M.Tech(with Credits)-Regular-Semester 2012-Electronics & Communication Engineering Sem II

Advanced Optical Communication

P. Pages : 2 **GUG/W/16/5981**

Time : Three Hours * 3 6 6 0 * Max. Marks : 70

Notes : 1. All questions carry equal marks. Attempt **any five** question.
2. Illustrate your answers wherever necessary with the help of neat sketches.

1. a) Draw and explain a general optical fiber communication system. What are the advantages of optical fiber communication. **6**

b) Explain ray leigh scattering. **2**

c) Silica has an estimated fictive temperature of 1400 k with an isothermal compressibility of 7×10^{-11} m^2 N^{-1}. The R I and the photoelastic coefficient for silica are 1.46 and 0.286 respectively. Determine the theoretical attenuation in decibels per kilometer due to the fundamental Rayleigh scattering in Silica at optical wavelength of 0.63, 1.00 and 1.30 µm. Boltzmann Constant is 1.381×10^{-23} Jk^{-1}. **6**

2. a) What is Modal birefringence in polarization. **4**

b) Two polarization maintaining fibers operating at a wavelength of 13 µm have heat lengths of 0.7 mm and 80m. Determine the modal birefringence in each case and comment on the results. **4**

c) Explain any two nonlinear scattering losses. **6**

3. a) Define operational efficiency of a semiconductor laser. Derive expressions for the same. Hence derive expressions for total efficiency. **5**

b) The total efficiency of an injection laser with a Ga As active region is 18%. The voltage applied to the device is 2.5 V and the band gap energy for GaAs is 1.43 eV. Calculate external power efficiency of the device. **5**

c) Explain the operation of ND: YAG laser **4**

4. a) Explain the operation of surface emitter LED. **4**

b) A DH surface emitter which has an emission area diameter of 50µm is butt joined to an 80 µm core step index fiber with a numerical aperture of 0.15. The device has a radiance of 30W sr^{-1} cm at a constant operating drive current. Estimate the optical power coupled into the fiber if it is assumed that the Fresnel reflection coefficient at the index matched fiber surface is 0.01. **6**

c) Explain in brief planar and Dome LEDs. **4**

5. a) Explain Quantum efficiency and responsivity in photodetector. **4**

b) When 3 x 10" photons each with a wavelength of 0.55µm are incident on a photodiode, on average 1.2×10^{11} electrons are collected at the terminals of the device. Determine the Quantum efficiency and responsivity of the photodiode at 0.85µm. **5**

c) Explain the operation of photoconductive detectors. **5**

6. a) Explain how spectral loss in optical fibers in measured using cutback technique. **7**

b) Explain how fiber scattering loss in measured experimentally. **7**

7. a) Explain multimode fiber dispersion measurement is done in time domain. **7**

b) Pulse dispersion measurements are taken over 1.2 km length of partially graded multimode fiber. The 3 dB widths of the optical input pulse are 300 ps and the corresponding 3 dB widths for the output pulses are found to be 12.6 ns. Assuming the pulse shapes and fiber impulse response are Gaussian calculate. **7**

a) the 3 dB pulse broadening for the fiber in ns km^{-1}

b) the fiber bandwidth length product.

8. Write short notes on **any two.** **14**

a) Angular dispersive devices.

b) Optical multiplex design considerations.

c) WDM.

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