國立臺灣科技大學
九十一學年度博士班招生考試試題

系所組別：電子工程系丙組
科　目：光電工程

總分 100 分

1. Waveplate (15%):
A monochromatic light is incident normally on a birefringent plate sandwiched between two polarizers. The plate is oriented so that the slow and fast axes are at 45° with respect to the polarizers. Derive output intensity if
(a) the two polarizers are parallel (5%)
(b) the two polarizers are crossed (orthogonal) (5%)
Please draw the output intensity against wavelength for both cases (5%).
2. Waveguide (25%):
(a) Explain the meaning of waveguide modes (5%)
(b) If there exist two modes in a straight waveguide of which their refractive indices is n_1 and n_2, respectively. Describe how the output field varies with the wavelength! (5%)
(c) What is multi-mode interference? (5%)
(d) Write down the wave equations for describing the field distribution of a symmetric slab waveguide where the refractive index of the core and cladding is n_{co} and n_{cl}, respectively. (5%)
(e) Describe the electromagnetic field components for a TE modes in a slab waveguide. (5%)
3. Febry-Perot (FP) etalon (15%)
(a) Derive the transmission coefficient, free-spectral range, bandwidth,and finesse of a FP etalon made of silica glass (n=1.5). (10%)
(b) Draw the impulse response of an etalon of 1cm length and 90% reflectivity on both facets. (5%)
4. Gain saturation (10%):
(a) Describe and compare homogeneous and inhomogeneous gain saturation mechanisms happened in a laser gain medium (5%).
(b) How do the saturation mechanisms affect the lasing spectrum of a laser. (5%)
5. Photodiodes (20%)
(a) Describe the operation principle of a PIN photodiode. (5%)
(b) Explain why its responsivity depends on the incident wavelength! (5%)
(c) Describe the mechanisms that limit the response speed of a photodiode. (5%)
(d) Describe the noise mechanisms happened in an optical receiver. (5%)
6. Amplification (15%)
(a) Prove that population inversion is necessary for a medium to have gain. (5%)
(b) What is amplified spontaneous emission? (5%)
(c) Describe Kramers-Kroning relations. (5%)