BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI, RAJASTHAN

First Semester 2022-2023
Mid Semester Test (Open Book)

Course no: EEE G591 Max. Marks :60
Course Title: Optical Communication Weightage : 30%
Date : 04-01-2022 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 graded index multimode fiber provides minimum dispersion for α=2 as 1.2 ns then in a SI fiber having same core size, axis index and cladding index the corresponding delay and supporting data rate would be –----------and ----------respectively if **Δ** value is 0.01.

   (ii) In a standard optical fiber a signal is to be transmitted at 1550 nm, to achive initial pulse compression during propagation the pulse should have positive/zero/negative chirp and for a chirp value of 4 the pulse width becomes minmimum at distance of 20 km, the dispersion length of the fiber would be ------..

   (iii) A SI fiber is operated at V=2.3 at 1520 nm, the critical wavelength to operate as a single mode would be ---------- and will support ----------no of modes at 1550 nm.

   (iv) A narrow source based optical system is working at 60 Gbps close to zero wavelength , the operating data would become --------if the link length is increased by 27 time. Further the data rate would be ----------if the source is kept away from zero wavelength in the extended length case.

   (v) The electro-optic based OR and EXOR gate circuits may be implemented by the following

(vi) In a semiconductor laser with 100 μm cavity length and index of 3.5, the frequency separation between adjacent longitudinal modes would be ---------- and contained number of modes would be ----------if the gain bandwidth is 16 THz.

(vii) Dispersion limited lengths in an optical fiber having β_2 and β_3 as 0.4 ps^2/km and 0.5ps^3/km for a pulse having FWHM as 17.6 ps would be ----------and ----------respectively.

(viii) In a SI fiber three 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) A SI fiber with core diameter of 8 micron operates at V=2.3 , the effective core area would be ------and the poer confinement of the fundamental mode in the core would be ------

(x) For a SRS in the long fiber having loss as 0.16 dB/km and 0.1 dB/km , the effective fiber length would be ----------and ----------respectively.

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First Semester 2022-2023
Mid Semester Test (Close Book) Tentative time: 45 minutes

Course no: EEE G591 **Max. Marks :60**
Course Title: Optical Communication **Weightage : 30%**
Date : 04-01-2022 **Duration : 90 minutes**

Q.1: A digital receiver working at 1 Gbps data rate on 1550 nm with quantum efficiency of 0.8, compute the minimum received power for a BER of 10^{-14}. How does the extinction ratio of transmitter biasing influence the power penalty at the receiver ? Estimate the average received power in terms of thermal noise (σ_t) at this receiver if r_{ex} is kept at 40% and also the power penalty offered in the system. (Assume thermal noise dominance)

(6)

Q.2: Discuss any four specification of a high speed optical transmitter mentioning temperature effect on operating wavelength and line width of the source. How and when external modulator is required in optical communication system , illustrate ASK,PSK and FSK modulation schemes using electro-optic modulation.

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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. Comment on the scattering process if an additional 1540nm source is also added in the same fiber. 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 20Gbps 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 two important non linear effects limiting pulse propagation through single mode fiber and explain their influence in terms of measurable parameters. How can these be mitigated ?

(6)
