CONTINUOUS ASSESSMENT (2023)
EE5134 OPTICAL COMMUNICATIONS AND NETWORKS Part II

Q. 1

(a) An optical fiber has a length of 30 km and an attenuation of 0.4 dB/km. The output optical power from the fiber is 10 μW. Calculate the input optical power launched into the optical fiber in terms of μW.

(5 marks)

(b) A step-index fiber has a core diameter of 12-μm and a core refractive index of 1.445. The relative refractive index difference Δ is 0.18% at operating wavelength of 1.3-μm. Useful constants are given in Appendix.

(i) Estimate the normalized frequency of the fiber.

(5 marks)

(ii) Estimate the number of guided modes.

(5 marks)

(iii) Determine the relative refractive index difference Δ required to make the fiber in single mode operation.

(5 marks)

Q. 2

(a) A ruby laser contains a crystal with refractive index of 1.77 and length of 5 cm. The peak emission wavelength is 0.56 μm.

(i) Calculate the number of longitudinal modes.

(5 marks)

(ii) Determine their frequency separation (free spectral range).

(5 marks)

(b) Explain the spontaneous emission process and stimulated emission process and compare their differences. (hint: can use figures/drawings to explain)

(5 marks)

(d) An avalanche photodiode (APD) is working with a quantum efficiency of 0.72 at 850 nm wavelength under multiplication factor M=1. The APD is then biased to work under M=100, and the multiplied photocurrent is 500 nA. Calculate its incident optical power. Useful constants are given in Appendix.

(5 marks)

Appendix

Speed of light in vacuum = 3×10^{8} m/s,
Electric charge = 1.6×10^{-19} C,
1eV = 1.6×10^{-19} J
Planck's constant = 6.63×10^{-34} J·s,
Boltzmann constant = 1.38×10^{-23} J/K
Room temperature = 300K
Air refractive index = 1