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B. TECH
(SEM V) THEORY EXAMINATION 2021-22
OPTICAL COMMUNICATION

Time: 3 Hours**Total Marks: 100****Note: 1.** Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

- 1. Attempt all questions in brief. 2 x 10 = 20**
- Define acceptance angle and numerical aperture.
 - Explain normalized frequency (V) value in a multimode and single mode optical fiber.
 - Classify different types of nonlinear scattering in an optical fiber.
 - Differentiate between electrical and optical bandwidth using frequency response curve.
 - Explain the importance of double hetero-junction structures in an optical source.
 - Plot the effect of temperature on the avalanche gain of a photodiode.
 - Define receiver sensitivity and quantum limit.
 - Define Intrinsic and extrinsic absorption in an Optical Fiber.
 - Formulate the condition of minimum Gain in Fabry-Perot Cavity to sustain Oscillation.
 - Define Stimulated emission.

SECTION B

- 2. Attempt any three of the following: 10 x 3 = 30**
- Find out the relationship between acceptance angle and refractive indices of core, cladding and medium for a light ray incident on the fiber core. Calculate the Numerical aperture of step index fiber having core refractive index of 1.56 and cladding refractive index as 1.40.
 - Define attenuation. Consider a 30 km long optical fiber working at wavelength (λ) of 130 nm and has an attenuation of 0.4dB/km, find out the output optical power if 200 μ W of optical power is launched into the fiber.
 - Define population inversion. Also Derive the threshold condition for laser oscillations to sustain.
 - Explain the possible noise sources in a photodiode. Also explain quantum noise in detail.
 - Discuss Free space optics (FSO) based communication systems.

SECTION C

- 3. Attempt any one part of the following: 10 x 1 = 10**
- Classify optical fibers on the basis of number of modes and core refractive index profile.
 - A multimode step index fiber with core diameter of 70 μ m, relative refractive index difference of 1.7% is operating at a wavelength of 0.85 μ m. If the core refractive index is 1.48, Estimate (i) Normalized frequency (ii) Number of Guided Modes.
- 4. Attempt any one part of the following: 10 x 1 = 10**
- Determine the rms pulse broadening (σ_s) due to intermodal dispersion in terms of core refractive index (n_1), cladding refractive index (n_2) and the length of fiber for a multimode step index fiber. A 6 km optical link consists of multimode step index fiber with a core refractive index of 1.5 and a relative refractive index difference of 1 %. Estimate the delay difference between the slowest and fastest modes.
 - Explain the bending losses in an optical fiber, also calculate the critical radius of curvature for a multimode fiber with a core refractive index of 1.8, a relative refractive index difference of 4 % and an operating wavelength of 0.82 μ m.



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5. **Attempt any *one* part of the following:** **10 x 1 = 10**
- (a) Explain Fabry Perot resonating cavity. A ruby laser contains a crystal of length 5cm with a refractive index of 1.67. The peak emission wavelength from the device is 0.65 μm . Determine the no of longitudinal modes and their frequency separation.
 - (b) Explain S-LED and E-LED structures with the help of proper diagram.
6. **Attempt any *one* part of the following:** **10 x 1 = 10**
- (a) Explain principle, construction and working of p-i-n diode. Discuss the factors which limit the speed of response of a photodiode.
 - (b) Discuss the requirements of an ideal photo detector; also explain the construction and working of avalanche photodiode.
7. **Attempt any *one* part of the following:** **10 x 1 = 10**
- (a) Discuss Eye pattern features in an optical communication, also comment on ISI using Eye diagram.
 - (b) Illustrate Power Penalty in an optical communication. Also explain different types of Power Penalties.

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