Kafrelsheikh University
Faculty of Engineering
Department of Electrical Engineering
Subject: Optical Electronics

Time allowed: 3 Hours
Full mark: 100 Marks
Academic year: 2020-2021
Year: 3rd year

Solve the following questions:-

Question One: **(20 Marks)**

Put (√) or (×) then correct the false one:

1- Refractive index is the ratio of the velocity of light in a medium to the velocity of light in a vacuum, it is always < 1.

2- The concept of total internal reflection at the core-cladding boundary saves light inside the core of an optical fiber.

3- The meridional rays propagate through the graded index fiber by total internal reflection.

4- At angles of incidence on (core cladding interface) smaller than the critical angle the light is reflected back into the dielectric medium.

5- Attenuation is directly proportional to area of the cable.

6- Attenuation is defined as the ratio of the output (received) optical power Po from the fiber to the input (transmitted) optical power Pi into a fiber.

7- Scattering of light energy due to heating of ion impurities results in dimming of light at the end of the fiber.

8- Macrobends is a type of bending loss due to complete fiber bends.

9- The bending losses occur in multimode fibers may be reduced by operating at the shortest wavelength possible.

10- The normalized frequency combines information about two important design variables for the fiber: namely, the core radius and the relative refractive index difference.

Question Two: **(20 marks)**

Choose the correct answer:

1- ..... of light energy due to heating of ion impurities results in dimming of light at the end of the fiber.
(a) Absorption (b) Scattering (c) Dispersion

2- Optical fibers suffer ..... losses at bends or curves on their paths.
(a) Absorption (b) Radiation (c) Scattering

3- The bending losses occur in multimode fibers may be reduced by designing fibers with small relative refractive index differences.
(a) Designing fibers with small relative refractive index difference.
(b) Operating at the shortest wavelength possible.
(c) both of them

4- The cutoff value of normalized frequency Vc to support a single mode in a graded index fiber with a parabolic index profile = ...

(a) 2.405 (b) $2.405\sqrt{2}$ (c) $2.405\sqrt{3}$

5- α is the profile parameter which gives the characteristic refractive index profile of the fiber core, which allows representation of the step index profile when α =

(a) ∞ (b) 1 (c) 2

6- It may be observed that the ..... fiber exhibits the smallest dispersion of a transmitted light pulse, which gives the minimum pulse broadening.

(a) Multimode step index (b) Single-mode (c) Graded index

7- Material dispersion is a type of ..... dispersion.

(a) Intramodal (b) Intermodal (c) Waveguide

8- The pulse broadening ..... linearly with fiber length and thus the bandwidth ..... with distance.

(a) Increases, increases (b) Increases, decreases (c) Decreases , increases

9- ..... is the maximum angle which light may enter the fiber in order to propagate.

(a) Acceptance angle (b) Critical angle (c) Reflection

10-λc is the wavelength above which a particular fiber becomes .....

(a) Single-mode (b) Multi-moded (c) Both of them

Question Three : **(30 Marks)**

1- Two step index fibers exhibit the following parameters:

- A **multimode** fiber of 80 mm with a core refractive index of 1.500, a relative refractive index difference of 3% and an operating wavelength of 0.82 μm
- A 8 μm core diameter **single-mode** fiber with a core refractive index the same as multimode, a relative refractive index difference of 0.3% and an operating wavelength of 1.55 μm.

Estimate the following:

a) The number of guided mode in the first fiber.
b) Estimate the critical radius of curvature at which large bending losses occur in both cases.
c) Estimate the loss in decibels due to Fresnel reflection at a single interface when jointing two lengths of these fibers as there is a small air gap between the fiber end faces.
d) Explain the problems occurred when jointing these fibers.

2- Explain with drawing the three types of misalignment which may occur when jointing compatible optical fiber.

3- Draw the block diagram of an Optical Communication System