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BTECH
(SEM V) THEORY EXAMINATION 2024-25
OPTICAL COMMUNICATION

TIME: 3 HRS

M.MARKS: 100

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

1. Attempt all questions in brief. 2 x 10 = 20

Q no.	Question	CO	Level
a.	Explain the basic components of a general communication system.	1	K1
b.	Define the acceptance angle in an optical fiber.	1	K1
c.	Define the polarization of light in optical communication..	2	K1
d.	Differentiate between electrical and optical bandwidth using frequency response curve.	2	K2
e.	Explain the importance of double hetero-junction structures in an optical source	3	K1
f.	What are the advantages of LED light?	3	K1
g.	When 3×10^{11} photons each with a wavelength of $0.85 \mu\text{m}$ are incident on a photodiode, on average 1.2×10^{11} electrons are collected at the terminals of the device. Determine the quantum efficiency.	4	K3
h.	Define receiver sensitivity and quantum limit.	4	K2
i.	Define Stimulated emission.	5	K2
j.	Define quantum limit in optical communication.	5	K2

SECTION B

2. Attempt any three of the following: 10 x 3 = 20

Q no.	Question	C O	Level
a.	Derive the expression for numerical aperture (NA) in an optical fiber.	1	K3
b.	Describe the various types of nonlinear scattering losses in optical wave guide.	2	K2
c.	Describe the optical feedback and laser oscillation in optical waveguide.	3	K3
d.	Discuss the requirements of an ideal photo detector; also explain the construction and working of avalanche photodiode.	4	K2
e.	Describe the multichannel & multiplexing transmission techniques in fiber optics.	5	K2

SECTION C

3. Attempt any one part of the following: 10 x 1 = 10

Q no.	Question	C O	Level
a.	A multimode step index fiber with core diameter of $70 \mu\text{m}$, relative refractive index difference of 1.7% is operating at a wavelength of $0.85 \mu\text{m}$. If the core refractive index is 1.48, Estimate (i) Normalized frequency (ii) Number of Guided Modes	1	K2, K3
b.	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.	1	K2, K3



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4. Attempt any one part of the following: 10 x 1 = 10

Q no.	Question	CO	Level
a.	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	2	K2, K3
b.	What is mean by dispersion? Describe the Intramodal dispersion.	2	K2

5. Attempt any one part of the following: 10 x 1 = 10

Q no.	Question	CO	Level
a.	Define population inversion. Also Derive the threshold condition for laser oscillations to sustain.	3	K2
b.	What factors influence the modulation bandwidth of an LED, and why is it important for communication systems?	3	K1, K2

6. Attempt any one part of the following: 10 x 1 = 10

Q no.	Question	CO	Level
a.	Explain the possible noise sources in a photodiode. Also explain quantum noise in detail.	4	K2
b.	Define the mode of laser and describe the threshold condition for laser oscillation.	4	K2

7. Attempt any one part of the following: 10 x 1 = 10

Q no.	Question	CO	Level
a.	Describe the homodyne detection and heterodyne detection.	5	K2
b.	Discuss Eye pattern features in an optical communication, also comment on ISI using Eye diagram.	5	K2