

國立中山大學九十學年度博士班招生考試試題

科目：電磁學【光電所】

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1. Explain (or depict) and define the (a) *phase velocity* and (b) *group velocity* of a wave packet propagated in a (c) *dispersive medium*, and (d) describe the impact of dispersion on the propagation of such wave packet. (10%)
2. What are the (a) light speed, (b) wavelength, (c) frequency, and (d) photon energy ranges of the visible light? (10%)
3. Prove that a linearly polarized plane wave can be resolved into a right-hand circularly polarized wave and a left-hand circularly polarized wave of equal amplitude. (10%)
4. A dielectric rod or fiber of a transparent material can be used to guide light or an electromagnetic wave under the conditions of total internal reflection. Determine the minimum index of refraction of the guiding medium so that a wave incident on one end at any angle will be confined within the rod until it emerges from the other end. (10%)
5. The electric field intensity of a linearly polarized uniform plane wave propagating in the +z-direction in seawater is $E = a_x 100 \cos(10^7 \pi t)$ (V/m) at $z = 0$. The constitutive parameters of seawater are $\epsilon_r = 72$, $\mu_r = 1$, and $\sigma = 4$ (S/m). (a) Determine the attenuation constant (2%), phase constant (2%), intrinsic impedance (2%), phase velocity (2%), wavelength (2%), and skin depth (2%). (b) Find the distance at which the amplitude of E is 1% of its value at $z = 0$ (8%).
6. A uniform plane wave ($\mathbf{E}_i, \mathbf{H}_i$) of an angular frequency ω is incident from air on a very large, perfect conducting wall at an angle of incidence θ_i with perpendicular polarization. Find (a) the current induced on the wall surface (10%), and (b) the time-average Poynting vector in medium 1 (10%).
7. A uniform plane wave, propagated in the left-hand dielectric material (μ_1, ϵ_1), impinges obliquely on a plane interface between two dielectric materials. The material constant of the right-hand material is (μ_2, ϵ_2). Derive the complete expressions of the fields of the reflected and transmitted waves for the parallel polarization case. (20%).