

CBCS SCHEME

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17EC82

Eighth Semester B.E. Degree Examination, July/August 2021 Fiber Optics and Networks

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions.

- 1 a. Outline any light advantages of optical fibers over copper wires or coaxial cables that are used in communication links as transmission media. (08 Marks)
b. Define Numerical Aperture(NA) and what is its significance. With an optical ray diagram and by derivation relate NA and core-cladding refractive indices as well as NA and relative refractive index Δ . (08 Marks)
c. With a simple block diagram, briefly explain the digital optical communication link that employs optical fiber. (04 Marks)
- 2 a. With neat sketches of the refractive index profile and light ray transmissions, explain the features of : i) multimode step index fiber ii) single mode step index fiber iii) multimode graded index fiber (parabolic RI profile). (11 Marks)
b. A multimode step index fiber with core diameter of $80\mu\text{m}$ and a relative index difference of 1.5% is operating at a wave length of $0.85\mu\text{m}$. If core RI is 1.48, find :
i) the normalized frequency (or V number for the fiber) ii) the number of modes guided by the fiber. (04 Marks)
c. Compare the meridional optical rays and skew optical rays in an optical fiber. (05 Marks)
- 3 a. The mean optical power launched into a fiber of length 8kms is $120\mu\text{W}$ and the mean optical power at the fiber output end is $3\mu\text{W}$. Find :
i) The overall signal attenuation in dB without any connectors or splices.
ii) The signal attenuation per kilometer for the fiber
iii) The overall signal attenuation for a 10 km optical link using the same type of fiber with splices at 1 km intervals, each giving an attenuation of 1dB. (06 Marks)
b. Explain the phenomena of : i) material absorption and ii) linear scattering in optical fibers that lead to losses of optical signals. (10 Marks)
c. With a neat diagram, explain the technique of fusion splice for optical fibers. (04 Marks)
- 4 a. Outline any six principal feature requirements of a good optical fiber connector. (06 Marks)
b. With a neat diagram of illustrative schematic, briefly explain the basic principle of operation and three advantages of expanded beam connectors. (07 Marks)
c. A 32×32 port multimode fiber transmissive star coupler has 1mW of optical power launched into a single input port. The average optical power at each output port is $14\mu\text{W}$. Find the total loss incurred by the star coupler and the average insertion loss through the coupler. (07 Marks)
- 5 a. With a neat schematic explain the structure and features of a high radiance surface emitting LED. (08 Marks)
b. Explain briefly the three key photon transition processes involved in laser action. (03 Marks)
c. Show the derivation of the mathematical expression that estimates the amount of photon emissions per unit volume, starting from the two rate equations of laser diode. (09 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and/or equations written eg, 42+8 = 50, will be treated as malpractice.

- 6 a. With relevant diagrams, explain the principles of conversion of optical signal into electrical signal by a PIN photodetector. (08 Marks)
- b. What are the three principal noises associated with photodetectors? Briefly explain how they originate. (06 Marks)
- c. Explain the operation of a digital optical receiver with a block diagram showing basic sections. (06 Marks)
- 7 a. With a neat block diagram, explain the operational principles and implementation of a WDM optical network. (06 Marks)
- b. Explain the construction and working of an optical isolator. (06 Marks)
- c. Based on the general applications, explain the three types of optical amplifiers with relevant block diagrams. (08 Marks)
- 8 a. Explain the construction and working of a dielectric thin film optical filter. (06 Marks)
- b. With relevant diagrams, explain the construction and operation of reflection and transmission type diffraction gratings. (08 Marks)
- c. With neat diagram, explain the operation of a MEMS technology based actuation mechanism. (06 Marks)
- 9 a. With a neat diagram, explain the optical public telecommunication network hierarchy. (07 Marks)
- b. With neat diagram, explain the optical circuit switched network. (06 Marks)
- c. Briefly explain each of the seven layers of OSI reference model. (07 Marks)
- 10 a. What are the four basic functions performed by an optical packet switch? Show the overall structural format of a typical packet used in the optical packet switched network and briefly explain. (07 Marks)
- b. Show the structure of a metropolitan area network and explain. (06 Marks)
- c. With a neat block diagram, briefly explain the generic Optical Label Switched (OLS) network configuration. (07 Marks)
