大葉大學 九十-二 學年度　研究所博士班　招生考試試題紙					
系　所　別	組 別	考　試　科　目 （中 文 名 稱）	考 試 日 期	節 次	備　　註
電機工程學系 博士班	丙組	電信工程	6 月 27 日	第 一 節	可帶P-1 可帶計算機

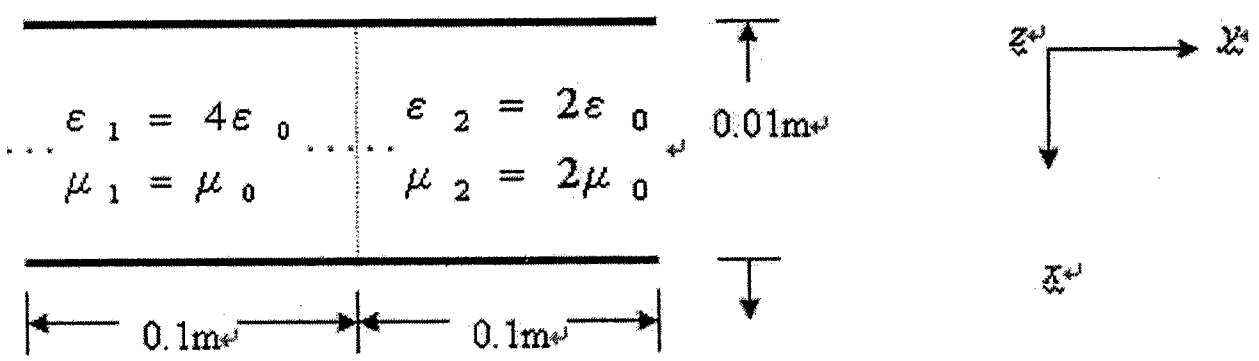
註：考生可否攜帶計算機或其他資料作答，請在備註欄註明（如未註明，一律不准攜帶）

計算與問答題: (共六題，選答其中之四題，每題 25 分: 對於計算題，需詳細列出推導及演算過程)

1. Please write down the Maxwell's equations set and continuity equation in integral form first, and then use Stoke's and Divergence theorems to derive their differential forms.

2. Current I flows in the positive z-direction with uniform density on the cylindrical surface $r = a$ and returns in the negative z-direction with uniform density on a second cylindrical surface $r = b$ with $b > a$. Find the energy stored in the magnetic field per unit length of the current distribution.

3. A parallel-plate transmission line consists of a arrangement of two perfect dielectrics as shown. Find the values of L, C, and Z_0 of the line.



4. Suppose that a binary message (either "0" or "1") must be sent. Voltage level +A is sent when the message is "1" and –A is sent when the message is "0". Assume the message "0" or "1" is sent with equal probability. The data sent over the channel is subject to a noise, N, that is a Normal (Gaussian) random variable with zero mean and variance σ^2. Then the value received at the receiver can be expressed as R=+A+N or R=–A+N. When the message is received at the receiver, the receiver makes decision according to the following rule: R is compared to a threshold V_T; If it is greater than V_T, the decision "+A sent" is made, otherwise "-A sent" is the decision.
   (1) Obtain an expression for the average probability of error, P_e, as a function of V_T, A, and σ^2.
   (2) Find V_T such that P_e is a minimum.
   (3) From (1) and (2), find the corresponding P_e.
   (4) To improve system performance, instead of sending each binary digit "***0***" or "***1***" binary digits "000" or "111" are sent respectively. If each digit is transmitted independently, majority-vote is used for detection. Find the probability of error under this time-diversity system.

   Note: you* SHOULD *express P_e in the form of Q function, where $Q(x) = \frac{1}{\sqrt{2\pi}} \int_x^\infty \exp\left(-\frac{t^2}{2}\right) dt$

5. Let X and Y be independent Gaussian random variables with means μ_X and μ_Y and variances σ_X^2 and σ_Y^2 respectively. Define the random process $Z(t) = X\cos\omega_c t + Y\sin\omega_c t$ where ω_c is a constant
   (a) Under what conditions is z(t) Wide-Sense Stationary (WSS)?
   (b) Find the probability density function at time t, $f_Z(z;t)$
   (c) Is the Gaussian assumption required for (a), why?
   (d) If a White Gaussian noise is added to another independent White Gaussian noise, will the resulting noise be White Gaussian noise also? Prove or disprove your answer.

大葉大學 九十-二 學年度　研究所博士班　招生考試試題紙					
系　所　別	組 別	考　試　科　目 （中 文 名 稱）	考 試 日 期	節 次	備　　註
電機工程學系 博士班	丙組	電信工程	6 月 27 日	第 一 節	P-2

6. (1) Show that the matched filter can be used as an optimum receiver in an AWGN environment.
(2) Show that the correlation receiver has the same performance as the matched filter

(3) Assume the waveform of $x_{i1}(t), x_{i0}(t)$ within $0 \le t \le T$ is shown as follows:

$$x_{i1}(t) = \begin{cases} e^{-\frac{t}{T}}; 0 \le t \le T, x_{i0}(t) = 0 \\ 0; otherwise \end{cases}$$

Plot the impulse response of the matched filter.