COLLEGE OF ENGINEERING PUNE

Final Year B. Tech (E and TC)

ET 411- 5: Fiber Optic Communication (Elective-I)

End Semester Examination

Semester: **VII**

Duration: **3Hr** Maximum Marks: **60**

Instructions to the candidate:

i. All questions are compulsory.
ii. Assume suitable data if necessary.

Q 1 A Derive an expression for the maximum pulse broadening arising from the modal delay in multimode step index fiber. **4**

A 10 Km optical link consists of MMSI fiber with core refractive index 1.48 and relative refractive index difference of 1% estimate the delay difference between the slowest and fastest modes at the output of fiber.

B What do you mean by the modes of an optical fiber? Starting from the Maxwell's equations give the outline of how TE, TM and hybrid mode solutions of step index fiber can be obtained. **6**

Q 2 A What are the factors contributing to the attenuation mechanism in fiber? Sketch typical optical fiber attenuation characteristics as a function of wavelength. Compare the parameters of second and third transmission windows of fiber optic communication. **5**

B A multimode step index fiber has a numerical aperture of 0.3 and core refractive index of 1.45. The material dispersion of the fiber is 200ps/nm-km. Estimate the total (intra modal and intermodal) rms pulse broadening per kilometer when the fiber is used with an LED source of rms spectral width 40 nm. Neglect waveguide dispersion. Also find the corresponding bandwidth length product of the fiber. **5**

Q 3 A Explain following terms as applied to LED **5**

i. Direct Band Gap Material.
ii. Internal Quantum Efficiency.
iii. Spectral width.
iv. Frequency response.
v. Double Hetero junction structure.

	B	Draw a schematic of Fabry-Perot cavity resonator and show how this structure works as laser diode. Derive an expression for threshold gain condition for producing sustained oscillations from the resonator. Draw a typical spectrum for this laser diode.	**5**
Q 4 A		Draw a equivalent circuit of photo detector receiver? What are the various types of noises in photo detector? Write an expression for signal to noise ratio at the amplifier input.	**6**
	B	With neat diagram explain the working of Avalanche photo diode.	**4**
Q 5 A		A 1550 nm single mode digital fiber optic link needs to operate at 622Mb/s over 80 Km without amplifiers. A single mode InGaAsP laser launches an average optical power of 0dBm into the fiber. The fiber has a loss of 0.35dB/km, and there is a splice with a loss of 0.1dB every kilometer. The coupling loss at the receiver is 0.5dB, and the receiver uses an InGaAs APD with a sensitivity of -39dBm. Excess noise penalties are predicted to be 1.5dB. Set up an optical power budget for this link and find system margin.	**5**
	B	A 100-Mb/s NRZ data transmission system uses a GaAlAs laser diode that has a 1-nm spectral width. The rise time of the laser transmitter output is 2 ns. The transmission distance is 7 km over a graded-index fiber that has an 800MHz-km bandwidth-distance product. If the receiver bandwidth is 100 MHz and mode-mixing factor q=0.7 what is the system rise time? Does this rise time meet the NRZ data requirement of a pulse width? (Given: D_{mat}=0.07ns/nm-km)	**5**
Q 6 A		With neat block diagram explain Wavelength Division Multiplexing. What are its advantages? What do you mean by the terms CWDM and DWDM?	**5**
	B	What is SONET? What is data rate of SONET level OC-192? Which SDH level is equivalent to SONET level OC-48? Explain the basic structure of STS -1 SONET frame.	**5**

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