科目：工程數學
考試時間：80 分鐘

系所：
電機工程學系轉三年級　　是否使用計算機：是
本科原始成績：100 分

1. Solve the system of equations: $\begin{cases} x & + & y & + & z & + & w & = & -4 \\ 2x & + & 3y & + & 4z & + & 5w & = & -6 \\ 4x & + & 9y & + & 16z & + & 25w & = & 26 \\ 8x & + & 27y & + & 64z & + & 125w & = & 336 \end{cases}$ (10%)

2. There exists a linear transformation $T : R^2 \to R^3$ such that $T(6,17) = (53, -111, -37)^T$ and $T(17, 6) = (108, 65, -106)^T$. Find $T(2, 3)$. (10%)

3. Given $X = (2, 1, 3, 2)^T$ and $Y = (-2, 4, 1, 2)^T$. Let θ be the angle between X and Y,

   a. find the square value of $\sin\theta$? (10%)

   b. find the normalzation of vector projection of Y onto X ? (10%)

4. Given $\begin{cases} x' = 2x + 11y; \\ y' = 2x - 7y. \end{cases}$ Also, $x(0) = 12$, $y(0) = 1$.

   a. Find $x(t)$? (10%)

   b. Find $y(t)$? (10%)

5. Given a continuous function $y(x)$, $x \geq 0$. Also, let $f(x) = \begin{cases} 1, & x \geq 1; \\ 0, & 0 \leq x < 1. \end{cases}$ Solve $y' + y = f(x)$ with $y(0) = 1$. (10%)

6. Given $y'' + y = (4x + 4) \cdot \cos x$.

   a. Find the homogeneous solution, $y_H(x)$? (15%)

   b. Find the particular solution, $y_P(x)$? (15%)

科目：電路學
考試時間：80 分鐘

系所：
電機工程學系轉三年級　　是否使用計算機：是
本科原始成績：100 分

1. (20%) Consider the two-terminal element with the i-v characteristic expressed by the piece-wise linear function as
   $i(v) = 5|v-1| + 2|v-4| - |v-6|$
   where i is the current in ampere and v is the terminal voltage in volt.
   (a) (5%) Plot the i-v curve of this element.
   (b) (5%) Determine the static resistance at $v = 2$ V.
   (c) (5%) Determine the dynamic resistance at $v = 2$ V.
   (d) (5%) Determine the dynamic resistance at $v = 5$ V.

2. (10%) Given the circuit as shown in Fig. P2 and $I_4 = 0.5$ A, find the source voltage V_o.
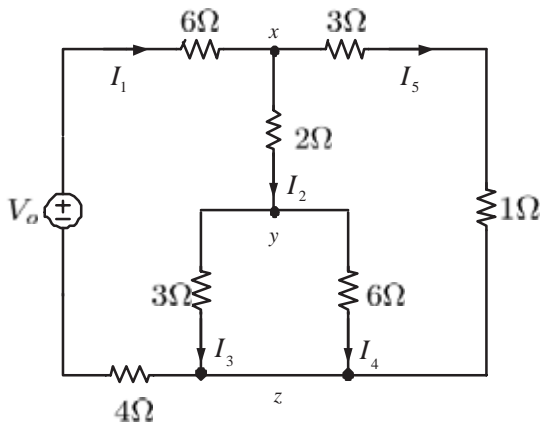

Fig. P2

3. (15%) Sketch the straight-line approximation of the Bode plot for the following transfer function.
   $$H(s) = \frac{10^{10}(s+10)}{(s+10^3)(s+10^6)}$$

4. (15%) Consider the parallel RLC circuit in Fig. P4. Assume that $v(0) = 5$ V, $i(0) = 0$ A, $L = 1$ H, $C = 10$ mF, and $R = 6.25\,\Omega$. Find $v(t)$ for $t \geq 0$.
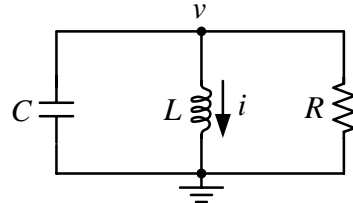

Fig. P4

5. (20%) A load with 0.8 lagging power factor absorbs 60 W from a 100-V (effective voltage), 60-Hz power line. It is required to correct the power factor to 0.9 lagging.
   (a) (7%) Find the *effective* original line current $\mathbf{I}_{eff,org}$.
   (b) (6%) Find the *effective* final line current $\mathbf{I}_{eff,final}$.
   (c) (7%) Determine the value of the element to be added to achieve the required power factor correction.

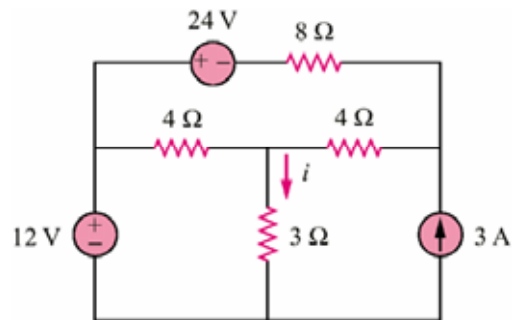6. (20%) Consider the circuit in Fig. P6. Use the *superposition theorem* to find the current i.

Fig. P6