國立臺北科技大學

九十二學年度機電科技研究所博士班入學考試

光學（光電組）試題

填准考證號碼

注意事項：

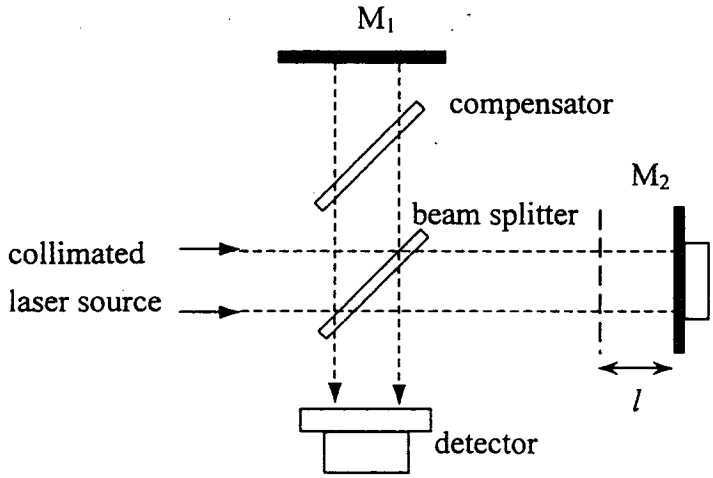
1. 本試題共【五】題，每題 20 分，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

1. Consider a laser source with center wavelength $\lambda_0 = 532$ *nm* and line width $\Delta\lambda = 0.01$ *nm*.
   (a) Express the line width in term of frequency. (10%)
   (b) Estimate the coherence length of the laser. (10%)

2. The following method is a convenient way to measure the focal length (f) of a positive lens. If a pair of conjugate object and image points (O and I) are separated by a distance $d > 4f$, there will be two locations of the lens, a distance l apart, for which the same pair of conjugates obtain.
   (a) Show that
   $$f = \frac{d^2 - l^2}{4d}. \quad (10\%)$$
   (b) Describe another method to measure the focal length of a negative lens. (10%)

3. We consider a half-wave plate is oriented in a direction with azimuth angle 45° (*i.e.*, the angle between the x-axis and the slow axis of the plate).
   (a) Find the polarization state of the transmitted beam, assuming that the incident beam is linearly polarized in the y direction. (10%)
   (b) Calculate the thickness of the plate with $n_o = 1.515$ and $n_e = 1.752$ at wavelength of 632.8 *nm*. (10%)

4. The Michelson interferometer is shown in the following figure, in which a He-Ne laser with wavelength of 632.8 *nm* is used as a light source, and then the output interference fringes are collected by a detector.
   (a) Calculate the number of cycles in the intensity change when M_2 moves a distance of l= 1.58 μm. (Note: 1 cycle means that the light intensity vary from the maximum to the minimum and then back to the maximum value) (10%)
   (b) When M_2 moves at a constant speed, the signal detected by the detector at the center changes at 2 kHz. Find the speed of the moving mirror. (10%)



5. Consider the case of diffraction by a rectangular aperture as shown in the following figure.
   (a) Estimate the distance for the far-field diffraction (assume that a visible light source with center wavelength of 500 nm and aperture size $a = b = 3$ mm are present). (5%)
   (b) Find the light distribution in the far-field diffraction regime. (5%)
   (c) Find the width of main lobe of the far-field intensity pattern. (5%)
   (d) Describe a simple method to accomplish the far-field diffraction in optical laboratory. (5%)