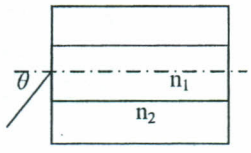
Mansoura University		Exam of Optoelectronics
Faculty of Engineering		Preliminary Master
Electronics and Electrical Comm. Dept.		Two Pages

25 / 9 /2013 Full Mark [100] Time allowed: 3 hours

Q1. (a) Estimate a relation for the modal dispersion in step index fiber? **[30 marks]**

(b) A multimode step index fiber with core diameter d = 80 μm, the refractive index of the cladding n_2=1.45, the modal dispersion is 15 ns/km. calculate the numerical aperture NA and the maximum bit rate when the signal is transmitted 20 km. What is the maximum value of θ for which the rays will be guided through the fiber. Corresponding to the maximum value of θ, calculate the number of reflections that would take place in traversing a kilometer through the length of the fiber.



(c) Discuss the optical losses of the fiber and what are the operating windows of minimum losses?

Q2. Estimate the 1-D Finite Difference Time Domain relations and use them within a written code in MATLAB for simulating the propagation of Electromagnetic fields in a dielectric slab (n=1.45), assuming the slab length is

(a) Finite and equal 10 μm and bounded by perfect metal,

(b) Infinite. **[20 marks]**

Q3. (a) Estimate a relation for a propagating plane wave in 1D lossless media? **[30 marks]**

(b) Estimate a relation for a propagating wave in 1D lossy media?

(c) The electric field of a plane wave propagating in a lossless nonmagnetic dielectric material with ε_r=2.5 is given by

$$E=10\cos(4\pi\times10^9\, t - kz)\ \hat{y}$$

Determine:

i) Frequency, phase velocity, wave vector and the intrinisic impedance.

ii) The relation of magnetic field

iii) Determine the positions where E_y is a positive maximum at time instant $t=10^{-8}$s.

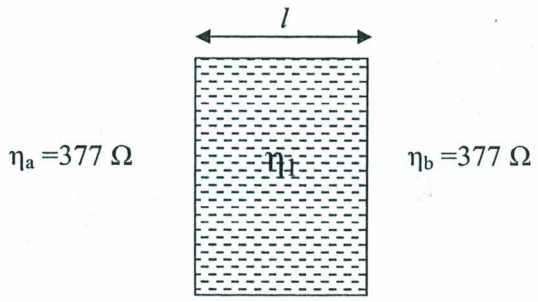
iv) Find the distance at which the amplitude of the electric field is 10 % of its value at z=0m.

v) Calculate the phase constant, attenuation constant, the intrinsic impedance, skin depth and the wavelength if the dielectric material has a loss tangent of 0.02.

Q4. The following figure shows a two-interface problem with a dielectric slab with intrinsic impedance of η_1 in Air.

a) With the aid of the matching and propagation matrices, find the reflection and transmission responses

b) Design a reflection-less slab for the wavelength 450 nm. **[20 marks]**



Note

$$\alpha \cong \frac{\omega\varepsilon''}{2}\sqrt{\frac{\mu}{\varepsilon'}} \quad (Np/m)$$

$$\beta \cong \omega\sqrt{\mu\varepsilon'}\left[1+\frac{1}{8}\left(\frac{\varepsilon''}{\varepsilon'}\right)^2\right] \quad (rad/m)$$

$$\eta_c \cong \sqrt{\frac{\mu}{\varepsilon'}}\left(1+j\frac{\varepsilon''}{2\varepsilon'}\right) \quad (\Omega)$$

Good Luck

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