

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:
- The critical angle in air for the fiber
 - The numerical aperture for the fiber
 - 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 $80\mu\text{m}$ and a relative index difference of 1.5% is operating at a wavelength of $0.85\mu\text{m}$. If the core refractive index is 1.48. Estimate:
- The normalized freq. for the fiber
 - 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 $0.85\mu\text{m}$ 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)

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 1.5×10^{-19} J are incident upon it.
- i) At wavelength is the photo diode is operating.
- 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)
