國立雲林科技大學 102 學年度 系所：電機系、營建系
碩士班暨碩士在職專班招生考試試題 科目：工程數學(2)

1 (10 pts) Find the general solution of the differential equation: $e^x \sin y - 2x + (e^x \cos y + 1)y' = 0$.
(Hint: find the exact differential equation first)

2 (10 pts) Find the general solution of the differential equation for $x > 0$: $y'' - \frac{3}{x}y' + \frac{3}{x^2}y = x + 1$.
(Hint: the second order differential equation is an Euler's equation)

3 (10 pts) Solve the initial value problem: $y'' - y' - 2y = 2\cos^2 x$; $y(1) = 1$, $y'(1) = 0$.

4 (10 pts) Use the Laplace transform to solve the equation: $f(t) = -1 + t - 2\int_0^t f(\alpha)\sin(t-\alpha)d\alpha$.

5 (10 pts) Find the Laplace transform of $f(t) = \begin{cases} 2t^2, & 0 \le t < 3 \\ 1 - 2t - 3t^2, & t \ge 3 \end{cases}$.

6 (10 pts) Find the Fourier series of $f(t) = 1 + t$ on the interval $-\pi \le t \le \pi$.

7 (10 pts) Find the determinant and inverse matrix of $A = \begin{bmatrix} -2 & 1 & 1 \\ 0 & 1 & 1 \\ -3 & 0 & 6 \end{bmatrix}$

8 (15 pts) Let $A = \begin{bmatrix} 4 & -2 & 3 & 10 \\ 1 & 0 & 0 & -3 \\ 2 & -3 & 0 & 1 \end{bmatrix}$; $B = \begin{bmatrix} 1 \\ 8 \\ 16 \end{bmatrix}$; $X = \begin{bmatrix} x_1 \\ \vdots \\ x_4 \end{bmatrix}$, (a) find the reduced form of $[A \vdots B]$, (b) find a basis for the row space of A, the rank of A, and the rank of augmented matrix $[A \vdots B]$, (c) find the general solution of $AX = B$. [Note: please show the general solution by matrix form]

9 (15 pts) Let $A = \begin{bmatrix} 3 & -18 \\ 2 & -9 \end{bmatrix}$; $X(t) = \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$, (a) find eigenvalues and eigenvectors of A, (b) find the fundamental matrix $\Omega(t)$ for the system of differential equations $X' = AX$, (c) find the general solution of $X' = AX$

國立雲林科技大學 102 學年度 系所：電機系
碩士班暨碩士在職專班招生考試試題 科目：線性代數(1)

1. Find the dimension and a basis of the solution space W of the system of linear equations (15%)

$$x + 2y - 4z + 3r - s = 0$$
$$x + 2y - 2z + 2r + s = 0$$
$$2x + 4y - 2z + 3r + 4s = 0$$

2. Let $A = \begin{pmatrix} 1 & 4 \\ 2 & 3 \end{pmatrix}$.

   (a) Find all eigenvalues of A and corresponding eigenvectors. (10%)

   (b) Find an invertible matrix P such that $P^{-1}AP$ is diagonal. (10%)

3. Let T be the linear operator on R^3 which is represented in the standard ordered basis by the matrix (15%)

$$\begin{bmatrix} 5 & -6 & -6 \\ -1 & 4 & 2 \\ 3 & -6 & -4 \end{bmatrix}.$$

Prove that T is diagonalizable by exhibiting a basis for R^3, each vector of which is a characteristic vector of T.

4. Let T be the linear transformation whose standard matrix is

$$A = \begin{bmatrix} 1 & -4 & 8 & 1 \\ 0 & 2 & -1 & 3 \\ 0 & 0 & 0 & 5 \end{bmatrix}$$

(a) Does T map R^4 onto R^3? (10%)

(b) Is T a one-to-one mapping? (10%)

Explain your reasons for both answers.

5. Determine if the columns of the following matrix form a linearly independent set. You must show the process of your reasoning. (15%)

$$\begin{bmatrix} 1 & 1 & 0 & 4 \\ -1 & 0 & 3 & -1 \\ 0 & -2 & 1 & 1 \\ 1 & 0 & -1 & 3 \end{bmatrix}$$

6. Show the process to find an LU factorization for the following matrix (15%)

$$\begin{bmatrix} 1 & 3 & -5 & -3 \\ -1 & -5 & 8 & 4 \\ 4 & 2 & -5 & -7 \\ -2 & -4 & 7 & 5 \end{bmatrix}$$

國立雲林科技大學 102 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：電路學與電力系統

1. A sinusoidal voltage source $v(t) = 240\sqrt{2}\sin(377t + 0.687)$ V is applied to a series R-L circuit with $R = 9.69\ \Omega$, $L = 6.63$ mH, at $t = 0$. Assume that the inductor has no initial current. Please determine the circuit current $i(t)$ for $t \geq 0$. (20%)

2. The **ABCD** transmission parameters of the two-port network in Fig. 2 are $[\,\mathbf{T}\,] = \begin{bmatrix} 1 & 10 \\ 5 & 2 \end{bmatrix}$.

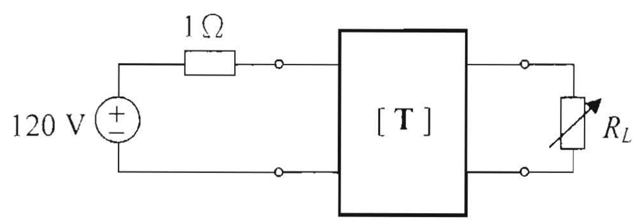


Fig. 2

The output port is connected to a variable load for maximum power transfer. Find R_L and the maximum power transferred. (15%)

3. Calculate the mesh currents $\underline{I}_1$ and $\underline{I}_2$ in the circuit of Fig. 3. (Note: $\underline{I}_1$ and $\underline{I}_2$ are the phasor representation of the sinusoid $i_1(t)$ and $i_2(t)$.) (15%)

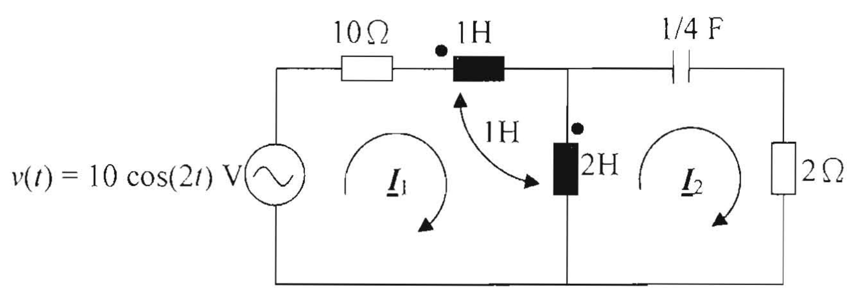


Fig.3

4. Two balanced Y-connected loads, one drawing 10 kVA at 0.6 power factor lagging and the other 4 kW at 0.8 power factor leading, are connected in parallel and supplied by a balanced three-phase Y-connected, 480-V source. (a) Draw the power triangle for each load and for the combined load. (b) Determine the power factor of the combined load and state whether lagging or leading. (c) Determine the magnitude of the source current. (d) If the load neutrals are connected to the source neutral by a zero-ohm neutral wire through an ammeter, what will the ammeter read? (20%)

國立雲林科技大學 102 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：電路學與電力系統

5 Consider a source of voltage $v(t) = 110\sqrt{2}\sin(377t)$ V, with an internal resistance of 800 Ω. A transformer that can be considered as ideal is used to couple a 50-Ω resistive load to the source. (a) Determine the transformer primary-to-secondary turns ratio required to ensure maximum power transfer by matching the load and source resistances. (b) Find the average power delivered to the load, assuming maximum power transfer. (15%)

6. The operating cost of two thermal units of a power system are

$$C_1 = 7.0P_1 + 0.008P_1^2 \quad \$/\text{hr}$$

$$C_2 = 8.0P_2 + 0.009P_2^2 \quad \$/\text{hr}$$

where P_1 and P_2 are in MW. The units are subject to the following limits:

$$100 \le P_1 \le 600 \quad \text{MW}$$

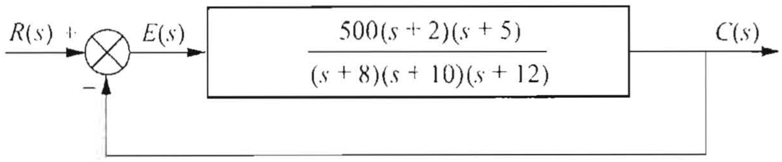
$$400 \le P_2 \le 1000 \quad \text{MW}$$

Determine the power output of each unit, the incremental operating cost, and the total operating cost $C_T = C_1 + C_2$ that minimizes C_T when the total system load is 1000 MW. Transmission losses are neglected. (15%)

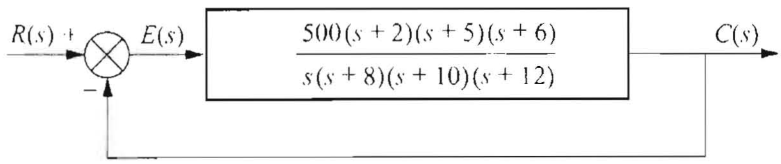
國立雲林科技大學 102 學年度 系所：電機系

碩士班暨碩士在職專班招生考試試題 科目：自動控制(2)

1. For each system of Figure 1 evaluate the static error constants and find the expected error for the standard step, ramp, and parabolic inputs. (15%)



(*a*)



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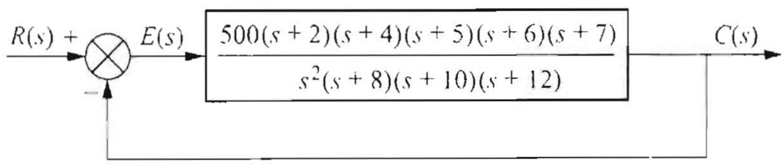


(*c*)

Figure 1

2. Using Mason's rule, find the transfer function, $T(s) = C(s)/R(s)$, for the system represented in Figure 2. (20%)

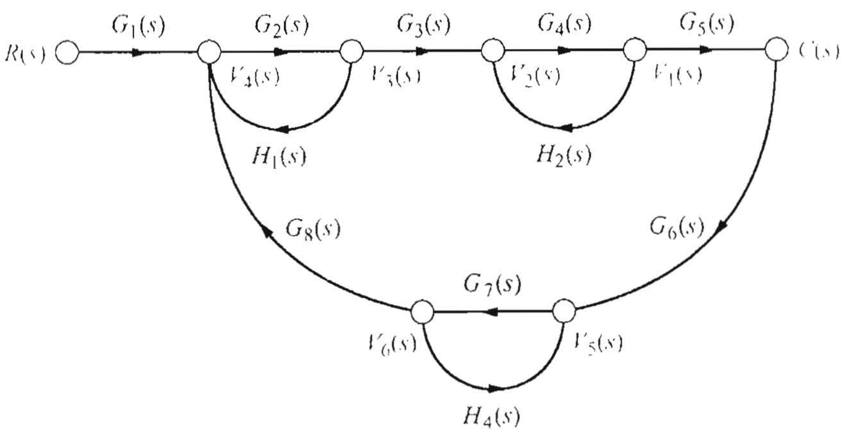


Figure 2

3. Find the transfer function, $T(s) = Y(s)/U(s)$, where $U(s)$ is the input and $Y(s)$ is the output (15%)

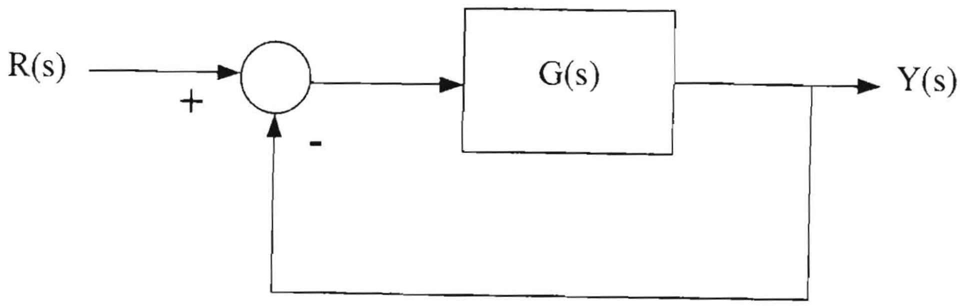
$$\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -2 & -3 \end{bmatrix} X + \begin{bmatrix} 10 \\ 0 \\ 0 \end{bmatrix} u(t), \quad y(t) = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} X$$

國立雲林科技大學 102 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：自動控制(2)

4. The forward path transfer function of a unity-feedback control is given: (25%)

$$G(s) = \frac{K}{s(s+10)(s+20)}$$



(a) Construct the root locus diagram for $K \geq 0$

(b) Find the value of gain K that the system is marginally stable.

(c) Find the value of gain K at all the breakaway point.

(d) Sketch the Nyquist plot with K=100.

(e) Find the phase-crossover frequency ω_p (rad/sec) and gain margin (dB) with K=100.

5. The transfer function of a system is given by (25%)

$$G(s) = \frac{20}{(s+1)(s+2)(s+4)}$$

(a) Transform the transfer function into the controllability canonical form.

$$\dot{X}(t) = AX(t) + BU(t)$$
$$Y(t) = CX(t)$$

(b) Is the system controllable?

(c) Is the system observable?

(d) Design a state control feedback $U(t) = -KX(t) = -[K_1 \quad K_2 \quad K_3]X(t)$ so that the closed-loop poles are located at $s = -2 + j2\sqrt{2}$, $s = -2 - j2\sqrt{2}$, and $s = 10$.

國立雲林科技大學 102 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：計算機概論(1)

1. (10%)請說明個人電腦的開機程序 (power on procedure)，包括 CPU、ROM、RAM、Hard Disk 間的互動順序。

2. (a) (3%)請寫出 DVD 的英文全名？
   (b) (4%)請說明 DVD 資料燒錄的方式？
   (c) (4%)請說明 DVD 資料讀取的方式？

3. (a) (3%)請寫出 ADSL 的英文全名？
   (b) (4%)何謂 ADSL？

4. 下列二函式 $f(x)=a_1x^3+a_2x^2+a_3x+a_4$ ， $g(x)=((a_1x+a_2)x+a_3)x+a_4$
   (a) (5%)試比較二函式在運算上，以及硬體設計上有何不同？
   (b) (5%)當 x 值趨近於 0 時，試比較二函式在運算上的準確度。

5. 請以二進制方式進行下列運算
   (a) (6%) $(AD)_{16}\times(B)_{16}$ = (?)$_{16}$
   (b) (6%) $(9B4)_{16}\div(2E)_{16}$ = (?)$_{16}$

6. (10%)What is the "MIPS" and "DMIPS", Please define it.

7. (10%)In C language, what is the "stack memory"? When and How to use it in program?

8. (10%) In C language, what is the "heap memory"? When and How to use it in program?

9. (a) (15%)Design a C function to perform the "bubble sort" from lowest number to greatest number ?
   The function definition is:
   void bubblesort(int n, int Xarray[])
   Note: n is the Element Number and Xarray is used to store numbers.
   (b) (5%)In (a), how many swap operation will happen in worst case? Please explain.

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系所：電機系
科目：電子學(1)

1. A typical transconductance characteristic of an NMOS transistor biased at saturation region is depicted in Figure 1. Choose two operating points (Q_A, Q_B).
   (a) Please compare the magnitude of the transconductance (g_{mA} vs. g_{mB}) for the two operating points (Q_A and Q_B) and discuss the reason. (5%)
   (b) Please compare the magnitude of output resistance (r_{OA} vs. r_{OB}) for the two operating points (Q_A and Q_B) and discuss the reason. (5%)

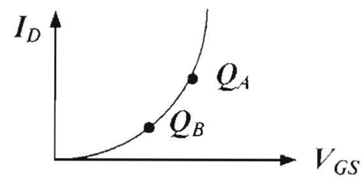

Figure 1

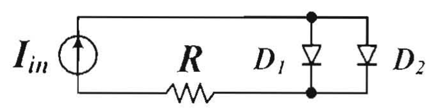

Figure 2

2. The two diodes in Fig. 2, D_1 and D_2, are identical except having different reverse saturation currents, I_{S1} and I_{S2}, respectively. For I_{in} is large enough to turn on both diodes, determine the current flow through each diode using the exponential model. (10%)

3. Determine the impedance (R_x) seen at the emitter of $Q2$ in Fig. 3. Ignore the Early effect. (10%)

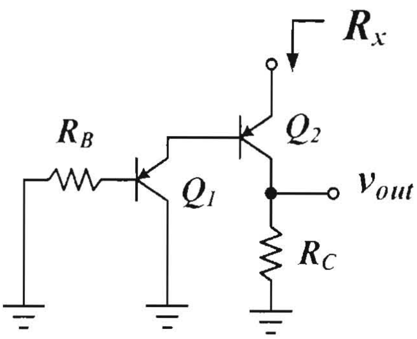

Figure 3

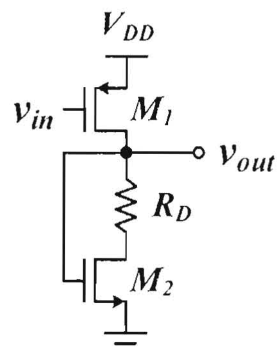

Figure 4

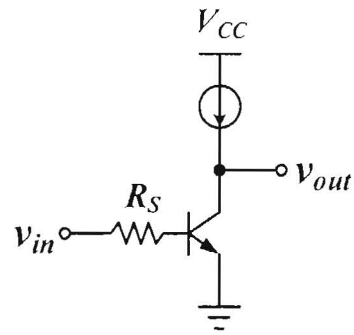

Figure 5

4. Draw the small signal model of the circuit shown in Fig. 4. Assume that both transistors operate at saturation and also consider the phenomenon of channel length modulation. (10%)

5. Assume $V_A < \infty$ and using Miller's theorem, determine the input and output poles and hence the transfer function of the common-emitter stage with ideal current source load in Fig. 5. (10%)

6. (a) For the MOS transistor circuit depicted in Fig. 6(a), calculate the voltage gain using the aspect ratios - $(W/L)_1$ and $(W/L)_2$. Assume λ=0 for both transistors. Design this amplifier if the magnitude of the voltage gain is targeted to be 2. Choose equal length for both transistors. (10%)
   (b) Calculate the voltage gain for the bipolar counterpart in Fig. 6(b). (5%)

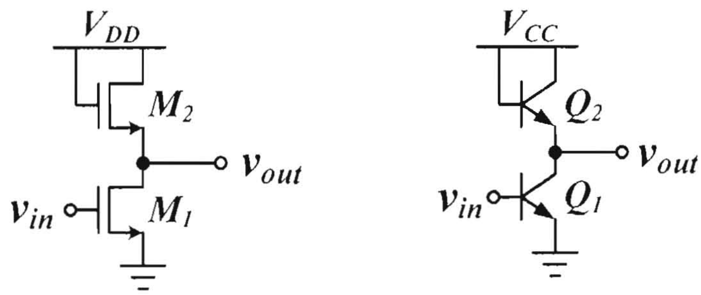

Figure 6 (a) Figure 6 (b)

7. Calculate the closed-loop transfer function of the non-inverting amplifier in Fig. 7 with the transfer function of the op-amp given below. Draw the bode plot of this circuit and also derive the closed-loop pole. (15%)

$$\frac{V_{out}}{V_{in1}-V_{in2}}(s)=\frac{A_0}{1+\frac{s}{\omega_1}}$$

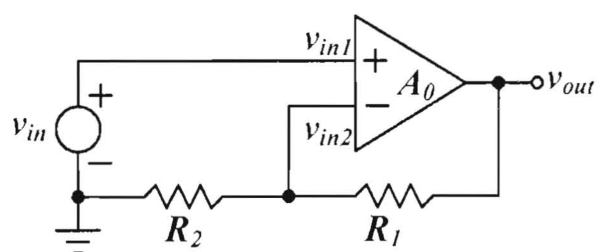

Figure 7

8. For the MOS cascode amplifier with a cascode current source load in Fig. 8,
   (a) Write down the output resistance, R_{op} and R_{on} in both of the exact and simplified forms. (10%)
   (b) What is the G_m of this amplifier? (5%)
   (c) Derive the amplifier gain, A_v, in the simplified form. (5%)

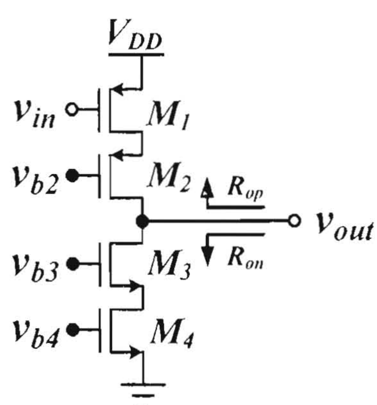

Figure 8

國立雲林科技大學 102 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：通訊原理

1. 計算下列信號之傳立葉轉換(Fourier transform):
 (a) (5%) $x(t)=e^{-a|t|}$, $a>0$;
 (b) (5%) $g(t)=\sin(2\pi t+\pi/4)$;
 (c) (10%) $y(t)=\begin{cases}1, & |t|<3 \\ 0, & |t|>3\end{cases}$，且結果 $Y(jw)$以 sinc 函數形式表現。

2. 一線性非時變系統(LTI system)其輸出 $y(t)$與輸入 $x(t)$關係可以用下列微分方程式來描述：

$$\frac{d^2y(t)}{dt^2}+4\frac{dy(t)}{dt}+3y(t)=\frac{dx(t)}{dt}+2x(t)$$

 (a) (10%) 此系統的脈衝響應 $h(t)$為何？
 (b) (10%) 若輸入信號 $x(t)=e^{-t}u(t)$，則系統輸出 $y(t)$為何？

3. FM 廣播系統的載波頻率範圍為 88–108 MHz，每組信號的頻寬為 200 kHz，超外差接收器 (superheterodyne receiver) 中所使用的中頻頻寬 $f_{IF}=10.7\,\text{MHz}$.
 (a) (4%) 寫出接收端本地震盪器 (LO) 可調頻率之範圍。
 (b) (6%) 如果想要收聽載波頻率為 102 MHz 的廣播訊號，本地震盪器之輸出頻率應為多少？此時，鏡像頻率 (image frequency) 為多少？
 (c) (10%) 請畫出接收器方塊圖並說明系統如何除去鏡像訊號 (image signal).

4. 已知基頻 (baseband) 訊號 $s(t)=\begin{cases}-A & 0<t<T/2 \\ A & T/2<t<T \\ 0, & t<0 \text{ or } t>T\end{cases}$

 其中 A 與 T 均為大於 0 的常數。請利用匹配濾波器 (matched filter) 設計一組最佳接收器 (optimal receiver) 以偵測此訊號。
 (a) (4%) 畫出訊號 $s(t)$ 之波形；$s(t)$ 是帶限(band-limited)或時限(time-limited)訊號嗎？
 (b) (3%) 訊號 $s(t)$ 的傳輸能量是多少？
 (c) (6%) 畫出接收器之完整方塊圖，並寫出匹配濾波器之脈衝響應。
 (d) (7%) 假設外加雜訊可以忽略，計算並畫出匹配濾波器之輸出波形。

5. 假設一個數位信號源送出之信號為

$$s_i(t)=a_i\phi_1(t)+b_i\phi_2(t),\quad 0<t<T,\ i=1,2,3,4$$

 其中 $\phi_1(t)$ 及 $\phi_2(t)$ 是一組正交基底函數; $(a_i,\ b_i)$ 的四組可能值分別為 (0, 0), $(0,\alpha)$, $(\alpha,0)$ 及 (α,α)，其中 $\alpha>0$ 為常數。假設送出各信號之機會均等。
 (a) (4%) 在信號空間上畫出信號分佈，以及各點對應的決策區間 (decision regions).
 (b) (4%) 計算平均傳輸能量 (energy per symbol), E_S.
 (c) (6%) 計算符元平均錯誤機率 (average probability of symbol error), P_S.
 (d) (6%) 對信號做格雷編碼 (Gray encoding), 並計算在 AWGN 通道中傳輸之位元錯誤率 (bit error rate, BER).