BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI, RAJASTHAN

First Semester 2023-2024
Mid Semester Test (Open Book)

Course no: EEE G591 Max. Marks :60
Course Title: Optical Communication Weightage : 30%
Date : 09-10-2023 Duration : 90 minutes

Note: Please fill the blanks with appropriate answers OR strike off the wrong words as per the question. (This part has to be returned) 10x3=30

1. (i) A step index multimode fiber provides a maximum data rate of 40 mbps , if the core index is 1.5 the typical value of **Δ** would be ----------and supported data rate for graded index fiber would be ---------.

   (ii) A SI fiber is operated at V=2.2 at 1520 nm, the critical wavelength to operate as a single mode would be ---------- and will support ----------no of modes at 1500 nm.

   (iii) Dispersion limited lengths in an optical fiber having β_2 and β_3 as 0.4 ps^2/km and 1ps^3/km for a pulse having FWHM as 16.7 ps would be ----------and ---------- respectively.

   (iv) In a standard fiber a pulse of T_0 as 10 ps broadens to 1.41 times after 800 km. The GVD parameter would be -- ------ and if the T_0 is 12 ps then pulse broadening would be ----------times after 1000 km.

   (v) A narrow source based optical system is working at 40 Gbps close to zero wavelength , the operating data would become --------if the link length is increased by 64 time. Further the data rate would be ----------if the source is kept away from zero wavelength in the extended length case.

   (vi) The electro-optic based (A+B) and (A.B) gate circuits may be implemented by the following

(vii) In a semiconductor laser with 200 μm cavity length and index of 3.2, the frequency separation between adjacent longitudinal modes would be ---------- and contained number of modes would be ----------if the gain bandwidth is 20 THz.

(viii) In a SI fiber five channels each with a channel seperation of 2 nm are to be employed for maximum data transmission. The tentative selected channel wavelength would be ----------, ---------- and ----------if the λ_z of the fiber is 1330nm. The data rate limitation due to D would be nearly----------. (assume S= 1ps/km.nm^2

(ix) Sketch the spectrum of a laser of 210 THz passing through a fiber in the forward direction in case (i) Raman scattering (ii) Brillouin Scattering showing their bandwidth also.

(x) A SI fiber operating at 1400 nm finds D value as + 4 ps/km.nm and can operate upto ----------data rate for a 40 km link. Now to compensate this dispersion after this link in the next link having the 20 km length, the dispersion value of the fiber would be ----------.

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First Semester 2023-2024
Mid Semester Test (Close Book) Tentative time: 45 minutes

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Q.1: Discuss different types of dispersions available in a single mode fiber mentioning their typical values and highlight the role of zero dispersion. Comment on the data rate capability of the optical fiber in terms of fiber, source parameters with some specific example.

(6)

Q.2: Discuss any four specification of a high speed optical transmitter mentioning temperature effect on operating wavelength, threshold current and line width of the source. How and when external modulator is required in optical communication system. Discuss in brief the difference between LED and ILD source.

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(6)

Q.3: : A signal at 1550 nm is propagating in a standard SI single mode fiber and shows a down shift in the scattered light in the backward/ forward direction. Discuss on the possible reason for this scattering, level of power required for this to happen and possible scattered wavelength for a strongest scattered light in this case with typical bandwidth. How non linear limited system length is calculated, explain with a specific example ?

(6)

Q.4: A lightwave system is to be designed at 1.55μm for a single channel bit rate of 10Gbps for a 200 Km link Show the appropriate system blocks needed to implement the project taking care of dispersion management with relevant specifications using the similar type of the fiber in the whole design.

(6)

Q.5: Discuss impairment caused by four wave mixing in multichannel transmission and mention the plan to avoid this effect. Explain how a FWM can be used to design a optical conjugator and also discuss the role of optical conjugator in dispersion compensation.

(6)
