# 國立中央大學100學年度碩士班考試入學試題卷

所別：電機工程學系碩士班 固態組(一般生)　科目：工程數學　共 1 頁 第 1 頁
電機工程學系碩士班 系統與生醫組(一般生)
本科考試禁用計算器

＊請在試卷答案卷（卡）內作答

1. (10%) Prove that if matrix $A$ and matrix $B$ are similar n×n matrices, then they have the same eigenvalues.
2. (a) (5%) Find the least squares solution of the following system $Ax=b$.
(b) (5%) Find the orthogonal projection of $b$ onto the column space of $A$.

For the above questions, where $A=\begin{bmatrix}0 & 2\\ 3 & 0\\ 1 & 0\end{bmatrix}$, $b=\begin{bmatrix}1\\ 1\\ 3\end{bmatrix}$.

3. (a) (5%) Find the determinant of the matrix $A$ by using cofactors method.
(b) (5%) Show the sum of all eigenvalues of $A$.

For the above questions, where $A=\begin{bmatrix}2 & 0 & 0 & 0\\ 4 & -2 & 0 & 0\\ -5 & 6 & 1 & 0\\ 1 & 5 & 3 & 3\end{bmatrix}$.



4. (15%) Solve the following initial value problem.

$$y''+2ty'-4y=1,\ \ y(0)=y'(0)=0$$

5. (15%) Find the inverse Laplace transform of the following function.

$$F(s)=\frac{s^3}{s^4+4a^4}$$

6.(10%) For two continuous-time periodic signals $x(t)=e^{-2t}$, for $0\le t\le T$ and $h(t)=e^{j2\pi k_0 t/T}$, both the signals $x(t)$ and $h(t)$ have the same repetition period $T=2$ and $k_0$ belongs to an integer. Please find the Fourier series coefficients for $y(t)=x(t)h(t)$ in terms of $k_0$.

7. (15%) Show that if $v(x,y)$ is a harmonic conjugate of $u(x,y)$, then their product $uv$ is also harmonic.

8. (15%) Evaluate the integral $\int_0^{2\pi}\frac{\cos^2\theta}{5-4\cos\theta}d\theta$.

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所別：電機工程學系碩士班 固態組(一般生)
電機工程學系碩士班 系統與生醫組(一般生)
電機工程學系碩士班 電波組(一般生)

科目：電子學　　共 2 頁 第 1 頁

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＊請在試卷答案卷（卡）內作答

參考用

**1** 問答題 (21 分)

1-1 Consider the BJT circuits in Fig. 1, please specify the corresponding configuration for each circuit (common-emitter, common-base, or emitter-follower?) (6 分)

1-2 Which of the following statements are true? (15 分)

(a) Fig. 1.1 A amplifier has a voltage gain $|A_v| > 1$,
(b) Fig. 1.1 B amplifier has a current gain $|A_i| > 1$,
(c) Fig. 1.1 C amplifier has a voltage gain $|A_v| < 1$.
(d) Fig. 1.1 B amplifier has the highest $R_{in}$,
(e) Fig. 1.1 amplifier C has the lowest $R_o$

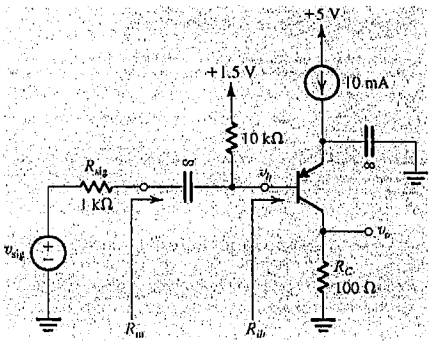
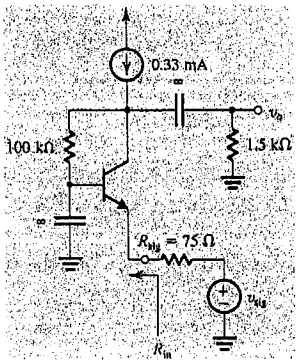
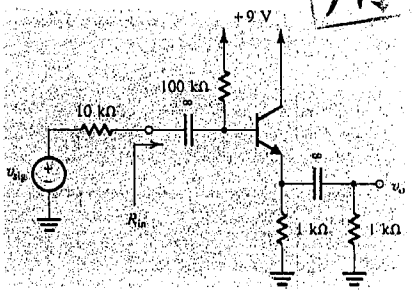



Fig. 1.1 (A)




(B)




(C)

**2.** 計算題 (16 分)

For the circuits in Fig. 2, $\mu_n C_{ox} = 2.5\ \mu_p C_{ox} = 20\ \mu A/V^2$, $|V_{TH}| = 1$ V, $\lambda = 0$ (or $V_A = \infty$), and $L = 1\ \mu m$ and $W = 4\ \mu m$ for all MOSFETs. Find the labeled currents and voltages, $I_1$, $V_2$, $I_3$, and $V_4$.

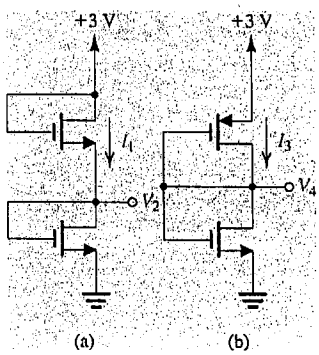



Fig. 2 (a) (b)

**3.** 計算題與問答題 (16 分)

A second-order filter is shown in Fig. 3.

3-1 Please derive the transfer function $T(s) = V_o(s) / V_i(s)$ in terms of $R$, $L$, and $C$. (12 分)

3-2 What is the filter type of this circuit? (4 分)

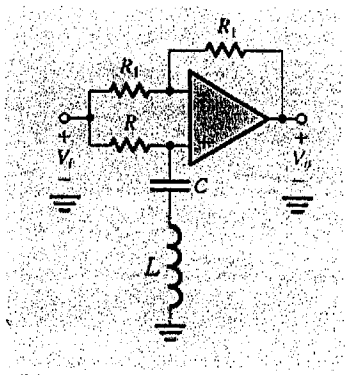



Fig. 3

注意：背面有試題