Q. Code:704322

Reg. No. | | | | | | | | | | | | | |

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Seventh-Semester

EC18702 – OPTICAL COMMUNICATION AND NETWORKS

(Electronics and Communication Engineering)

(Regulation 2018 / 2018A)

TIME: 3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Evaluate the transmission characteristics and classify the structures of Optical fiber and types	**5**
CO 2	Investigate the various signal degradation factors associated with optical fiber	**4**
CO 3	Evaluate the various optical sources and optical detectors and their use in the optical communication system	**5**
CO 4	Examine the digital transmission and its associated parameters on system performance with the optical fiber measurements and various coupling techniques	**4**
CO 5	Enrich their knowledge on design of optical fiber networks such as SONET/SDH and optical CDMA systems	**5**

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Compare and contrast when to use step index versus graded index optical fibers.	**1**	**3**
2.	Mention the merits and demerits of optical fiber communication, considering factors such as bandwidth, attenuation, and cost-effectiveness.	**1**	**3**
3.	Describe the various types of losses that occur in optical fibers.	**2**	**2**
4.	List out the causes of dispersion in optical fibers.	**2**	**2**
5.	Interpret the three requirements for laser action, which involve a gain medium, an optical cavity, and a pumping mechanism.	**3**	**3**
6.	Justify why silicon is not suitable for fabricating LEDs or laser diodes.	**3**	**2**
7.	Point out the common parameters to evaluate the performance of a digital receiver.	**4**	**3**

8.	Write the advantages of using a trans-impedance amplifier in optical communication systems.	**4**	**2**
9.	Outline about the advantages of link budget in optical communication system design.	**5**	**3**
10.	Mention the challenges involved in establishing optical networks.	**5**	**3**

PART- B (5 x 14 = 70 Marks)

			Marks	CO	RBT LEVEL
11. (a)	**(i)**	Construct a diagram illustrating the elements of an optical communication system, and apply your understanding of the evolution of optical fiber systems to explain the key advancements in each generation.	**(8)**	**1**	**3**
	(ii)	Given a step-index silica fiber with a core refractive index of 1.52 and a cladding refractive index of 1.49 calculate: (a) the critical angle at the core-cladding interface, (b) the numerical aperture for the fiber, (c) the acceptance angle in air for the fiber.	**(6)**	**1**	**3**
		(OR)			
(b)	**(i)**	Apply the propagation characteristics of different rays and explain how these rays are effectively guided and transmitted through the fiber with relevant diagrams.	**(6)**	**1**	**3**
	(ii)	Apply Snell's law to explain the light refraction at the interface between two media with different refractive indices, and demonstrate the significance of the numerical aperture in determining the light-gathering ability of an optical fiber.	**(8)**	**1**	**3**

12. (a)	Analyze the causes of attenuation in optical fibers due to scattering losses and bending losses, and illustrate these mechanisms with appropriate diagrams.		**(14)**	**2**	**4**
	(OR)				
(b)	Explain the mechanisms of material dispersion and waveguide dispersion in optical fibers, applying the necessary mathematical expressions to quantify their contributions to overall dispersion.		**(14)**	**2**	**4**
13. (a)	Compare and contrast the structures and operating principles of surface emitter LEDs and edge emitter LEDs, and recommend the most suitable type for a specific applications.		**(14)**	**3**	**4**
	(OR)				
(b)	Derive the equations for external quantum efficiency and external power generated in an LED, and apply them to calculate the expected performance of an LED.		**(14)**	**3**	**4**
14. (a)	Discuss the different techniques available for measuring dispersion in optical fibers, considering their respective advantages, limitations, and suitability for specific applications.		**(14)**	**4**	**3**
	(OR)				
(b)	**(i)**	Construct a step-by-step procedure to measure the total fiber attenuation and numerical aperture of an optical fiber.	**(8)**	**4**	**3**
	(ii)	Discuss the various error sources in a fiber optic receiver, and propose strategies to mitigate their impact on the system's performance.	**(6)**	**4**	**3**
15. (a)	Construct the SONET (Synchronous Optical Network) frame structure, and analyze its components and their respective functions in enabling efficient data transmission over optical networks.		**(14)**	**5**	**4**

(OR)

			Marks	CO	RBT LEVEL
(b)	**(i)**	Explain the principle of Wavelength Division Multiplexing (WDM) by designing a simple WDM system that combines multiple wavelengths onto a single optical fiber.	**(6)**	**5**	**4**
	(ii)	Explain the detailed notes on Optical CDMA with its applications	**(8)**	**5**	**4**

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	Using the basic Maxwell's equations for a source-free condition, derive the mode equations for the cylindrical fiber	**(10)**	**1**	**4**

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