Roll No: | | | | | | | | | | | | | |

BTECH
(SEM V) THEORY EXAMINATION 2023-24
OPTICAL COMMUNICATION

TIME: 3 HRS **M.MARKS: 100**

Note: 1. Attempt all Sections. If require any missing data, then choose suitably.

SECTION A

1. Attempt *all* questions in brief.

Q no.	Question	Marks	CO
a.	Discuss Mode field diameter.	2	1
b.	Explore why the Refractive Index (R.I.) of core and cladding are different. Which one has greater R.I. and why.	2	1
c.	Illustrate stimulated Raman Scattering.	2	2
d.	Explain Kerr Effect used in an optical communication.	2	2
e.	Discuss the concept of population inversion in Optical Source.	2	3
f.	Differentiate surface emitting LED and edge emitting LED.	2	3
g.	Illustrate Source to Fiber Power Launching in optical communication.	2	4
h.	Illustrate the importance of multiplication factor in avalanche photodiodes.	2	4
i.	Explain Quantum Limit in optical communication.	2	5
j.	Discuss receiver selectivity.	2	5

SECTION B

2. Attempt any *three* of the following:

a.	Explain Phase and Group Velocity with proper derivation.	10	1
b.	Illustrate the linear scattering losses in optical fibers with respect to a) Rayleigh Scattering b) Mie Scattering	10	2
c.	Explain the requirement for optical sources to feed into fiber and optical modulation bandwidth. Enlist the advantage & Disadvantages of LASER & LED.	10	3
d.	Explain p-n junction photodiode. A photodiode has a quantum efficiency of 65 % when the photons of energy 1.5 x 10^{-19} J are incident upon it. Evaluate (i) the wavelength at which the photodiode is operating (ii) the incident optical power required to obtain a photocurrent of 2.5 μA.	10	4
e.	Write a short note on the following terms. 1. Multichannel & Multiplexing Transmission Techniques 2. Eye Diagram Pattern Features	10	5

SECTION C

3. Attempt any *one* part of the following:

a.	A typical relative refractive index difference for an optical fibre designed for long distance transmission is 1%. Estimate the *NA* and the solid acceptance angle in air for the fibre when the core index is 1.46. Further, compute the critical angle at the core–cladding interface within the fibre. It may be assumed that the concepts of geometric optics hold for the Fiber.	10	1
b.	Summarize between step index and Graded index fiber. Compute the cutoff wavelength for a step index fibre to exhibit single-mode operation when the core refractive index and radius are 1.46 and 4.5 mm, respectively, with the relative index difference being 0.25%.	10	1

4. Attempt any *one* part of the following:

a.	When the mean optical power launched into an 8 km length of fibre is 120 mW, the mean optical power at the fibre output is 3 mW. *Calculate:*	10	2

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	(a) the overall signal attenuation or loss in decibels through the fibre assuming there are no connectors or splices. (b) the signal attenuation per kilometre for the fibre. (c) the overall signal attenuation for a 10 km optical link using the same fibre with splices at 1 km intervals, each giving an attenuation of 1 db. (d) the numerical input/output power ratio in (c).		
b.	Illustrate Intermodal dispersion in detail. Derive rms pulse broadening due to intermodal dispersion in a multimode step index fiber.	10	2

5. Attempt any *one* part of the following:

a.	Explain the principle, construction and working of semiconductor injection laser. Also define total efficiency and external power efficiency of a semiconductor injection laser.	10	3
b.	Explain heterojunction structure of LED. The radiative and non-radiative recombination lifetime of the minority carriers in the active region of a double heterostructure LED are 60 ns and 100 ns respectively. Evaluate the bulk recombination or total carrier recombination lifetime and power generated internally in the device when the peak wavelength is 0.87 μm at a drive current of 40mA.	10	3

6. Attempt any *one* part of the following:

a.	Explain the construction and working of APD photo diode. Also explain the effect of temperature on gain of an avalanche photodiode.	10	4
b.	Explain P-I-N photodiode in detail. Also explain factors which limit the speed of a photodiode.	10	4

7. Attempt any *one* part of the following:

a.	Explore Power Penalty in optical communication. Also Explain Different Types of Power Penalties. Explore Error Control Techniques in detail	10	5
b.	Explore basic concept of Free Space Optics (FSO) based Communication System in detail and Explain Heterodyne Detection used in optical communication in details.	10	5