THE UNIVERSITY OF DODOMA

COLLEGE OF INFORMATICS AND VIRTUAL EDUCATION

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

TN 420: OPTICAL COMMUNICATION SYSTEMS

TUTORIAL-01

[1] Discuss the advantages of optical fibers over conventional copper systems.

[2] Discuss the different spectral windows that can be used for optical fiber communication.

[3] Draw a well labeled diagram showing the major elements of an optical fiber transmission link.

[4] Calculate the carrier frequency for optical communication systems operating at 0.88, 1.3, and 1.55μm. What is the photon energy (in eV) in each case?

[5] Find the core radius necessary for single-mode operation at 820nm of a step-index fiber with core index = 1.480 and cladding index = 1.478. What is the numerical aperture and maximum acceptance angle for this fiber?

[6] A manufacturer wishes to make a silica-core, step-index fiber with normalized frequency, V=75 and a numerical aperture, NA=0.30 to be used at 820nm. If η_1=1.458, what should the core size and cladding index be?

[7] A graded index fiber with a parabolic refractive index profile core has a refractive index at the core axis of 1.5 and a relative index difference of 1%. Estimate the maximum possible core diameter which allows single-mode operation at a wavelength of 1.3μm.

[8] Determine the cutoff wavelength for a step index fiber to exhibit single-mode operation when the core refractive index and radius are 1.46 and 4.5μm, respectively, with the relative index difference being 0.25%.

[9] The velocity of light in the core of a step index fiber is 2.01×108 m s^{-1}, and thecritical angle at the core–cladding interface is 80°. Determine the numerical apertureand the acceptance angle for the fiber in air, assuming it has a core diametersuitable for consideration by ray analysis. The velocity of light in a vacuum is2.998×10^3 m s^{-1}.

[10] A graded index fiber with the core axis refractive index of 1.5 has a characteristic index profile (α) of 1.90, a relative refractive index difference of 1.3% and a core diameter of 40 μm. Estimate the number of guided modes propagating in the fiber when the transmitted light has a wavelength of 1.55 μm, and determine the cut off value of the normalized frequency for single mode transmission in the fiber.

[11] A manufacturer wishes to make a silica-core, step-index fiber with normalized frequency, V=75 and a numerical aperture, NA = 0.30 to be used at 820nm. If η_1=1.458, what should the core size and cladding index be?

[12] A step index fiber has an acceptance angle in air of 250 and a relative refractive index difference 3%. Find the NA and the critical angle at the core-cladding interface.

[13] Consider a graded index fiber with a parabolic index profile that supports the propagation of 742 guided modes. The fiber has a numerical aperture in air of 0.3 and a core diameter of 70μm. Determine the wavelength of light propagating in the fiber and the maximum diameter of the fiber which gives single mode operation at the same wavelength.