marks)**

6 a. Derive an expression for carrier to noise ratio of an analog optical fiber communication. **(08 Marks)**

b. Explain sub-carrier multiplexing technique in detail with neat diagram. **(06 Marks)**

c. Explain Radio over fiber links. **(06 Marks)**

7 a. Explain the operation of a polarization independent isolator with neat diagram. **(06 Marks)**

b. Discuss about chromatic dispersion compensator. **(06 Marks)**

c. Derive an equation for path difference in a 2×2 Mach-Zehnder interferometer. **(08 Marks)**

8 a. Derive an equation for amplifier gain in semiconductor optical amplifiers. **(08 Marks)**

b. Explain Ultra fast point to point transmission system using optical TDM. **(08 Marks)**

c. Consider an EDFA being pumped at 980 nm with a 30 mW pump power. If the gain at 1550 nm is 20 dB. Find the maximum input and output power of the amplifier. **(04 Marks)**

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