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ECE 1816 PE 12

19/6/23

Roll No. of candidate

2023

B.Tech. 6th Semester End-Term Examination

OPTICAL FIBER COMMUNUICATION

(New Regulation (w.e.f 2017-18) & (New Sylalbus (w.e.f 2018-19)

Full Marks – 70   Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *Four* from the rest.

1. Answer the following (MCQ/ Fill in the blanks) : $(10 \times 1 = 10)$

    (i)   Multimode step index fiber has _____

        (a)   Large core diameter and large numerical aperture

        (b)   Large core diameter and small numerical aperture

        (c)   Small core diameter and large numerical aperture

        (d)   Small core diameter and small numerical aperture

    (ii) In optical communication _____ acts as a transmission medium

        (a)   Coaxial cable

        (b)   Waveguide

        (c)   Optical fiber cable

        (d)   None of the above

    (iii) A GaAs optical source having a refractive index of 3.2 is coupled to a silica fiber having a refractive index of 1.42. Determine Fresnel reflection at interface in terms of percentage.

        (a)   13.4%

        (b)   17.4%

        (c)   17.6%

        (d)   14.8%

[Turn over

(iv) In single mode fibers, which is the most beneficial index profile?

    (a) Step index

    (b) Graded index

    (c) Step and graded index

    (d) Coaxial cable

(v) Fiber mostly situated in single- wavelength transmission in O-band is?

    (a) Low-water-peak non dispersion-shifted fibers

    (b) Standard single mode fibers

    (c) Low minimized fibers

    (d) Non-zero-dispersion-shifted fiber

(vi) A step index fiber has a coupling efficiency of 0.906 with uniform illumination of all propagation modes. Find the insertion loss due to lateral misalignment?

    (a) 0.95 dB

    (b) 0.40 dB

    (c) 0.42 dB

    (d) 0.62 dB

(vii) Two joined graded index fibers that are perfectly aligned have refractive indices $\alpha_R = 1.93$ for receiving fiber $\alpha_E = 2.15$ for emitting fiber. Calculate the coupling loss.

    (a) 0.23 dB

    (b) 0.16 dB

    (c) 0.82 dB

    (d) 0.76 dB

(viii) The losses caused due to hydrogen absorption mechanisms are in the range of _____

    (a) 20 dB/km to 25 dB/km

    (b) 10 dB/km to 15 dB/km

    (c) 25 dB/km to 50 dB/km

    (d) 0 dB/km to 85 dB/km

(ix) What is the Young's modulus of Kevlar, an aromatic polyester?

   (a) 9×10^{10} NM^{-2}

   (b) 10×10^{10} NM^{-2}

   (c) 12×10^{10} NM^{-2}

   (d) 13×10^{10} NM^{-2}

(x) A measure of amount of optical fiber emitted from source that can be coupled into a fiber is termed as _____

   (a) Radiance

   (b) Angular power distribution

   (c) Coupling efficiency

   (d) Power – launching

2. (a) Define the following terms with respect to optical laws: (5)

   (i) Reflection

   (ii) Total internal reflection

   (iii) Refractive index

   (iv) Snell's law

   (v) Critical angle

   (b) Derive an expression for number of modes exists in step indexed fiber. Also explain about mode filed diameter. (5)

   (c) If a single mode fibre has a step index of 0.03, the core refractive index is 1.45 at the cut off wavelength 1300 nm, then calculate the core radius. (5)

3. (a) Explain the function of each block with a help of neat block diagram of a digital optical fibre communication system (5)

   (b) What are the principle requirements of a good conducts design? (5)

   (c) A single mode fibre operating at the wavelength of 1.3 μm is found to have a total material dispersion of 2.81 ns and a total waveguide dispersion of 0.495 ns. Determine the received pulse width and approximate bit rate of the filter if the transmitted pulse has a width of 0.5 ns. (5)

4. (a) What power is radiated by an LED if its quantum efficiency is 3% and the peak wavelength is 670 nm?   (5)

    (b) Derive the expression for lasing and threshold condition.   (5)

    (c) Explain about avalanche photo diode   (5)

5. (a) A photo diode has quantum efficiency of 65 %. When photons of energy 1.5×10^{-19} J are incident on it? (i) What is the wavelength of the photo diode? (ii) Calculate the incident optical power required to obtain a photo current of 2.5 μA, when the photo diode is operating as described above.   (5)

    (b) What is LASER diode? Compare its performance with that of LED.   (5)

    (c) A practical surface LED has 50 μm diameter emitting area and operates at peak modulation current of 100 mA. What is BW of GaAL AS LED having at 2.0 μm active area thickness assume $B_r/10^{-10}$ cm^3/s, $\delta\delta = 10^4$ cm/sec.   (5)

6. (a) What is WDM? Explain the features of WDM.   (5)

    (b) Briefly discuss 2 × 2 passive optical coupler.   (5)

    (c) Design an optical fiber link for transmitting 15 Mb/sec of data for a distance of 4 km with BER of 10^{-9} (5)

7. (a) Write short notes on error control in digital link.   (5)

    (b) What is optical circulator? Explain in detail.   (5)

    (c) Explain the construction and applications of dielectric thin film filter.   (5)

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