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Unique Paper Code	**:**	**32511603**
Name of the Paper	**:**	**Photonics**
Name of the Course	**:**	**B.Sc. (H) Electronics (core)**
Semester	**:**	**VI**
Duration	**:**	**3 Hours**
Maximum Marks	**:**	**75**

Instructions for candidates

1. There are six questions in all, out of which you have to attempt any four questions.
2. All questions carry equal marks.

1 What do you understand by homogenous and linear medium? What are dominant, evanescent and degenerate modes in a waveguide? Consider a waveguide of dimensions (a x b) 3cm x 1.6 cm with filled with material of $\sigma = 0$, $u = u_o$, $\varepsilon = 1.44\varepsilon_o$. Determine the following parameters of waveguide whose one field component is given below:

$Hx = 4 \text{ Sin } (2\pi x/a) \cos (4\pi y/b) \text{ Sin } (1.5\pi \text{ x } 10^{11} t - \beta z)$ A/m

The mode of operation
The cut off frequency
The phase constant
The propagation Constant
The intrinsic wave impedance

2 Explain how Michelson interferometer can be used to determine the wavelength of a given source of light. A Michelson interferometer is illuminated by the sodium doublet with vacuum wavelengths of 5895.923A and 5889.953A. One mirror is moved continuously and the fringe pattern fades in and out periodically. Compute how much the mirror travels corresponding to a shift in visibility from maximum to minimum.

3 Derive the Fraunhuffer's diffraction pattern of a single slit. What is the basic difference between Fresnel and Fraunhuffer diffraction in term of wavefront? Consider the experimental setup of diffraction is hidden, how would you comment whether the pattern is due to Fresnel or Fraunhuffer just by examining the pattern on the screen (you are at liberty to move the screen along `x'-axis).

4 Explain what are quarter wave-plates? Explain what would be the output coming through a quarter wave-plate, if the incident wave is circularly polarized. Explain with relevant mathematics.

5 Derive an expression for quantum efficiency and responsivity of photo-detectors. Based on the

results discuss the relation between the two. Also, based on the derived results explain how can the photon detector activity of a photodiode be improved.

6 Why optical fiber provides an attractive alternative to wire transmission lines? Discuss how diameter of core influences the pulse propagation in an optical fiber. For a step index multimode fiber has a core diameter of 75um, refractive index of 1.58 and numerical aperture of 0.19. Calculate the following parameters:

The refractive index of cladding material.

Acceptance angle & critical angle of optical fiber.

Number of modes that the fiber can propagate at wavelength 0.75um.