BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI, RAJASTHAN
First Semester 2023-2024
Comprehensive Examination

Course no: EEE G591 Max. Marks :70
Course Title: Optical Communication (**Open-Book- 35)** Weightage : 35%
Date : 07-12-2023 Duration : 3Hrs

Strike off the incorrect alternative or fill in the gaps with appropriate words as per the question. (Q1 to Q 7 each 2 marks + Q 8 to Q 14 each 3 marks)

Q.1: A standard SM fiber would have material dispersion at 1200nm as --------- and at at 1400 tis would be --------- which can be minimized by ---------.

Q2. A standard SM fiber dispersion slope would be maximum at --------nm and minimum at ---------- nm.

Q.3 : If the extinction ratio power penaly is nearly 2 db, the P_1/P_0 ratio would be close to ----------if this ratio is increased the power penalty increases/decreases.

Q.4: An optical source with small spectral width source operates near 1330 nm in an optical fiber and can support 40 Gbps for 20 km. If the data rate requirement is relaxed to 20 Gbps , then it may operate up to a ---------km distance. Now if the same source operating wavelength is shifted to 1500 nm and still works for 40 Gbps upto 20 km , then the new distance would be for a 20 Gbps equal to ----------km.

Q.5: In a fiber if the effective index is 1.6 and acoustic wave velocity is 6km/s , the scattered frequency due to SBS scattering would be ----------and will be in backword/forward / both backward and forward direction to the propagating wave.

Q.6 : In a semiconductor laser if the active length is 100 micron and index is 1.6 , then the spectral spacing between two longitudinal modes would be ---------- and this spacing would become---------- if the active region length is doubled.

Q.7 : Intensity induced power penalty would be nearly ----------for a source having intensity nioise parameter r_I as 0.08 at 10^{-12} BER and this penalty would be ----------if r_I is doubled.

Q.8 : AWR has a FSR as 500 GHz when waveguide medium has a index as 1.5 . The required ΔL would be around ----------assuming input and output ports has negligible width. Now in this 10 channels provides 0.5 dB power penalty for the system having fineness as 40 , then predict the allowed bit rate----------.

Q.9: In a coherent lightwave receiver to have a power penalty around 0.5 dB at 20 Gbps, the line width requirement would be ----------and this requirement becomes ---------if the receiver is asynchronous heterodyne ASK .

Q. 10 : A bright soliton would be formed if P_0 is equal to -------- for a pulse having 17.6 ps and corresponding dispersion length would be ----------. (Assume GVD as 0.4 ps^2/km and γ as $1W^{-1}$/km.

Q. 11: A semiconductor amplifier having 100 micron active region length and index as 3.5 shows medium gain as 10 with each end reflections as 0.02. The maximum gain and bandwidth of the amplifier would be ----------and ----------respectively.

Q. 12 : A single mode fiber having a diameter of 8 µm operates at V as 2 for 1500 nm wave would show fundamental spot size as ----------and core power confinement as ------./

Q. 13 : An optical pulse having 1/e intensity point width as 10 ps propagates through a fiber having GVD parameter as -1 ps^2/km. If the pulse finds a chirping parameter C as +2 , the pulse width will increase/decrease with propagation and becomes minimum /maximum at a distance of ------.

Q. 14 : An optical receiver working at 10^{-9} BER. Assuming current for 0 state as 40% of the 1 state, the approximate value of would be ----------time of the noise level σ_1 of 1 state. (use $\sigma_0 = 0.2\sigma_1$)

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Q1:A multimode optical fiber having core index as 1.5 and accepts 9 % of incident light at 1500 nm. If the core diameter is 40 μm, then estimate :

(i) V parameter
(ii) index of cladding
(iii) Delay / km
(iv) Data rate per km for a similar GI fiber with parabolically graded index
(v) If the same fiber is to be operated as single mode then discuss the conditions if any **(5)**

Q2: Explain the functioning od EDFA and comment on the noise figure and gain bandwidth of such amplifier with some specific example. Design a two stage such amplifier to have a good gain and low noise figure.

(5)

Q3: Discuss role of power penalty in power budget management. Mention any three important causes of power penaly with its typical estimation and comment on the limitations on the data rate .

Q4 : Discuss AWG routers concepts and conditions to use as demultiplexer. Find the expression for FSR and discuss suitable assumptions to make it more appropriate. **(5)**

Q5: Discuss two approached to compensate the dispersion in and optical communication link mentioning some typical examples and limitations.

Q. 6 : Discuss Electrooptic based external modulator design and design suitable AND, OR and EXR logical implementation using MZI based modulators. **(5)**

Q. 7 : Write short notes on nay two of the following :

(i) Gour wave mixing
(ii) Homodyne coherent lightwave receiver
(iii) Wavelength Converter

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