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Question Paper Code : 10722

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Fifth/Sixth/Seventh Semester

Electronics and Communication Engineering

CEC345 — OPTICAL COMMUNICATION AND NETWORKS

(Common to : Computer and Communication Engineering/Electronics and
Telecommunication Engineering)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Compare ray model and mode model of light propagation in optical fibers.
2. Why is group velocity important in digital optical communication systems?
3. What are the typical causes of extrinsic absorption in silica optical fibers?
4. Define chromatic dispersion in optical fibers.
5. Mention the effect of quantum efficiency and responsivity in optical receivers.
6. How does optical feedback and gain medium losses determine the laser threshold?
7. Give the principle of OT DR.
8. What is optical return loss (ORL)? Why is it important in fiber links?
9. Differentiate between CWDM and DWDM systems.
10. Compare circuit switching and packet switching.

PART B — ($5 \times 13 = 65$ marks)

11. (a) (i) Explain how the refractive index profile differs between step-index and graded-index cylindrical optical fibers, and how this affects the propagation of light. (6)
- (ii) Determine the cutoff wavelength for a step index fiber to exhibit single-mode operation when the core refractive index and radius are 1.46 and 4.5 μm , respectively, with the relative index difference being 0.25%. (7)

Or

- (b) (i) Discuss the significance of cutoff wavelength in single-mode fibers. (5)
- (ii) Graded index fiber has a core with a parabolic refractive index profile which has a diameter of 50 μm . The fiber has a numerical aperture of 0.2. Estimate the total number of guided modes propagating in the fiber when it is operating at a wave-length of 1 μm . (8)
12. (a) (i) Explain linear scattering losses in optical fibers. (5)
- (ii) With neat diagrams, describe the difference between Rayleigh and Mie scattering. Discuss their impact on optical communication performance at different wavelength bands. (8)

Or

- (b) When the mean optical power launched into an 8 km length of fiber is 120 μW , the mean optical power at the fiber output is 3 μW . Determine :
- (i) The overall signal attenuation or loss in decibels through the fiber assuming there are no connectors or splices; (4)
- (ii) The signal attenuation per kilometer for the fiber. (4)
- (iii) The overall signal attenuation for a 10 km optical link using the same fiber with splices at 1 km intervals, each giving an attenuation of 1 dB; (5)
13. (a) (i) Explain the working principle of an Avalanche Photodiode (APD) with a neat diagram. (6)
- (ii) An avalanche photo diode has a quantum efficiency of 65 % at a wavelength of 900 nm. Find the multiplication factor M, if 0.5 μW of optical power produces a multiplied photo current of 10 μA . (7)

Or

- (b) (i) Explain how population inversion is achieved in a laser medium and why it is essential for laser action? (6)
- (ii) A GaAs laser operating at 850 nm has a 500-mm length and a refractive index $n = 3.7$.
- (1) What are the frequency spacing and the wavelength spacing?
- (2) If, at the half-power point, $\lambda_1 - \lambda_0 = 2$ nm, what is the spectral width σ of the gain? (7)
14. (a) With the help of diagram, explain how a connection is established and released in a connection-oriented network.

Or

- (b) (i) Explain the functionalities of routing and wavelength assignment. (8)
- (ii) Explain how traffic grooming benefits the network. (5)
15. (a) Explain the objectives and the principles of fault protection and restoration techniques used in logical networks.

Or

- (b) (i) Explain the concept of a meshed network topology. (5)
- (ii) Describe the structure of an arbitrary mesh topology and explain how traffic flows between nodes with the help of diagrams. (8)

PART C — (1 × 15 = 15 marks)

16. (a) (i) A C-band earth station has an antenna with a transmit gain of 45 dB. The transmitter output power is set to 100W at a frequency of 8 GHz. The signal is received by a satellite at a distance of 37,500 km by an antenna with a gain of 26 dB. Determine the path loss (dB) and power at the output port (dBW). (8)
- (ii) Draw the system model of optical communication network and illustrate the principle of transmission and reception. (7)

Or

- (b) (i) Investigate the operation of wavelength convertor in WDM system. (7)
- (ii) Analyze how wavelength stabilization happens in optical networking. (8)

1. The first part of the paper is devoted to the study of the properties of the function $f(x)$ defined by the equation

$$f(x) = \int_0^x \frac{1}{1+t^2} dt, \quad (1)$$

where x is a real number.

2. In the second part we shall study the properties of the function $F(x)$ defined by the equation

$$F(x) = \int_0^x \frac{1}{1+t^2} dt, \quad (2)$$

where x is a real number. We shall show that the function $F(x)$ is continuous and differentiable on the whole real axis.

3. In the third part we shall study the properties of the function $G(x)$ defined by the equation

$$G(x) = \int_0^x \frac{1}{1+t^2} dt, \quad (3)$$

where x is a real number. We shall show that the function $G(x)$ is continuous and differentiable on the whole real axis.

4. In the fourth part we shall study the properties of the function $H(x)$ defined by the equation

$$H(x) = \int_0^x \frac{1}{1+t^2} dt, \quad (4)$$

where x is a real number. We shall show that the function $H(x)$ is continuous and differentiable on the whole real axis.

5. In the fifth part we shall study the properties of the function $I(x)$ defined by the equation

$$I(x) = \int_0^x \frac{1}{1+t^2} dt, \quad (5)$$

where x is a real number. We shall show that the function $I(x)$ is continuous and differentiable on the whole real axis.

6. In the sixth part we shall study the properties of the function $J(x)$ defined by the equation

$$J(x) = \int_0^x \frac{1}{1+t^2} dt, \quad (6)$$

where x is a real number. We shall show that the function $J(x)$ is continuous and differentiable on the whole real axis.

7. In the seventh part we shall study the properties of the function $K(x)$ defined by the equation