Dr Abhijeet Bhattacharya 21/11/2023 (64)

Roll No.:

National Institute of Technology, Hamirpur (HP)

Electronics & Communication Engineering Department

B. Tech. and Dual Degree End Semester Examination (November 2023)

Semester: 7th

Subject: Optical Communication Systems and Networks **Subject Code:** EC - 412

Time: 3 Hour **Maximum Marks:** 50

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Note:

1. All the questions are compulsory.
2. Assume standard values for any missing data.

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1. i) A graded index fiber has a core with a parabolic refractive index profile which has a diameter of 40 μm. The fiber has a numerical aperture of 0.1. Estimate the total number of guided modes propagating in the fiber when it is operating at a wavelength of 1 μm.

ii) Silica has an estimated fictive temperature of 1400 K with an isothermal compressibility of 7×10^{-11} m^2 N^{-1}. The refractive index 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 wavelengths of 0.63, 1.00 and 1.30 μm. Boltzmann's constant is 1.381×10^{-21} J K^{-1}.

iii) Explain different nonlinear scattering losses. **2+4+4=10**

2. i) The radiative and nonradiative recombination lifetimes of minority carriers in the active region of a double-heterojunction LED are 60 ns and 100 ns respectively. The refractive index of the material is 3.5. Determine the power internally generated within the device and power emitted from the device when the peak emission wavelength is 0.87 μm at a drive current of 40 mA.

ii) Derive the expression for different longitudinal modes of a laser. Further discuss the procedure for obtaining single longitudinal mode lasing action. **5+5=10**

3. i) Explain the procedure for lasing. Further derive the expression of threshold gain for lasing action in a resonator cavity.

ii) With mathematical expressions discuss the quantum efficiency and photocurrent of an optical detector. **5+5=10**

4. i) Explain optical wavelength division multiplexing technique.

ii) Explain the procedure for optical amplification using EDFA. Further discuss about its quantum conversion efficiency. **5+5=10**

5. Write notes on **any two** of the following:

a) Liquid phase techniques **b)** Optical networks **c)** Double heterostructure LED **d)** Splices **5+5=10**

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