



SLOT: D2

**SCHOOL OF ELECTRONICS ENGINEERING
CONTINUOUS ASSESSMENT TEST - I
FALL SEMESTER 2025-2026**

Programme Name & Branch	:	B.Tech & ECE, BML
Course Code and Course Name	:	BECE318L and Optical Fiber Communications
Faculty Name(s)	:	Dr S Revathi, Dr A Jabeenaa, Dr Chittaranjan Nayak, Dr N Sangeetha
Class Number(s)	:	V12025260500854, 0857, 0859
Date of Examination	:	30/1/2026
Exam Duration	:	90 minutes
		Maximum Marks: 50

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes
 1. List the fundamental optical laws, structures and waveguides.
 2. Comprehend the various signal degradation in the fiber optical communication.

Q. No	Question	M	CO	BL
1.	a) The velocity of light in the core of a step index fiber is $2.01 \times 10^8 \text{ ms}^{-1}$, and the critical angle at the core-cladding interface is 80° . Determine the numerical aperture and the acceptance angle for the fiber in air, assuming it has a core diameter suitable for consideration by ray analysis. The velocity of light in a vacuum is $2.998 \times 10^8 \text{ ms}^{-1}$.	5	1	3
	b) A multimode step index fiber in air has a numerical aperture of 0.16, a core refractive index of 1.45 and a core diameter of $60 \mu\text{m}$. Determine the normalized frequency for the fiber when light at a wavelength of $0.9 \mu\text{m}$ is transmitted. Further, estimate the number of guided modes propagating in the fiber.	5		
2.	a) Draw the waveguide structure of the following fibers and explain their characteristics. i) Step- Index ii) Graded- Index	5	1	1
	b) What is photo-sensitive fibers? Write about their constructional features and applications?	5		
3.	A single-mode GeO_2 -doped silica optical fiber operates at wavelengths of 850 nm and 1550 nm. The second derivative of the refractive index of the core material with respect to wavelength is $-4.3 \times 10^{-5} \text{ nm}^{-2}$ at 850 nm and $-1.9 \times 10^{-6} \text{ nm}^{-2}$ at 1550 nm. The cladding refractive index of the fiber is 1.48, the relative refractive-index difference is 0.2%, the normalized frequency is 2.4, and the <u>dispersion</u> factor at this normalized frequency is 0.26. The fiber length is 1 km. A GaAlAs LED with a spectral width of 40 nm is used at 850 nm, while a laser diode with a spectral width of 0.2 nm is used at 1550 nm. i) Determine the material dispersion coefficient and the corresponding rms pulse broadening at both wavelengths. ii) Also determine the waveguide dispersion coefficient and the corresponding rms pulse broadening at 850 nm and 1550 nm. iii) Hence, calculate the total dispersion at each wavelength and comment on which dispersion mechanism is dominant at 850 nm and at 1550 nm.	10	2	3
4.	a) What is kerr effect? How it leads to Self-phase modulation (SPM) in optical fibers?	4	2	3

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	b) Find the attenuation coefficient of a 60 km long single mode fiber of core diameter $8\text{ }\mu\text{m}$ which induces stimulated Raman scattering for a threshold optical power of 1.17 W when the wavelength of the light signal launched is $1.55\text{ }\mu\text{m}$.	6		
5.	a) A GaAs planar LED emitting at a wavelength of $0.85\text{ }\mu\text{m}$ has an internal quantum efficiency of 70% when passing a forward current of 20 mA . Estimate the optical power emitted by the device into air and hence determine the external power efficiency if the potential difference across the device is 1V. It may be assumed that the transmission factor at the GaAs-air interface is 0.68 and that the refractive index of GaAs is 3.6. Comment on any assumptions made.	6	3	3
	b) Describe the relationship between the electrical and optical modulation bandwidths for an optical fiber communication system. Estimate the 3 dB optical bandwidth corresponding to a 3 dB electrical bandwidth of 50 MHz. A Gaussian frequency response may be assumed.	4		