

## CBCS SCHEME

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15EC82

**Eighth Semester B.E. Degree Examination, Dec.2019/Jan.2020**  
**Fiber Optics and Networks**

Time: 3 hrs

Max. Marks: 80

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

- 1 a. What are the advantages of optical fiber communication? (04 Marks)  
 b. Explain the photonic crystal fiber with cross-sectional end view of the structure of an index guiding photonic crystal fiber. (06 Marks)  
 c. A silica fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.50 and a cladding refractive index of 1.47. Determine:  
 i) The critical angle in air for the fiber  
 ii) The numerical aperture for the fiber  
 iii) The acceptance angle in air for the fiber. (06 Marks)

OR

- 2 a. With suitable structures give comparison of conventional single mode and multi mode step index and graded index optical fibers. (06 Marks)  
 b. Explain briefly about fiber materials used in optical communication. (06 Marks)  
 c. A multimode step index fiber with a core diameter of 80 $\mu$ m and a relative index difference of 1.5% is operating at a wavelength of 0.85 $\mu$ m. If the core refractive index is 1.48. Estimate:  
 i) The normalized freq. for the fiber ii) The number of guided modes. (04 Marks)

Module-2

- 3 a. Explain about material absorption losses in an optical fiber. (06 Marks)  
 b. Explain the significance of fiber connector with relevant diagram explain the function of cylindrical ferrule connector. (06 Marks)  
 c. A glass fiber exhibits material dispersion given by  $|\lambda^2 (d^2n_1 / d\lambda^2)|$  of 0.025. Determine the material dispersion parameter at a wavelength of 0.85 $\mu$ m and estimate the rms pulse broadening per kilometer for a good LED source with an rms spectral width of 20nm in this wavelength. (04 Marks)

OR

- 4 a. Explain the fiber bend loss with relevant diagram and expressions. (06 Marks)  
 b. Explain intermodal dispersion. With suitable diagram show the paths taken by the axial and an extreme meridional ray in a perfect multimode step index fiber. (06 Marks)  
 c. Write a note on fiber splices. (04 Marks)

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Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
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**Module-3**

- 5 a. Explain the structure of double heterostructure light emitter showing energy diagram and refractive index profile. (06 Marks)
- b. Explain the operation of the front-end amplifier showing pulse spreading in an optical signal that leads to intersymbol interference and generic structure of a high impedance amplifier. (06 Marks)
- c. A photodiode has a quantum efficiency of 65% when photons of energy  $1.5 \times 10^{-19} \text{J}$  are incident upon it.
- i) At wavelength is the photo diode is operating. (04 Marks)
- ii) Calculate the responsivity of a photo diode. (04 Marks)

OR

- 6 a. Explain the physical principles of photodiode with suitable diagram. (06 Marks)
- b. Explain the receiver sensitivity with relevant expressions. (05 Marks)
- c. Explain the structure and operation of the single mode laser using basic architecture of a vertical-cavity surface emitting laser. (05 Marks)

**Module-4**

- 7 a. Explain the operational principles of Wavelength Division Multiplexing (WDM) network containing various types of optical amplifiers. (06 Marks)
- b. Explain the design and operation of a polarization independent isolator made of three miniature optical components. (05 Marks)
- c. Explain the operation of the wideband optical amplifiers representing two different band amplifiers in parallel and in series. (05 Marks)

OR

- 8 a. Explain the operational concept of a three-port circulator with relevant diagram. (05 Marks)
- b. Explain the operation of the dielectric thin film filters showing two parallel light reflecting mirrored surfaces define a Fabryperot resonator cavity. (05 Marks)
- c. Explain the principle of Raman amplifiers with stokes shift and the resulting Raman gain spectrum from a pump laser operating at 1445nm. (06 Marks)

**Module-5**

- 9 a. Explain the optical network concepts with relevant optical network structure. (05 Marks)
- b. Explain the principle of operation of the public telecommunications network hierarchy showing optical cross-connects (OXC's) in the long haul, optical add/drop multiplexers (OADM's) in the metropolitan and an optical fiber access network. (06 Marks)
- c. With suitable diagram explain the operation of the access network transmission media deployment strategies. (05 Marks)

OR

- 10 a. Explain optical fiber network fiber evolution with suitable diagram. (06 Marks)
- b. Briefly explain about wavelength routing networks deployment strategies. (05 Marks)
- c. Write a note on metropolitan area networks. (05 Marks)

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**Eighth Semester B.E. Degree Examination, June/July 2019**  
**Fiber Optics and Networks**

Time: 3 hrs.

Max. Marks: 80

*Note: Answer any FIVE full questions, choosing  
ONE full question from each module.*

**Module-1**

- 1 a. With the help of neat diagram, explain the main blocks of an optical fiber communication link. (10 Marks)
- b. Explain the advantages and disadvantages and applications of optical fiber communication system. (06 Marks)

OR

- 2 a. With the neat diagram, discuss the structure of single mode and multimode step index fiber with advantages for each type. (08 Marks)
- b. A silica glass optical fiber has a core refractive index of 1.480 and the cladding refractive index of 1.460 ( $n_1 = 1.480$ ,  $n_2 = 1.460$ ) calculate critical angle, acceptance angle and numerical aperture and the number of guided modes at 1300nm if core radius is 20 $\mu$ m. (08 Marks)

**Module-2**

- 3 a. Explain different absorption mechanisms in optical fibers. (08 Marks)
- b. Explain linear and non-linear scattering losses in optical fibers. (08 Marks)

OR

- 4 a. Explain macro bending and micro bending losses with a neat diagram. (06 Marks)
- b. Explain briefly about chromatic dispersion within an optical fiber. (06 Marks)
- c. When the mean optical power launched into an 8 km length of fiber is 120  $\mu$ w, the mean optical power at the fiber output is 0.3  $\mu$ w.  
Determine :
- i) The overall signal attenuation or loss in decibels thro' the fiber assuming that there are no connectors and splices.
- ii) The signal attenuation per kilometer for the fiber. (04 Marks)

**Module-3**

- 5 a. Draw the diagram of a typical GaAlAs double Hetrostructure LED along with energy band diagram and refractive index profile and explain. (10 Marks)
- b. Explain the terms :
- i) Spontaneous emission
- ii) Stimulated emission
- iii) Quantum efficiency. (06 Marks)

OR

- 6 a. Explain Fabry-Perot resonator cavity of laser with a neat diagram. (06 Marks)
- b. Briefly discuss the possible sources of noise in optical fiber receiver. (06 Marks)
- c. A GaAs laser operating at 850nm Los 560 $\mu$ m length and refractive index  $n = 3.7$ . What are the frequency and over length spacing's? (04 Marks)

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**Module-4**

- 7 a. Explain the operational principle and implementations of WDM with diagram. (08 Marks)  
b. Explain polarization independent Isolator with a neat diagram. (08 Marks)

OR

- 8 a. Explain optical circulators and optical add/drop multiplexers in detail. (06 Marks)  
b. Explain the amplification mechanism in EDFA amplifier with the help of energy band diagram. (10 Marks)

**Module-5**

- 9 a. Explain about synchronous networks with STS frame structure. (08 Marks)  
b. Describe about internet protocol and in evolution over physical layer evolution and traffic flow pattern with relevant diagram. (08 Marks)

OR

- 10 a. Explain with neat diagrams, Wavelength convertible routing network architecture. (08 Marks)  
b. Write short note on optical fiber access networks and local area networks. (08 Marks)

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15EC82

Eighth Semester B.E. Degree Examination, November 2020

## Fiber Optic and Networks

Time: 3 hrs.

Max. Marks: 80

*Note: Answer any FIVE full questions irrespective of modules.*Module-1

- 1 a. With relevant diagrams, explain the different types of optical fibers, considering the number of the modes and material composition of the core. (08 Marks)
- b. Describe what is implied by the term Photonic Crystal Fiber (PCF) and explain the guidance mechanism for electromagnetic modes in such optical fibers. (08 Marks)
- 2 a. Explain the ray theory of the optical fiber, with the help of neat sketch. (08 Marks)
- b. Explain mode field diameter of single mode fiber. (04 Marks)
- c. A multimode step index fiber with core diameter of  $80 \mu\text{m}$  and relative index difference of 1.5% is operating at a wavelength of  $0.85 \mu\text{m}$ , if the core RI is 1.48. Estimate :
- i) The normalized frequency for the fiber    ii) The number of guided modes. (04 Marks)

Module-2

- 3 a. Discuss the followings for optical fibers :  
i) Fiber bend loss    ii) Material absorption. (08 Marks)
- b. Define fiber splicing. Explain electric arc fusion splicing with neat sketches. (08 Marks)
- 4 a. Describe linear scattering losses in an optical fiber. (08 Marks)
- b. A four port multimode fiber FBT coupler has  $60 \mu\text{W}$  optical power launched into port 1. The measured output powers at ports 2, 3 and 4 are 0.004, 26.0 and  $27.5 \mu\text{W}$  respectively. Determine the excess loss, insertion losses between input and output ports, the cross talk and split ratio for the device. (08 Marks)

Module-3

- 5 a. Explain the 3 factors, which affects the response time of photodiode. (08 Marks)
- b. Derive an equation for optical receiver sensitivity. (08 Marks)
- 6 a. What are the characteristic requirements of an optical source? With the help of diagram, describe the operation of surface emitting LED. (08 Marks)
- b. Explain the different amplifiers used in optical receiver. (08 Marks)

Module-4

- 7 a. Describe the principles of working of isolators and circulators with a neat diagram. (08 Marks)
- b. Briefly discuss Raman amplifiers. (08 Marks)
- 8 a. Write a note on : i) Diffraction gratings    ii) MEMS technology. (08 Marks)
- b. With the aid of neat diagram, explain three possible EDFA configurations. (08 Marks)

Module-5

- 9 a. Explain public telecommunications network review with neat diagram. (08 Marks)
- b. Explain an optical packet switched network with neat diagram. (08 Marks)
- 10 a. Explain the concept of optical burst switching. (08 Marks)
- b. Explain the different types of optical networking node elements. (08 Marks)

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15EC82

**Eighth Semester B.E. Degree Examination, Aug./Sept.2020**  
**Fiber Optics and Networks**

Time: 3 hrs.

Max. Marks: 80

- Note: i) For Regular Students: Answer any FIVE full questions irrespective of modules.  
 ii) For Arrear Students : Answer any FIVE full questions, choosing ONE full question from each module.*

**Module-1**

- 1 a. Explain Optical Fiber transmission link with suitable block diagram. (06 Marks)
- b. Discuss classification of Optical Fiber depending on Refractive Index profile, mode of operation and material used. (06 Marks)
- c. Find Numerical aperture and number of propagation modes for a step index fiber with indices 1.5 and 1.48 with core radius 25  $\mu\text{m}$ . If the wavelength of the optical signal propagating in the fiber is 1300 nm. (04 Marks)
- 2 a. What are the different types of materials used for fabrication of optical fiber and their requirements? (06 Marks)
- b. Explain Index-guiding photonic crystal fiber with suitable diagram. (04 Marks)
- c. Discuss Ray Theory model for multimode step index and graded index fiber. (06 Marks)

**Module-2**

- 3 a. Explain the different mechanism caused by absorption loss. (05 Marks)
- b. The Input power to an optical fiber is 2 mw while the power measured at the output end is 2  $\mu\text{w}$ . If the fiber attenuation is 0.5 db/km, calculate the length of the fiber. (05 Marks)
- c. What are the different types of bending losses in fiber and explain with suitable diagram. (06 Marks)
- 4 a. Explain the different types of mechanical misalignment between two fibers. (05 Marks)
- b. What are the different types of splicing and explain V-groove optical fiber splicing technique. (05 Marks)
- c. What are the principles of good connector design. (06 Marks)

**Module-3**

- 5 a. Explain Electron recombination and the associated photon emission for Direct and Indirect bandgap materials. (06 Marks)
- b. With schematic explain high-radiance surface emitting LED. (06 Marks)
- c. A double-heterojunction InGaAsP LED emitting at a peak wavelength of 1310 nm has radiative and non-radiative recombination time of 30 ns and 100 ns respectively. The drive current is 40 mA calculate internal efficiency and optical power generated internally to the LED. Assume  $h = 6.6256 \times 10^{-34}$  J-s ;  $Q = 1.602 \times 10^{-19}$  C. (04 Marks)

OR

- 6 a. Explain the three key transition process involved in laser action. (04 Marks)
- b. Explain Reach-Through avalanche photodiode with neat diagram. (06 Marks)
- c. With schematic explain reverse biased pin photodiode. (06 Marks)

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**Module-4**

- 7 a. Explain the implementation of WDM networks with various types of optical amplifiers. (06 Marks)  
b. With layout explain 2×2 Mach-Zehnder Interferometer. (04 Marks)  
c. Explain Design and operation of a Polarization-Independent Isolator. (06 Marks)
- 8 a. Explain MEMS actuation method with neat diagram. (04 Marks)  
b. Explain 4×4 OADM with miniature switching mirrors. (06 Marks)  
c. Explain the Basic operation of a generic optical amplifier. (06 Marks)

**Module-5**

- 9 a. Explain IPV6 packet with extension header. (06 Marks)  
b. Explain ATM Protocol Architecture. (04 Marks)  
c. Explain the Basic operation of long-haul circuit switching Telecommunication Networks. (06 Marks)
- 10 a. Explain Optical-cross connect architecture using optical space switches. (08 Marks)  
b. Explain Generic Structure of an optical burst switching networks. (08 Marks)

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