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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.



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- 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)

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