國立高雄大學九十五學年度轉學招生考試試題

科目：工程數學　　系所：電機工程學系三年級　　■可 □否　使用計算機

考試時間：90 分鐘　　本科原始成績：滿分 100 分

每題 10 分。

1. Solve $\frac{dy}{dx}=\frac{y^2-1}{x^2-1}$, $y(2)=2$.

2. Solve $y'''-2y''+y'=2-24e^{x}+40e^{5x}$, $y(0)=\frac{1}{2}, y'(0)=\frac{5}{2}, y''(0)=-\frac{9}{2}$.

3. Solve $x^2y''-5xy'+8y=0$, $y(2)=32, y'(2)=0$.

4. Use the power series method to solve $(x-1)y''+y'=0$ about $x=0$.

5. Solve
$$\begin{aligned}\frac{dx}{dt} &= -4x+y+z\\ \frac{dy}{dt} &= x+5y-z\\ \frac{dz}{dt} &= y-3z.\end{aligned}$$

6. Find a basis for the nullspace of
$$A=\begin{bmatrix}2 & 2 & -1 & 0 & 1\\ -1 & -1 & 2 & -3 & 1\\ 1 & 1 & -2 & 0 & -1\\ 0 & 0 & 1 & 1 & 1\end{bmatrix}.$$

7. Let $T:R^2\to R^3$ be the linear transformation defined by
$$T\left(\begin{bmatrix}x_1\\ x_2\end{bmatrix}\right)=\begin{bmatrix}x_2\\ -5x_1+13x_2\\ -7x_1+16x_2\end{bmatrix}.$$
Find the matrix for the transformation T with respect to the bases $B=\{u_1,\ u_2\}$ for R^2 and $B'=\{v_1,\ v_2,\ v_3\}$ for R^3, where
$$u_1=\begin{bmatrix}3\\ 1\end{bmatrix},\quad u_2=\begin{bmatrix}5\\ 2\end{bmatrix};\quad v_1=\begin{bmatrix}1\\ 0\\ -1\end{bmatrix},\quad v_2=\begin{bmatrix}-1\\ 2\\ 2\end{bmatrix},\quad v_3=\begin{bmatrix}0\\ 1\\ 2\end{bmatrix}.$$

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8. Find the orthogonal projection of the vector $u=[-3,\ -3,\ 8,\ 9]^T$ on the subspace of R^4 spanned by the vectors

$$u_1=[3,\ 1,\ 0,\ 1]^T,\quad u_2=[1,\ 2,\ 1,\ 1]^T,\quad u_3=[-1,\ 0,\ 2,\ -1]^T.$$

9. Find the $QR-$decomposition of

$$A=\begin{bmatrix}1 & 0 & 0\\ 1 & 1 & 0\\ 1 & 1 & 1\end{bmatrix}.$$

10. Find a matrix P that diagonalizes

$$A=\begin{bmatrix}0 & 0 & -2\\ 1 & 2 & 1\\ 1 & 0 & 3\end{bmatrix}.$$

3

國立高雄大學九十五學年度轉學招生考試試題

科目：電路學　　系所：電機工程學系三年級　　■可 □否　使用計算機

考試時間：90 分鐘　　本科原始成績：滿分 100 分

1. (10 分) Determine the current i in the circuit shown in Fig. 1.
2. (15 分) Consider the linear time-invariant circuit shown in Fig. 2. At t=0 a constant voltage source of 10 volts is applied to the circuit. Find all branch voltages and all branch currents at t=0 and at t=∞, given $i_1(0)=2$ amp and $v_4(0)=4$ volts.

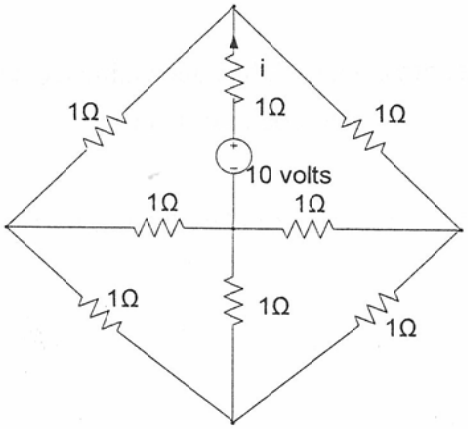

Fig. 1

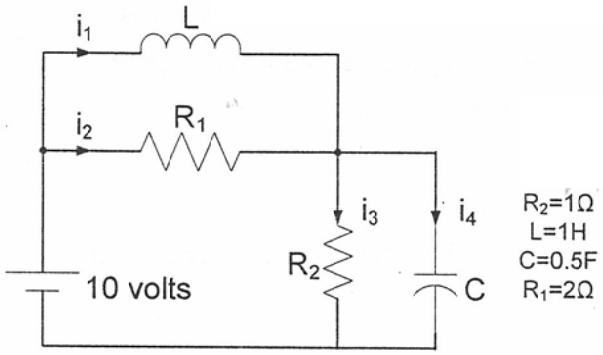

Fig. 2

3. (15 分) Write the node equations for the linear time-invariant circuit shown in Fig. 3. Determine the differential equations for the voltages v_1 and v_2. Indicate the needed initial conditions for each case in term of $v_c(0)$ and $i_L(0)$.
4. (15 分) Repeat the preceding problem (see Fig. 3) using mesh analysis. (Hint: You have to transform the current source to an equivalent voltage source.)

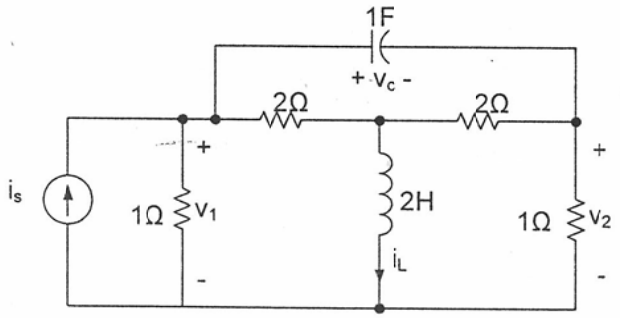

Fig. 3

5. (10 分) Find the zero-input response [that is, $v_1(t)$ and $v_2(t)$, for $t \geqq 0$] of the networks in Fig. 4.
6. (15 分) Calculate the zero-state response of the networks in Fig. 4 when $e_1(t)=u(t)$, and $e_2(t)=\delta(t)$.

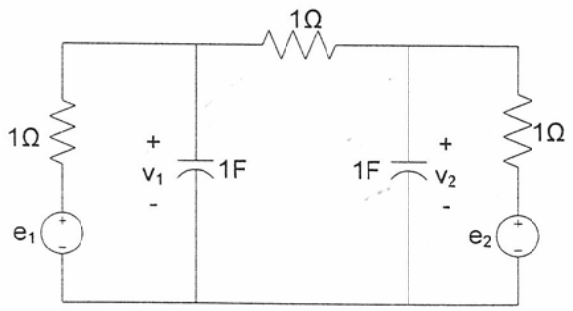

Fig. 4

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7. (20 分) Two sets of measurements are made on a resistive network consisting of one known resistor and four unknown resistors, as indicated in Fig. 5. In the first measurement we have $i_1=0.6i_s$ and $i_1'=0.3i_s$, as shown in Fig. 5(a); in the second measurement, we have $i_2=0.2i_s$ and $i_2'=0.5i_s$, as shown in Fig. 5(b).

   a. Use the reciprocity theorem to calculate R_1.

   b. Consider the configuration of sources shown in Fig. 5(c), where k has been adjusted so that no voltage appears across R_3 (that is, $i_3=i_3'$). Use the superposition theorem to determine this value of k.

   c. From the value of k obtained above, calculate i_3 ($=i_3'$) in terms of i_s, and hence determine R_2 and R_4.

   d. Determine R_3, using either measurement.

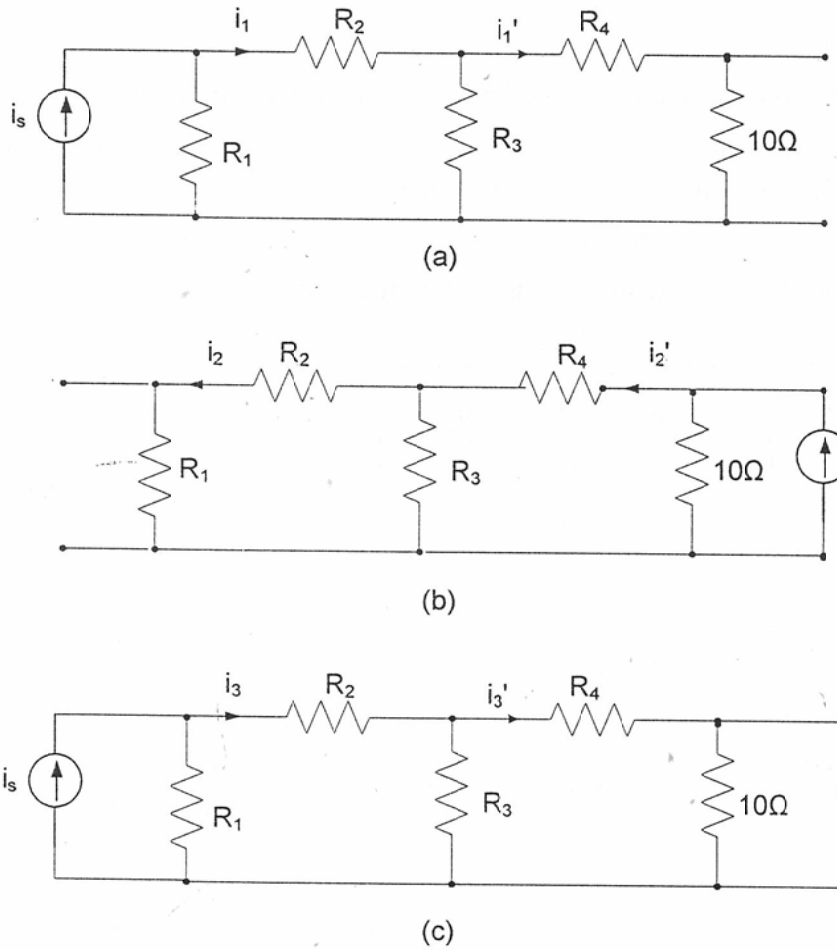

Fig. 5