國立雲林科技大學
100學年度碩士班暨碩士在職專班招生考試試題

系所：電機系、營建系
科目：工程數學(2)

本試題共 8 題，共計 100 分，請依題號作答並將答案寫在答案卷上，違者不予計分。

1. Solve the general solution of differential equations: (本題共 20 分)

(1) $\frac{dy}{dx} = 2x$ (5 分)

(2) $x\sin(y)\frac{dy}{dx} = \cos(y)$ (5 分)

(3) $[(x-1)^3 D^3 + (x-1)^2 D^2 - 4(x-1)D]\, y = 3(x-1)^2$ [Note: $D^n y = y^{(n)} = \frac{d^n}{dx^n} y$] (10 分)

2. Find the Laplace transform of the function: $f(t) = te^{-3t}\sin(2t)$. (本題 10 分)

3. Find the inverse Laplace transform of the function: $F(s) = 2\ln\left[\frac{(s-1)}{(s+1)}\right]$. (本題 10 分)

4. Find the eigenvalues and eigenvectors of the matrix A and A^{-1} (inverse of matrix A), where $A = \begin{pmatrix} -2 & 0 \\ 1 & 4 \end{pmatrix}$. (本題 10 分)

5. Find the Fourier half cosine and Fourier half sine expansions (i.e. Fourier cosine series and Fourier sine series) of $f(x)$ for

$$f(x) = \begin{cases} 1, & 0 \le x < 1 \\ 0, & 1 \le x \le 3 \\ -1, & 3 < x \le 5 \end{cases}$$

(本題 15 分)

6. Find the Fourier integral for the function

$$f(x) = \begin{cases} -1, & -\pi \le x < 0 \\ 1, & 0 < x \le \pi \\ 0, & |x| > \pi \end{cases}$$

(本題 10 分)

7. Find values of a, b, c and d such that the following system of linear equations has (i) exactly one solution, (ii) no solution and (iii) an infinite number of solutions. (本題 15 分)

$$\begin{aligned} x + y \quad &= 2 \\ y + z &= 2 \\ x \quad - z &= d \\ ax + by + cz &= 0 \end{aligned}$$

8. Find all values of t for which the set S is linear independent.

$$S = \left\{ \begin{bmatrix} t \\ 1 \\ 1 \end{bmatrix} \begin{bmatrix} 1 \\ t \\ 1 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ t \end{bmatrix} \right\}$$

(本題 10 分)

國立雲林科技大學　系所：電機系
100學年度碩士班暨碩士在職專班招生考試試題　科目：計算機概論(1)

本試題共十題，共計 100 分，請依題號作答並將答案寫在答案卷上，違者不予計分。

1. 試計算下列算式
   a.(5%)　$(110.01)_2 \div (10.1)_2 = (?)_2$
   b.(5%)　$(0.101100110011001100\ldots)_2 = (?)_{10}$

2. 試計算下列算式
   a. (5%)　$(101010111100.1)_2 = (?)_{16}$
   b. (5%)　$(101010111100.1)_2 = (?)_8$

3. (5%)何謂嵌入式系統(Embedded System)？

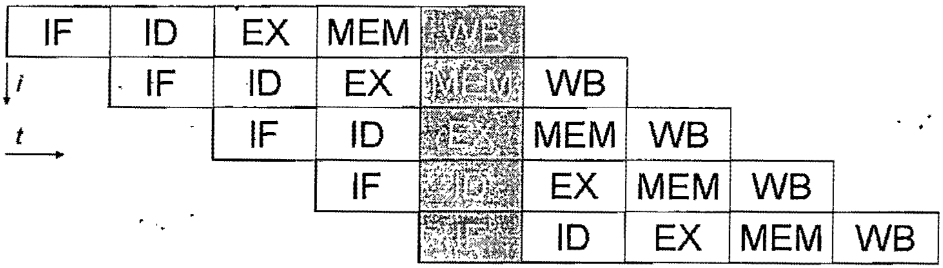
4. (a) (5%)請說明 Linux 作業系統的起源與發展過程？
   (b) (5%)請說明使用 Linux 作業系統與使用微軟 Windows 作業系統的最主要不同之處？

5. 試利用輾轉相除法求二個正整數的最大公因數：
   (a)　(5%)請列出解答的流程圖或演算法？
   (b)　(10%)將上述流程圖或演算法改成 C 語言程式？

6. (10%)在軟體程式中，「資料型態」(Data Type)是資料最重要的屬性之一，會決定資料的可表示範圍與記憶體使用容量。請任舉五種在 C 語言程式中，可以宣告的「資料型態」？

7. 布林代數(Boolean Algebra)證明題：
   (a) (5%)請證明 $(X+Y)(\overline{X}+Z)=\overline{X}Y+XZ$ ？
   (b) (5%)請證明 $\overline{(\overline{A}+B)}+\overline{(\overline{A}+\overline{B})}=A$ ？

8. 管線化(Pipeline)技術可以讓處理器大幅地減少一連串指令的總執行時間，如圖一所示：
   (a) (5%)當每個指令被切割成 N 個 stage 且應用理想化的管線化技術時，請證明處理器執行一連串指令的總執行時間將變為原來未採用管線化技術的總執行時間的 1/N？
   (b) (5%)相較於複雜指令集(CISC)型處理器，為何精簡指令集(RISC)型處理器比較容易利用管線化技術來做提升執行效能與做最佳化？



IF	ID	EX	MEM	WB				
	IF	ID	EX	MEM	WB			
		IF	ID	EX	MEM	WB		
			IF	ID	EX	MEM	WB	
				IF	ID	EX	MEM	WB

圖一：管線化技術之示意圖

9. (10%)假設 $f(1)=f(2)=2$ 且 $f(n)=f(n-1)+f(n-2)$, where $n \geq 1$
請使用 C 程式語言設計一個遞迴程式(recursive program)來求得 $f(n)$？

10. 在作業系統核心(Kernel)中，多工排程器(Scheduler)與記憶體管理(Memory Management)是最重要的二個核心模組：
(a) (5%)請問多工排程器的主要功能為何？
(b) (5%)請問記憶體管理的分頁(paging)機制的主要功能為何？

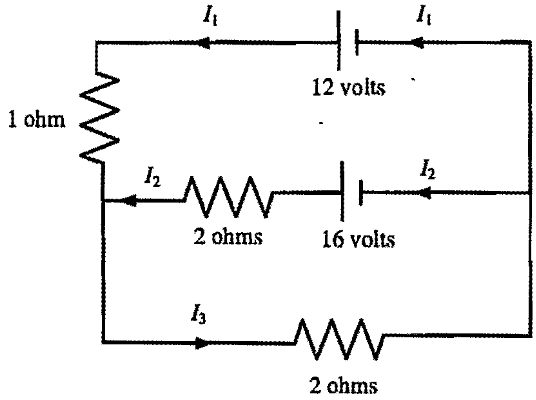
國立雲林科技大學

100學年度碩士班暨碩士在職專班招生考試試題

系所：電機系

科目：線性代數與機率學

1. (20%) Determine the currents through the various branches of the electrical network in the figure using the **Gauss-Jordan elimination** operation.



2. (15%) The following stochastic matrix P gives the probabilities for a certain region of college- and noncollege-educated households having at least one college-educated child. By college-educated we understand that at least one parent is college educated, while by noncollege-educated we mean that neither parent is college-educated. If there are currently 300,000 college-educated households and 750,000 noncollege-educated households, what is the predicted distribution for two generation hence?

$$\begin{array}{cccc} & \multicolumn{2}{c}{\text{household}} & \\ & \text{college educated} & \text{noncollege educated} & \\ & \nwarrow & \nearrow & \\ P = & \left[\begin{matrix} 0.9 & 0.25 \\ 0.1 & 0.75 \end{matrix}\right] & \begin{matrix} \text{college educated} \\ \text{noncollege educated} \end{matrix} & \text{child} \end{array}$$

3. (15%) Let the set $\{v_1, v_2, v_3\}$ be linearly independent in R^3. Let c be a nonzero scalar. Prove that the set $\{v_1, v_1 + cv_2, v_3\}$ are also linearly independent.

4. (9%) Explain the definitions for these terms; (a) a priori, (b) a posteriori, (c) the sample space of the experiment.

5. (16%) We may model the arrival of telephone calls with a Poisson probability density function. Suppose that the average rate of calls is 10 per minute. What is the probability that less than three calls will be received in the first six seconds? in the first six minutes?

6. (10%) Suppose two random variables are related such that $Y = aX^2$. Assume that $p_Y(y)$ is even about the origin. Show that $\rho_{XY} = 0$.

7. (15%) A Gaussian random variable with zero mean ($\mu = 0$) and variance σ^2 is applied to a device that has only two possible outputs, zero or one. The output zero occurs when the input is negative, and the output one occurs when the input is zero or positive. What is the output probability density function? Rework the problem when $\mu = 0.5$ and $\sigma = 1$.

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系所：電機系
科目：電路學與電力系統

1. (20%)

In Fig. 1, switch S_1 is closed at t=0. Switch S_2 is opened at t=4ms. Obtain i for t>0.

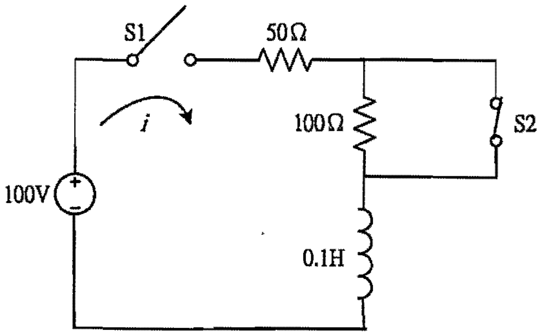


Fig. 1

2. (20%)

In the circuit of Fig. 2 find v_c (the voltage at node C), i_1, R_{in} (the input resistance seen by the 9V source), v_2, and i_2.

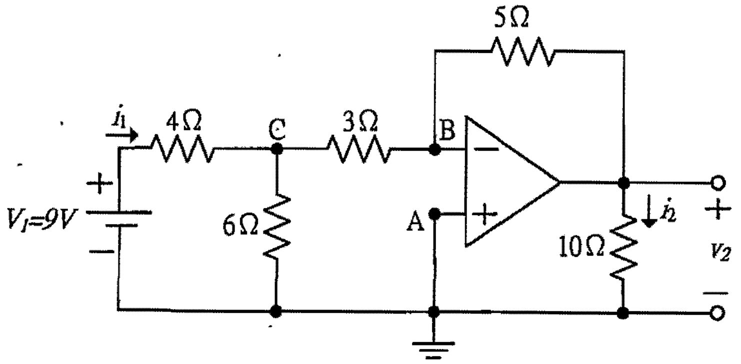


Fig. 2

3. (10%)

Obtain the complete power triangle for the circuit shown in Fig. 3, if the total reactive power is 2500 var (inductive). Find the branch powers $P_1$and P_2.

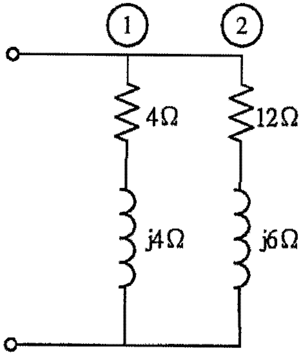


Fig. 3

4 Synchronous Generator

A 60 Hz, 14-pole, Y-connected, three-phase synchronous generator is rated at 250 MVA, 25.0 kV, power factor 0.9 lagging. The reactances X_d and X_q of this salient-pole synchronous generator are 0.83Ω and 0.57Ω respectively. The armature resistance and all rotational losses can be neglected.

4.1 (7%) Please sketch the phasor diagram for the internal generated voltage $\boldsymbol{E_A}$, the armature current $\boldsymbol{I_A}$, the terminal voltage $\boldsymbol{V_t}$, the d-axis current $\boldsymbol{I_d}$, the q-axis current $\boldsymbol{I_q}$, and the power angle δ.

4.2 (7%) What is the internal generated voltage under this rated conditions?

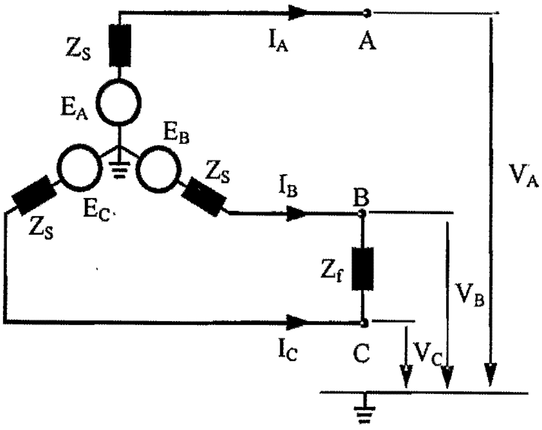
4.3 (6%) What is the power angle δ so that the generator can supply maximal power? And what is the maximal power?

5 Unsymmetrical Faults: Line-To-Line Fault

A three-phase generator with a fault through an impedance Z_f between phases B and C as shown in Fig. 5. Assume that the generator is on no-load.

5.1 (8%) Please use the symmetrical components analysis to find the fault current in term of zero-, positive-, and negative-sequence impedance (Z_o, Z_+, Z_-) and Z_f.

5.2 (7%) Sketch the sequence network connection for this line-to-line fault.



Symmetrical Components :

zero-sequence : Z_o, I_o, V_o

positive-sequence : Z_+, I_+, V_+

negative-sequence : Z_-, I_-, V_-

Fig. 5

6 Transmission Lines: Steady-State Operation

A three-phase, 60-Hz, completely transposed 345-kV, 170-km line has two 795,000-cmil (403 mm^2) 26/2 ACSR conductors per bundle and the following positive-sequence line specific constants: $z' = 0.017 + j0.223$ Ω/km, $y' = j3.7 \times 10^{-6}$ S/km. Full load at the receiving end of the line is 750 MW at 0.98 p.f. lagging and at 91% of rated voltage. Assuming a medium-length line, determine the following:

6.1 (7%) *ABCD* parameters of the nominal π circuit.

6.2 (8%) Sending-end voltage V_s, current I_s, and real power P_s.

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系所：電機系
科目：自動控制(2)

1. Reduce the system shown in Figure 1. to a single transfer function, T(s)=C(s)/R(s) (15%)

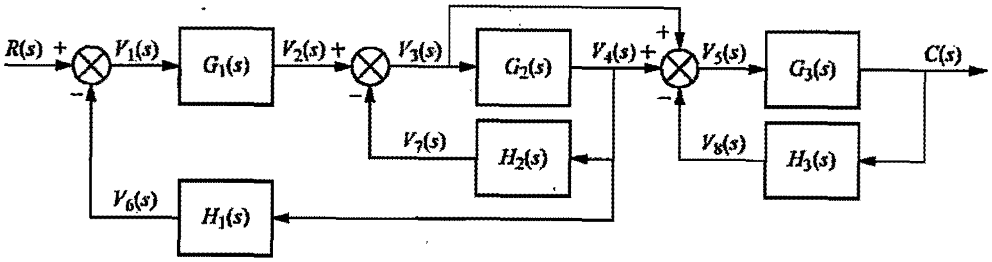

Figure 1.

2. Find the transfer function $G(s) = V_O(s)/V_i(s)$, for the circuit given in Figure 2 (15%)

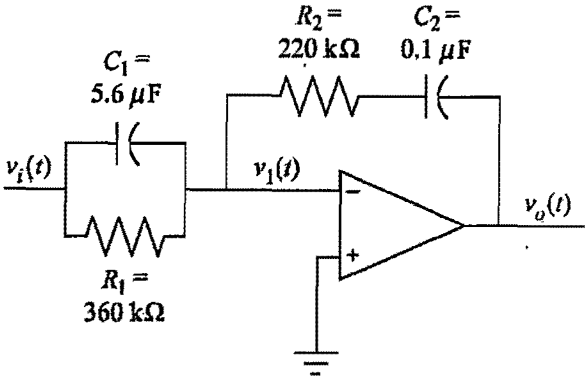

Figure 2

3. Find the state space representation of the electrical network shown in Figure 3. The output is $v_0(t)$. (10%)

$$X = \begin{bmatrix} V_{C1} \\ i_L \\ V_{C2} \end{bmatrix}, \quad V_{C2} = V_O$$

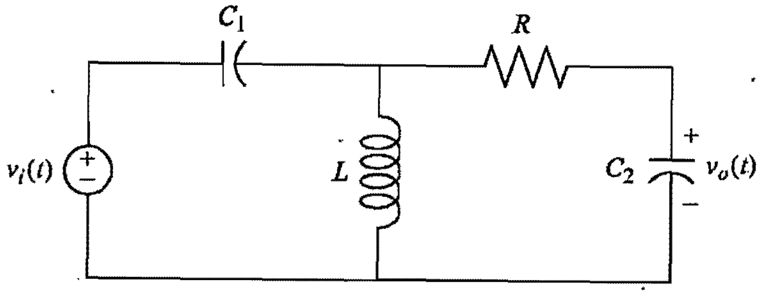

Figure 3

4. Linearize the equation for small excursions about $x = \pi / 4$ (10%)

$$\frac{d^2x}{dt^2} + 2\frac{dx}{dt} + \cos x = 0$$

5. Plot the root locus of the characteristic equation $1 + G(s)D(s) = 0$ where

$$G(s) = \frac{(s+0.1)^2 + 6^2}{s^2\left[(s+0.1)^2 + 6.6^2\right]}$$

is in a unity feedback structure with the controller transfer function (25%)

$$D(s) = K\frac{s+1}{s+12}$$

6. Suppose you have a pendulum with frequency w_0 and a state-space description given by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -w_0^2 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_1 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

Find the control law that places the closed-loop poles of the system so that they are both at $-2w_0$ and compute the estimation matrix that will place both the estimation error poles at $-10w_0$. (25%)

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系所：電機系
科目：線性代數(1)

1. Let $A=\begin{bmatrix} 1 & 2 & -3 & 4 \\ -4 & 2 & 1 & 3 \\ 3 & 0 & 0 & -3 \\ -1 & -2 & 1 & -1 \end{bmatrix}$,

   (a) (8%) Find the determinant of A

   (b) (8%) Compute the rank of A

2. Let the set of vectors $\{\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3\}$ be linearly independent. Determine whether the following sets of vectors are linearly dependent or independent.

   (a) (8%) $\{\mathbf{v}_1+\mathbf{v}_2, \mathbf{v}_2+\mathbf{v}_3, \mathbf{v}_3+\mathbf{v}_1\}$

   (b) (8%) $\{\mathbf{v}_1-\mathbf{v}_2, \mathbf{v}_2-\mathbf{v}_3, \mathbf{v}_3-\mathbf{v}_1\}$

3. (18%) Compute the eigenvalues and associated eigenvectors of $A=\begin{bmatrix} 0 & 0 & 3 \\ 1 & 0 & -1 \\ 0 & 1 & 3 \end{bmatrix}$.

4. (4%) Write down a 3×3 matrix A so that if the vector $v=(x, y, z)$ in $\mathbf{R}^3$ is multiplied by A, the x and y coordinates of v are unchanged, but the z coordinate becomes zero.

5. (10%) Find a unit vector orthogonal to $u=4\mathbf{i}-6\mathbf{j}+\mathbf{k}$ and $v=2\mathbf{i}+\mathbf{j}-3\mathbf{k}$.

6. Consider $a=(1,-1, 0, 0)$, $b=(0, 1,-1, 0)$, and $c=(0, 0, 1,-1)$.

   (a) (8%) Find the orthonormal vectors A, B, C by Gram-Schmidt operations from a, b, and c.

   (b) (8%) Show that $\{A, B, C\}$ and $\{a, b, c\}$ are bases for the space of vectors perpendicular to $d=(1, 1, 1, 1)$.

7. (8%) Given $A=\begin{bmatrix} 1 & 0 \\ -2 & 1 \\ 1 & 3 \end{bmatrix}$ and $b=\begin{bmatrix} 2 \\ 3 \\ 0 \end{bmatrix}$, find the projection of b onto the column space of A by solving $A^T A\hat{x}=A^T b$ and $p=A\hat{x}$.

8. (12%) Find the least squares parabola for the data points $\{(1, 2), (2, 5), (3, 7), (4, 1)\}$.

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系所：電機系
科目：電子學(1)

1. Two diodes with identical reverse saturation currents of I_S are placed in series as shown in Fig. 1. Calculate I_B, V_{D1}, and V_{D2} in terms of V_B and I_S. (10%)

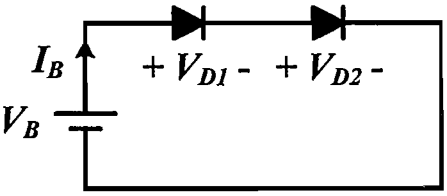

Figure 1

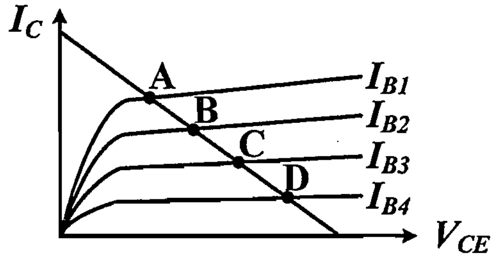

Figure 2

2. Figure 2 shows the output characteristics of a bipolar junction transistor. The load line is inserted with four operating points A, B, C and D with different base currents. Answer the following questions and explain why.
   (a) Which operating point leads to the largest transconductance, g_m ? (5%)
   (b) Which operating point leads to the largest output resistance, r_O ? (5%)

3. The bipolar *pnp* amplifier is depicted in Fig. 3. Assume $r_O < \infty$.
   (a) Draw the small signal equivalent circuit diagram. (5%)
   (b) Compute the output impedance. (5%)
   (c) Calculate the voltage gain. (5%)

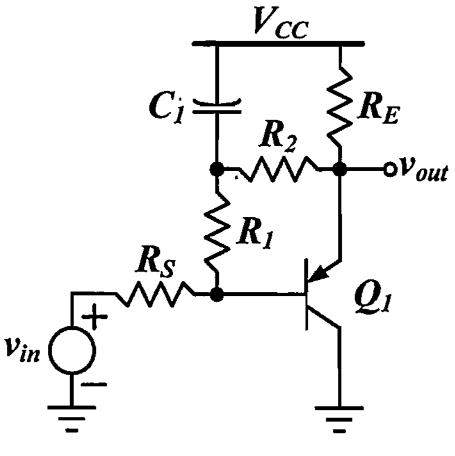

Figure 3

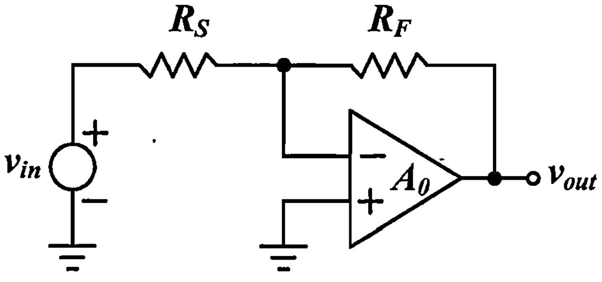

Figure 4

4. Answer the questions below for the Op-Amp-based circuitry shown in Fig.4.
   (a) Which type is this amplifier? (5%)
   (b) If the gain of Op-Amp, A_0, is infinite, calculate the voltage gain, v_{out}/v_{in}. (5%)
   (c) If the gain of Op-Amp, A_0, is finite, calculate the voltage gain, v_{out}/v_{in}. (5%)

5. For the MOS cascode amplifier illustrated in Fig. 5, we assume that the transistors are symmetric, i.e., M_1, M_3, M_5 and M_7 are identical to M_2, M_4, M_6 and M_8, respectively. Two equal resistors, R_1 and R_2, appear across the source and drain of M_5 and M_6 due to the non-ideal IC process. Assume $\lambda \neq 0$ and all the MOS transistors operate in saturation region.
   (a) Draw the equivalent half circuit. (5%)
   (b) Calculate the output resistance. (5%)
   (c) Calculate the differential voltage gain. (5%)
   (Note : All the small signal parameters of MOS transistors are added with suffix equal to the number of their corresponding transistor. For example, the transconductance and output resistance of M_1 are written as g_{m1} and r_{O1}.)

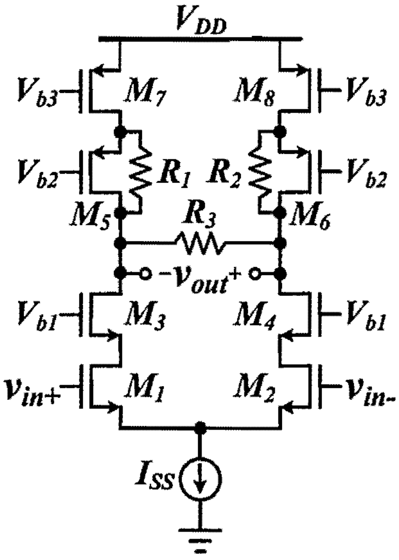

Figure 5

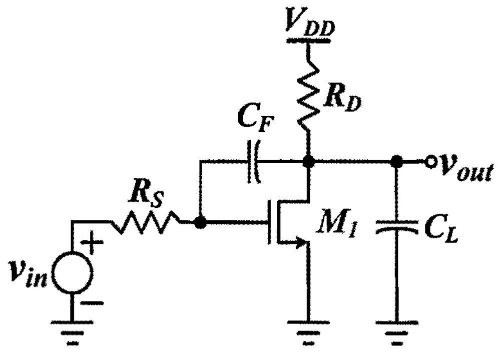

Figure 6

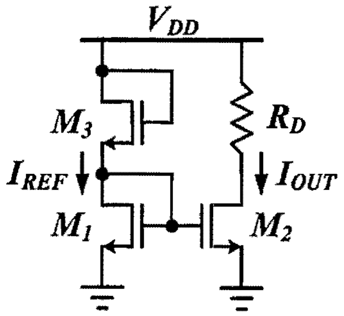

Figure 7

6. For the amplifier shown in Fig. 6, the MOS transistor, M_1, operates in saturation region. Assume $\lambda \neq 0$.
   (a) Draw the small signal equivalent circuit diagram of this amplifier with all parasitic capacitances. (5%)
   (b) Calculate the mid-band voltage gain, v_{out}/v_{in}. (5%)
   (c) Use Miller's theorem to estimate the input and output poles with all parasitic capacitances. (10%)

7. The current mirror shown in Fig. 7 uses two NMOS transistors to determine the output current. The parameters of the transistors are $V_{TH} = 0.4\text{V}$, $\mu_n C_{ox} = 20\mu\text{A/V}^2$ and $\lambda = 0$. Let V_{DD} be 2V. The aspect ratio (W/L) of M_1, M_2 and M_3 are 4, 6 and 1, respectively. Neglect the body effect.
   (a) Calculate I_{OUT}, I_{REF}, V_{GS1} and V_{GS3}. (10%)
   (b) What is the largest value of R_D such that M_2 still works in the saturation region? (5%)

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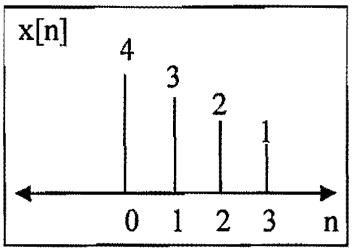
100學年度碩士班暨碩士在職專班招生考試試題

系所：電機系
科目：信號與系統

1. Given x[n] (as shown) (20%)
   (a) Plot x[-n]
   (b) Plot x[n+2]
   (c) Plot x[3-n]
   (d) Plot x[2n-1]



2. Given two systems S1 and S2, (20%)
   S1: y1[n]= x[n+1] + 2x[n] and
   S2: y2[n]= 3x[n] + 5x[n-2]
   (a) Find Impulse Response h1[n] and h2[n] of S1 and S2.
   (b) Is S1 and S2 stable? Causal? LTI?
   (c) Let S be the series connection of S1 and S2, what is the impulse response of S?
   (d) Let S be the parallel connection of S1 and S2, what is the impulse response of S?

3. Draw block diagram for implementation of the following LCCDE (10%)
   $5y[n]+2y[n-1]-3y[n-3]=2x[n]+4x[n-2]$

4. A continuous time signal x(t) is sampled at sampling frequency Fs Hz for 1 second,
   (a) How many points (N) of discrete samples x[n] are obtained in total? (5%)
   (b) What is the frequency resolution of the N-points DFT computed using the N points x[n]? Explain your answer. (5%)
   (Hints: N-points DFT (Discrete Fourier Transform) of discrete signal x[n] is defined as $X[k]=\sum_{n=0}^{N-1} x[n]e^{-j\frac{2\pi}{N}nk}$ for k=0,1,..,N-1, where N is the total number of samples used in computing DFT.)

5. The impulse response of a LTI system is
   $h(t)=e^{-at}u(t), \qquad a>0$
   And the input signal is:
   $x(t)=e^{-bt}u(t), \qquad b>0$
   Please find the response y(t) = h(t) ⊗ x(t) (20%) (⊗: Convolution)

6. The frequency spectrum of a signal x(t) is from 10K Hz to 20K Hz,
(a) What is the minimal sampling frequency to sample x(t) into discrete time signal x[n] without aliasing? Give your reason. (10%) (Note that there is no signal in the spectrum range from 0 to 10KHZ.)
(b) Under ideal conditions, how to reconstruct x(t) ? Give your reason.(10%)