國立雲林科技大學
九十學年度研究所碩士班入學考試試題

系所：電機系
科目：工程數學 (乙)

1. Find the general solutions for the following differential equations.

   (a) $6xy+2y+8+xy'=0$ (10%)

   (b) $x^3y'''+x^2y''-2xy'+2y=x^3\ln(x)$ (15%)

2. Use the Laplace transform to solve the following differential equation.

$$y''+4y=\begin{cases}0, & 0\le t<\pi\\ 3\cos(t), & t\ge\pi\end{cases}, \quad y(0)=y'(0)=1. \qquad (10\%)$$

3. Find the inverse Laplace transform for the following function

$$F(s)=\frac{2k^3}{(s^2+k^2)^2}, \qquad (15\%)$$

   where k is a constant.

4. Under what condition on b_1, b_2, b_3 is the following system solvable? Find all solutions. (10%)

$$\begin{aligned} x_1+2x_2-2x_3 &= b_1\\ 2x_1+5x_2-4x_3 &= b_2\\ 4x_1+9x_2-8x_3 &= b_3 \end{aligned}$$

5. The matrix

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

   has complex eigenvalues. Let $\mathbf{z}=\mathbf{u}+i\mathbf{v}$ be an eigenvector of A associated with the eigenvalue $\lambda=\alpha+i\beta$, where α,β are real numbers and $\mathbf{u},\mathbf{v}$ are real vectors.

   (a) Find α,β and $\mathbf{u},\mathbf{v}$. (5%)

   (b) Show that $\mathbf{u},\mathbf{v}$ are linearly independent vectors. (5%)

   (c) Show that $A\mathbf{u}=\alpha\mathbf{u}-\beta\mathbf{v}$ and $A\mathbf{v}=\beta\mathbf{u}+\alpha\mathbf{v}$. (5%)

   (d) Find a nonsingular matrix P such that

$$P^{-1}AP=\begin{bmatrix}\alpha & \beta\\ -\beta & \alpha\end{bmatrix}. \qquad (5\%)$$

   (**Hint**: See *Part* (c).)

   (e) Let $D=P^{-1}AP$ be the matrix given in Part (d). Find e^{Dt} for any t. (5%)

   (f) Find two *real-valued* linearly independent solutions to the system of differential equations: $\dot{\mathbf{x}}(t)=A\mathbf{x}(t)$. (5%)

6. Determine the Fourier transform of the following functions

   (a) $e^{-3|t|}$ (5%)

   (b) $\frac{5e^{i3t}}{t^2-4t+13}$. (5%)

國立雲林科技大學
九十學年度研究所碩士班入學考試試題

系所：電機系
科目：科技英文

I. (24%) Choose the correct word from each parenthesis and write them down on the answer sheet.

1. (When; During) electric current is the (manipulating; manipulated) variable in a closed-loop control system, the final (corrected; correcting) device is often a relay or a contactor. For example, in an electric (heat; heating) process,the temperature might be controlled in the ON-OFF mode simply by opening and closing a contact (lead; leading) to the heating element.

2. The ADC 0808 is an 8-bit analog-to-digital converter. It uses successive approximation as the conversion (technique; skill). It features a high (impedance; resistance) chopper comparator, a 256R voltage divider with analog switches and a successive approximation register. Its 8-channel multiplexer can directly (approach; access) any of 8-single-ended analog signals. The device needs no (external; internal) zero and full-scale adjustments. The (latched; latching) and (decoded;decoding) multiplexer address inputs and latched TTL 3-state outputs provide easy interfacing to microprocessors. ADC0808 is ideally (suited; suiting) to applications from process and machine control to home and automotive control.

II. (18%) Choose one answer which matches the meaning of the given sentence.

3. You don't look your age.
   (A)You look younger than you are.
   (B)You don't think much of your age.
   (C)You seem to be older.
   (D)You are on the right side of twenty.
4. He gives himself up to drinking.
   (A)He has a strong objection to drinking
   (B)He abstains from wine.
   (C)He stops drinking.
   (D)He indulges himself in drinking.
5. He has eyes for me.
   (A)He is jealous of me.
   (B)He is angry with me.
   (C)He is interested in me.
   (D)He envies me very much.
6. We were six days going from St. Louis to St. Joe.
   (A)We were allowed to go from St. Louis to St. Joe in six days.
   (B)We took six days to go from St. Louis to St. Joe.
   (C)Six days later, we went from St. Louis to St. Joe.

(D)We waited six days before we went from St. Louis to St. Joe.

7. Grace was said before dinner.

(A)They talked about Grace before dinner.

(B)They asked Grace to say something before dinner.

(C)They said grace before dinner.

(D)Grace said she would come back before dinner.

8. The city government spares no efforts to raise the city's cultural level.

(A)The city government won't raise the city cultural level.

(B)The city government wastes so much time in raising the city's cultural level.

(C)The city government makes every effort to raise the city's cultural level.

(D)The city government doesn't think much of culture,so the city government won' t spare any effort to raise the city's cultural level.

III. (36%) Reading comprehension

The first coins to appear in the Western world were issued by theLydians and the Ionian Greeks in the eighth century B.C. These coins, which were made ofelectrum, a natural combination of gold and silver, were irregular in weight and quality and apparently of private issue. The pure gold and silver coins with related values which appeared during the reign of Croesus (560-546 B.C.) provide the first undoubted evidence of standard coinage by state authority. The coins were not perfectly shaped, however, for they were struck with a hand-wielded hammer. The trend toward complete mathematical symmetry did not, in fact, begin until the coining press, invented byLeonardo da Vinci in the sixteenth century, was generally adopted in the middle of the seventeenth century.

One should not assume, however, that only machine-made coins are prized for their workmanship. The silver dekadrachm from Syracuse, struck about 413B.C., is considered one of the finest Greek coins and is worth more than a thousand dollars today. An artistic masterpiece of a much later period is the silvertaler minted in Ratisbon, southern Germany, in 1754.

The value of a coin is not primarily determined by its age, as many people seem to think. Many Greek and Roman coins that were issued in abundance can be purchased for a moderate price. On the other hand, a German coin made of shrapnel during the First World War is very rare and valuable. Among the especially rare United States coins are the 1804 silver dollar, the 1822 five-dollar gold piece, and the 1894silver dime.

9. The reason some old Roman coins are not costly is that they are

(A) available in quantity

(B) inferior in workmanship

(C) irregular in shape and size
(D) made out of inexpensive metal

10. Which of the following statements may NOT be made about the coins made in Lydia during the reign of Croesus?
(A) They were issued by the government.
(B) They were given standard values.
(C) They were all of equal purity.
(D) They were all alike in shape.

11. The author specifically mentions all of the following features of the Syracusan dekadrachm EXCEPT its
(A)appearance
(B)scarcity
(C)value
(D)age

12. Leonardo da Vinci is mentioned in the passage in connection with
(A) the first government issue of coins
(B) the artistic aspect of coin making
(C) coins issued in the sixteenth century
(D) the production of uniform coins

13. The author makes it clear that the Syracusan dekadrachm and the German taler mentioned in the passage are
(A) hand-made Western coins
(B) worth about a thousand dollars each today
(C) made out of different metals
(D) noted for their craftsmanship

14. The author emphasizes the importance of which of the following factors in establishing the purchase price of a coin?
(A) The date of issue
(B) The country of origin
(C) The number in existence
(D) The quality of craftsmanship

15. Which of the following statements about the United States coins mentioned CANNOT be concluded from the passage?
(A) They are available for immediate purchase.

(B) They were produced by a coining press.
(C) They were produced in small quantities.
(D) They are high-priced collectors' items.

16. The author makes it clear that coins made by machine are
(A) usually of greater value than hand-made coins
(B) more uniform in size and shape than hand-made coins
(C) available in larger quantities than hand-made coins
(D) generally superior in workmanship to hand-made coins

What can you do if you "lose" the data from your disks? To find an expert, who would recover the lost information for you, is probably the easiest solution. Jack Olson is one of these experts. Jack and a few of his friends set up a company called "Sack's Disk Doctor Service" in 1984. They work from home and give all the money they earn to charity. The fees are always the same, no matter how precious the data on the disk is. Some people, however, are so grateful that they send extra money to Jack or to the charities his company supports. One oil company offered him $2000 for his help and an architect even sent him a blank check.

It would be difficult to put a value on the things rescued by the Disk Doctor. There have been disks containing medical research, television scripts, manuscripts of whole books, a lawyer's papers for a court case, and even Margaret Thatcher's travel plan for a visit to eastern Europe. For this last case, Jack had to go in person to Thatcher's office "for security reasons"!

Disks are usually sent to the Disk Doctor by post, but sometimes people are in such a hurry that they cannot wait for the mail to come. For example, some radio scripts had to be rushed by taxi to Jack's house because they were needed for broadcasting the next day. When the material has been recovered, the disk is returned to the sender with a diagnosis and a prescription for avoiding the problem in the future. One grateful client, an author, put a "thank you" to Jack in the front of his book. "Jack saved me from a heart attack," he wrote. "But, " says Jack, "most people don't take any notice of the doctor's advice!"

17. What does the word rescued in the second paragraph mean?
(A) Recovered.
(B) Prescribed.
(C) Examined.
(D) Discovered.
18. Why did the architect send Jack a blank check?
(A) The architect did not have any money.

(B) The architect did it for security reasons.
(C) The architect always followed the doctor's advice.
(D) The architect thought Jack's service was priceless.

19. Which of the following statements is NOT true"
(A)Jack's Disk Doctor Service has only one standard fee.
(B)Jack and his company have made a fortune from their service.
(C) Margaret Thatcher is a very important person.
(D)Jack's clients are from all walks of life.

20. From the statement "But...most people don't take any notice ofthe doctor's advice!" we can infer that:
(A) most people don't lake medicine regularly.
(B) many of Jack's patients would probably get sick again.
(C) many of Jack's clients have sought for his help more than once.
(D) most people don't read the instruction when using a computer.

IV. (22%) General test

Most people like to talk, but few people like to listen. (21)listening well is a rare talent that everyone should treasure. Because they hear more, goodlisteners (22) to know more and to be more sensitive to what is going on around them than other people. In addition, good listeners are inclined to accept or tolerate (23) to judge and criticize. Therefore, they have (24) enemies than other people. (25), they are probably the most loved of people. However, there are (26) to that generality. For example, JohnSteinbeck is (27) to have been an excellent listener, yet he was hated by some of the people he wrote about. No doubt his ability to listen contributed (28) his capacity to write. (29), the results of his listening did not make him popular. Thus, (30) on, what a good listener (31), he may become either popular or disliked in his lifetime.

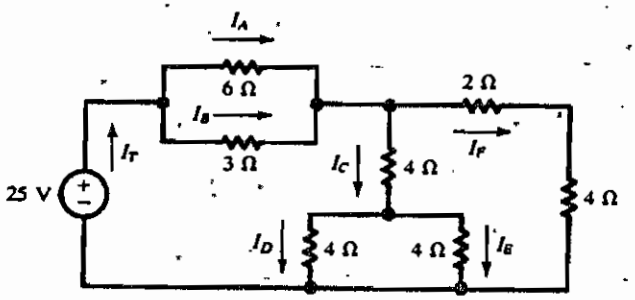
21. (A)Yet (B)And (C)Or (D)So
22. (A)mean (B)like (C) end (D)act
23. (A) instead of (B) rather than (C) in order (D) in addition
24. (A)little (B)least (C)lesser (D) fewer
25. (A)In contrast (B)In particular (C)In fact (D)In other words
26. (A)situations (B) exceptions (C)perceptions (D)observations
27. (A)called (B)named (C)said (D)told
28. (A)on (B)to (C)for (D)in
29. (A)Nevertheless (B)Conversely (C)Consequently (D)Moreover
30. (A)depend (B)depends (C)depended (D)depending
31. (A)did (B)does (C) was (D) is

國立雲林科技大學
九十學年度研究所碩士班入學考試試題

系所：電機系

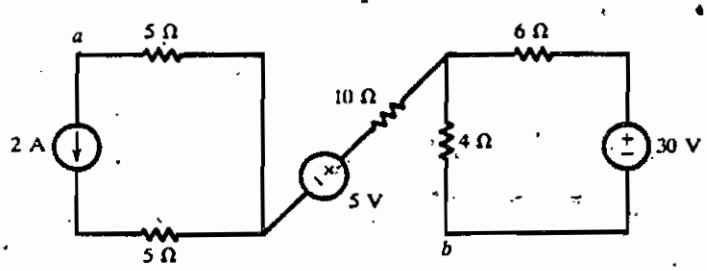
科目：電路學

1. 如圖一所示之電路，求流過每一個電阻的電流。(10%)



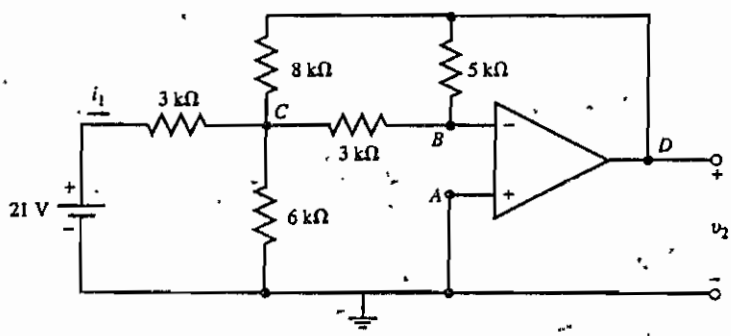
圖一

2. 如圖二所示之電路，求電壓 V_{ab} 。(10%)



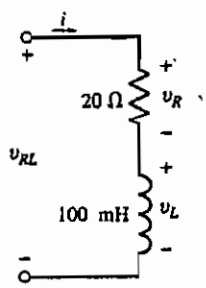
圖二

3. 如圖三所示之電路，求 v_C , i_1 , v_2 及由 21V 電源看到的輸入電阻 R_{in} 。(15%)

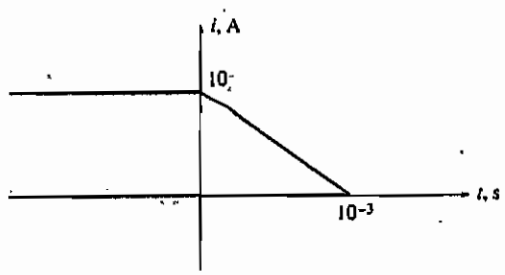


圖三

4. 如圖四所示之電路，有一電流 i (如圖五所示)流過。求電壓 v_R , v_L 及 v_{RL} ，並畫出這些電壓的波形。(15%)



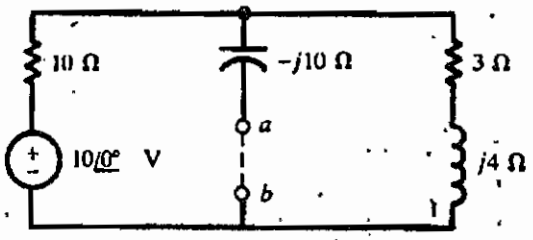
圖四



圖五

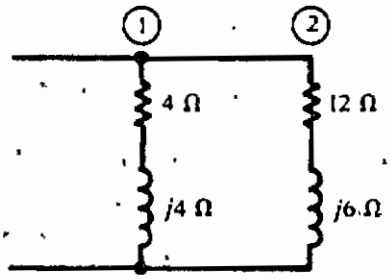
國立雲林科技大學　　系所：電機系
九十學年度研究所碩士班入學考試試題　　科目：電路學

5. 如圖六之電路，求 *ab* 兩端之諾頓等效電路與戴維寧等效電路。(15%)



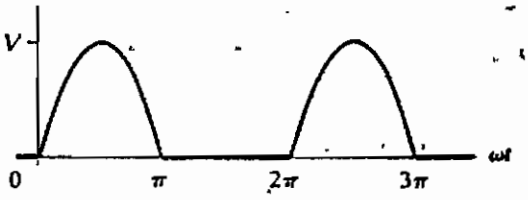
圖六

6. 如圖七之電路，若總電抗功率爲 2500 VAR(電感性)，求支路功率 P_1 與 P_2，畫出完整之功率三角形。(15%)



圖七

7. 如圖八所示之電壓波形，求其傅立葉(Fourier series)級數。(20%)



圖八

國立雲林科技大學
九十學年度研究所碩士班入學考試試題

系所：電機系
科目：線性代數與機率

1. (15%) Let **W** be the two-dimensional subspace of R_3 with orthonormal basis $\{w_1, w_2\}$ Where $w_1 = [\frac{2}{3}, -\frac{1}{3}, -\frac{2}{3}]$, $w_2 = [\frac{1}{\sqrt{2}}, 0, \frac{1}{\sqrt{2}}]$ and let v = [1, 1, 0]. Find the distance from v to **W**.

2. (20%) Let L: $R^3 \rightarrow R^3$ be defined by $L\left(\begin{bmatrix} a \\ b \\ c \end{bmatrix}\right) = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 2 \\ 2 & 1 & 3 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix}$

   (1) Is L onto?
   (2) Find a basis for range L.
   (3) Find Ker L.
   (4) Is L one-to-one?

3. (15%) Diagonalize matrix $A = \begin{bmatrix} 0 & 0 & -2 \\ 0 & -2 & 0 \\ -2 & 0 & 3 \end{bmatrix}$ (Show the details)

4. (15%) A miner is trapped in a mine containing three doors. The first door leads to a tunnel which takes him to safety after two-hour's travel. The second door leads to a tunnel which returns him to the mine after three-hour's travel. The third door leads to a tunnel which returns him to his mine after five hours. Assuming that the miner is at all times equally likely to choose any one of the doors, what is the expected length of time until the miner reaches safety?

5. (10%) Each customer who enters Peter's clothing store will purchase a suit with probability p. If the number of customers entering the store is Poisson distributed with mean λ, what is the probability that Peter sells k suits?

6. (15%)(a) If X and Y are independent binomial random variables with parameters (n, p) and (m, p), respectively, then what is the distribution of $X+Y$? (b) Calculate the distribution of $X+Y$ when X and Y are independent Poisson random variables with mean λ_1 and λ_2 respectively.

7. (10%) Let X be exponential distribution with mean $1/\lambda$; that is $f_X(x) = \lambda e^{-\lambda x}$, $0 < x < \infty$, Find $E[X \mid X > 1]$.

國立雲林科技大學
九十學年度研究所碩士班入學考試試題

系所：電機系

科目：工程數學 (在)

(1) Find the solution for the following differential equation. (15%)

$$y' = 3x^2 - \frac{y}{x} \; ; \qquad y(1) = 5$$

(2) Find the general solution for the following differential equation. (20%)

$$y'' + 2y' + y = -3e^{-x} + 8xe^{-x} + 2\sin(x) + 1$$

(3) Find the Laplace transform of the function $f(t) = te^{-2t}\cos(3t)$. (10%)

(4) Solve the following differential equations. (20%)

$$\begin{cases} x'' - 2x' + 3y' + 2y = 4 \\ -x' + 2y' + 3y = 0 \end{cases}, \qquad x(0) = x'(0) = y(0) = 0$$

(5) Using the Cramer's rule, solve the following equations (20%)

$$\begin{cases} x - y + 2z = -5 \\ -x + 3z = 0 \\ 2x + y = 1 \end{cases}$$

(6) Find the determinants and the eigenvalues of $A = \begin{bmatrix} 4 & -5 \\ 1 & -2 \end{bmatrix}$ (15%)

國立雲林科技大學
九十學年度研究所碩士班入學考試試題

系所：電機系
科目：計算機概論

1. 欲求函數 $f(x)=\frac{1-\cos x}{x}$ 的值 ($x\neq 0$)，當 $|x|\leq 0.01$ 時 $\cos x\approx 1$，為避免在運算過程中有誤差放大的情形，可採用何種解決之道來計算。(15%)

2. 試說明 SPOOL (Simultaneous Peripheral Operation On Line) 技術的意義。(12%)

3. 請自行設計一種 32 位元浮點數表達法，其中指數部份佔 7-位元，並將 -10.125 以上述格式表達之。(23%)

4. 請解出下列方程式。(10%)

$$T(n)=\begin{cases}2T(\frac{1}{2}n)+O(n)+O(n\log_2 n) & n>1\\ 1 & n=1\end{cases}$$

5. 請解釋下列名詞。
   (a) AVL tree。(3%)
   (b) Min-max heap。(3%)
   (c) NP-Complete 。(4%)

6. 請簡要說明下列 2 種演算法並用它們分別找出圖 1 之擴張樹。
   (a) Kruskal's algorithm.。(5%)
   (b) Prim's algorithm。(5%)

7. 請簡要說明下列 2 種 traversal 方式並用它們分別列出圖 2 的節點順序。
   (a) Preorder traversal。(5%)
   (b) Postorder traversal。(5%)

8. (a) 請寫出 $f(n)=O(g(n))$ 的定義。(5%)

   (b) 請証明 "If $f(n)=a_m n^m+\cdots+a_1 n+a_0$ is a polynomial of degree m then $f(n)=O(n^m)$." (5%)

國立雲林科技大學
九十學年度研究所碩士班入學考試試題

系所：電機系
科目：計算機概論

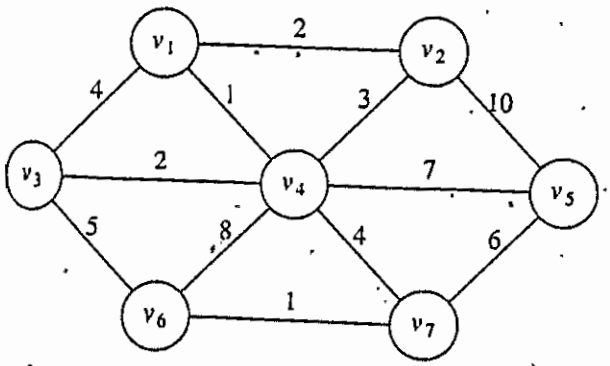


圖 1

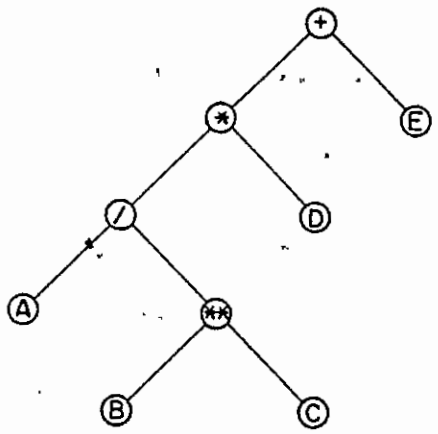


圖 2

國立雲林科技大學
九十學年度研究所碩士班入學考試試題

系所：電機系
科目：通信理論

(30%) 第一題

10% (A) Please explain the purpose of Fourier series expansion and Fourier transform used in signal analysis and how they are related.

10% (B) Please comment and compare the PCM, ADPCM, Delta modulation, and Delta-sigma modulation systems.

10% (C) What is the physical significance of the autocorrelation function? What is its relation with the power spectral density?

(20%) 第二題

What's ISI within a communication channel? How does it happen? In what condition this phenomenon can be avoided? Also, please conceptually describe how it be handled in practice?

(20%) 第三題

Given a set of real-valued energy signals $S_1(t), S_2(t), \cdots, S_M(t)$, each of duration T seconds, and one set of real-valued basis functions $\phi_1(t), \phi_2(t), \cdots, \phi_N(t)$. These basis functions are orthonormal and can be utilized to represent those energy signals.

15% (A) Please draw respectively, the detector parts of both the correlation receiver and the matched filter receiver.

5% (B) On what condition, the outputs of both detectors are equal?

(30%) 第四題

10% (A) What's the major difference between the MSK and GMSK schemes? Also compare them in terms of both the spectral efficiency and performance degradation.

5% (B) Explain the types and the basic principles of the spread spectrum communication as concise as possible.

10% (C) Draw simply a coherent, direct-sequence spread spectrum PSK system.

5% (D) Please briefly compare the features of IMT-2000 system with those of current 2nd-generation digital mobile systems.

國立雲林科技大學
九十學年度研究所碩士班入學考試試題

系所：電機系
科目：電力系統

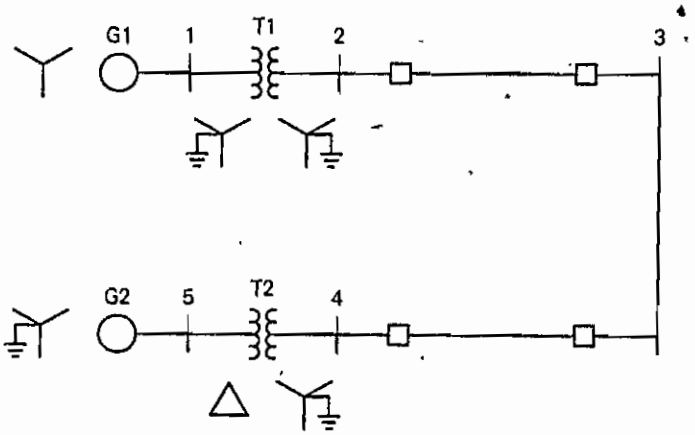
1. Equipment ratings for the five-bus power system shown in Figure 1 are as follows:

   Generator G1 : 50 MVA, 12 kV, X"=0.2 per unit
   Generator G2 : 100 MVA, 15 kV, X"=0.2 per unit
   Transformer T1 : 50 MVA, 10 kV Y/138 kV Y, X=0.10 per unit
   Transformer T2 : 100 MVA, 15kV Δ /138 kV Y, X=0.10 per unit
   Each 138-kV line : X_l=40Ω

   A three-phase short circuit occurs at bus 4, where the prefault voltage is 138 kV. Prefault load current is neglected.

   (a) Draw the positive-sequence reactance diagram in per-unit on a 100-MVA, 15-kV base in the zone of generator G2.
   (b) Determine the bus impedance matrix, $\boldsymbol{Z}_{bus}$, using the one-step-at-a-time method.
   (c) Determine the subtransient fault current in per-unit and in kA rms using $\boldsymbol{Z}_{bus}$.
   (30%)

   Figure 1



2. A 500-km 500-kV, 60 Hz three-phase uncompensated three-phase line has a positive-sequence series impedance $z = 0.03 + j0.35\,\Omega/\text{km}$ and a positive-sequence shunt admittance $y = j4.4\times10^{-6}\,\text{S/km}$. At full load the line delivers 1000 MW at unity power factor and at 475 kV.
   (a) Calculate the characteristic impedance, Z_c.
   (b) Calculate the exact *ABCD* parameters for this line.
   (c) Calculate the sending-end voltage.
   (d) Calculate the percent voltage regulation.
   (40%)

3. A three-phase impedance load consists of a balanced-Δ load in parallel with a balanced-Y load. The impedance of each leg of the Δ load is $Z_\Delta = 6 + j6\Omega$, and the impedance of each leg of the Y load is $Z_Y = 2 + j2\Omega$. The Y load is grounded through a neutral impedance $Z_n = j1\Omega$. Unbalanced line-to-ground source voltages V_{ag}, V_{bg}, and V_{cg} with sequence components V_0=10 ∠60°, V_1=100 ∠0°, and V_2=15 ∠200° volts are applied to the load.
   (a) Draw the zero-, positive-, and negative-sequence networks.
   (b) Determine the complex power delivered to each sequence network.
   (c) Determine the total complex power delivered to the three-phase load.
   (30%)

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系所：電機系
科目：電力電子學

1. A three-pulse and a six-pulse diode rectifiers are supplied from a 230-V ac line. Compare the dc output voltages available from these rectifiers. (20%)

2. The full-wave controlled bridge rectifier of Fig. 1 has an ac input of 110V rms at 60Hz and a 20Ω load resistor. The delay angle α is 30°. Determine the average current in the load, the power absorbed by the load, and the power factor. (20%)

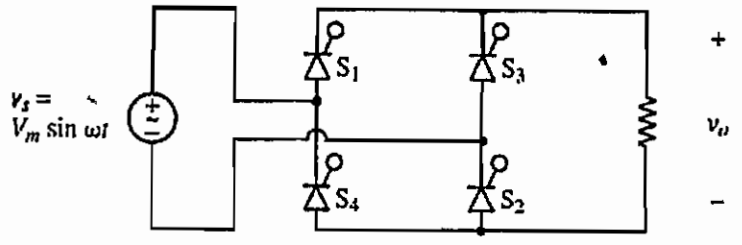

Fig. 1

3. An integral-cycle control is used to control the converter shown in Fig. 2. The source is 230-V (rms), 60-Hz, and the load is resistive with R=5.29Ω. The load power must be varied from 3kW to 9kW. The number of cycles for the full period of operation is 30. Find (a) the fraction of time that the load is energized to produce maximum power, (b) the number of the cycles for which the load is energized to produce minimum power. (10%)

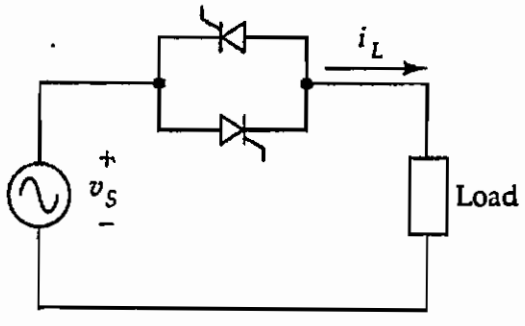

Fig. 2

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系所：電機系
科目：電力電子學

4. A PWM inverter is to supply a small ac motor. The motor has an input inductance of about 40mH, and draws 500W at full load. The input dc voltage is 400V, and the motor requires a nominal 230V at 50Hz. It is assumed that the switching frequency is 25kHz. (1)What modulation depth will be used when 50Hz is applied to the motor? (2) Calculate the L/R time constant of the motor. (3)What modulation depth will be used if the motor is adjusted to run at 70% of rated speed?(27%)

5. Please explain how can the direct switching converter (as shown in Fig.3) be changed to the common buck converter? (23%)

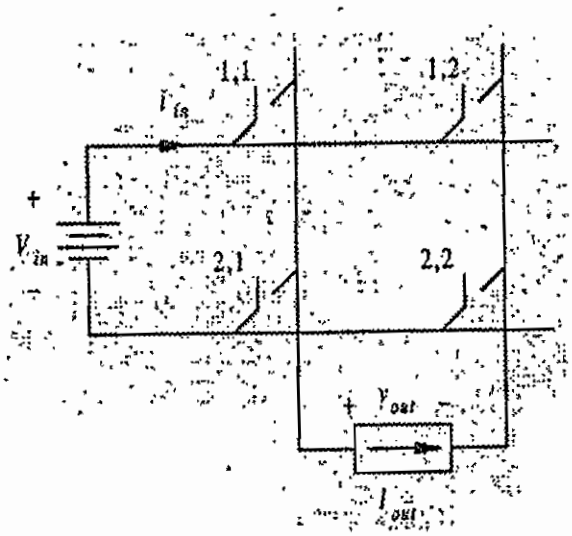

Fig. 3

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系所：電機系
科目：電子學

1. In the circuit of Fig. 1, the NMOS transistor has $|V_t| = 0.9\text{V}$ and $V_A = 50\text{V}$, and operates with $V_D = 2\text{V}$. What is the voltage gain v_o / v_i? What do V_D and the gain become for I increased to 1mA? (25%)
2. In the circuit of Fig. 2, assume that the op-amps A_1 and A_2 are ideal. Find the transfer function $V_o(s)/V_i(s)$. (25%)
3. For the devices in the circuit of Fig. 3, $|V_t| = 1\text{V}$, $\lambda = 0$, $\mu_n C_{ox} = 20\mu\text{A/V}^2$, $\gamma = 0$, $L = 1\mu\text{m}$, and $W = 20\mu\text{m}$. Find the values of V_1 and I_1. (25%)
4. The BJTs in the circuit of Fig. 4 have $\beta = 100$. Find the voltage gain v_o / v_i and the input resistance R_i. (25%)

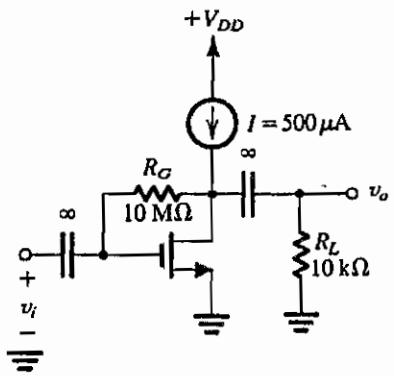

Fig. 1

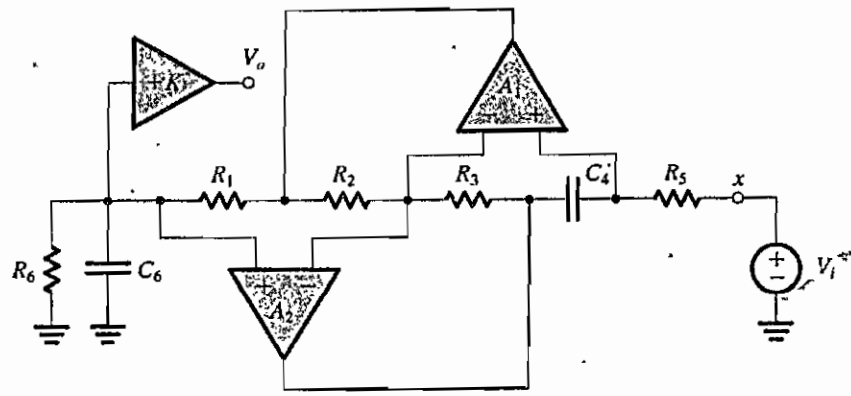

Fig. 2

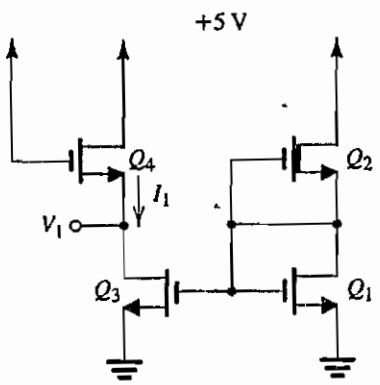

Fig. 3

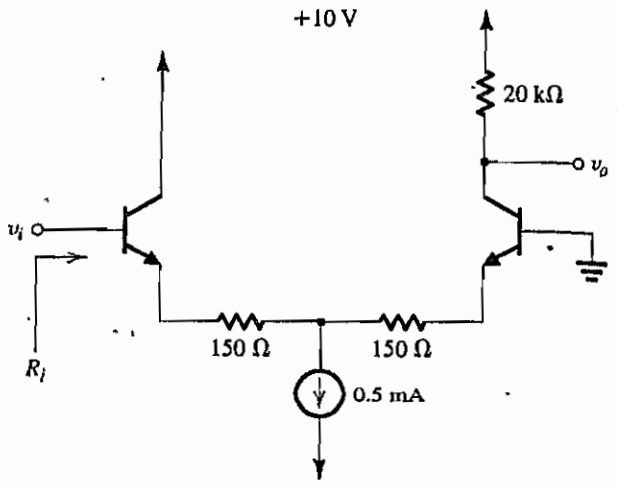

Fig. 4

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系所：電機系
科目：自動控制

1. 試解釋下列的名詞：
   (a). 狀態可控制性 (state controllability) (5%)
   (b). Routh-Hurwitz 準則 (5%)

2. 試判別特性函數 $F(s) = s^3 + 7s^2 + 25s + 35 = 0$ 之根是否有 $s = -1$ 右半邊之根。 (10%)

3. 對一轉移函數 $G(s) = \dfrac{2(s+1)}{s(s+2)(s+3)}$，試利用下述不同分解法分別求出其狀態圖及動態方程式。
   (a). 直接分解法 (10%)
   (b). 串接分解法 (10%)
   (c). 並聯分解法 (10%)

4. 考慮圖(一)的回授控制系統，其中 K_1、K_2 為設計參數。
   (a). 求出閉迴路(closed-loop)轉移函數。 (5%)
   (b). 若要求閉迴路系統對一單位步階(unit step)輸入滿足如下的規格：(1) 最大超越量 M_p (maximum overshoot)百分比小於 5%，且(2) 安定時間 t_s (settling time)(到達終值的 1% 範圍內所需要的時間)小於 4 秒；試在複數平面上，畫(決定)出閉回路極點可能落在的範圍。
   (提示：$M_p = e^{-\zeta\pi/\sqrt{1-\zeta^2}}$；$t_s = \frac{4.6}{\zeta\omega_n}$) (5%)
   (c). 設 $K_1 = 36$，若要求閉迴路極點落在上述可能範圍的邊界(boundary)上，K_2 值應為何？ (5%)

5. 圖(二)的控制系統，其中 $G_p(s) = \dfrac{10}{s(s+2)}$；考慮 PID 控制器 $G_c(s) = K_1 + \dfrac{K_2}{s} + K_3 s$。若要求閉迴路系統的極點在：$-10$ 和 $-2 \pm j2$，則 K_1、K_2 和 K_3 的值應為多少？並計算單位斜坡(unit ramp)輸入時的穩態誤差？ (15%)

6. 考慮圖(三)的回授系統。
   (a). 用 Routh 準則求出使系統穩定的 K 值範圍。 (10%)
   (b). 畫出根軌跡圖（標示離開和抵達角、分離點和虛軸跨越點之 K 值和 s 值）。 (10%)

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系所：電機系
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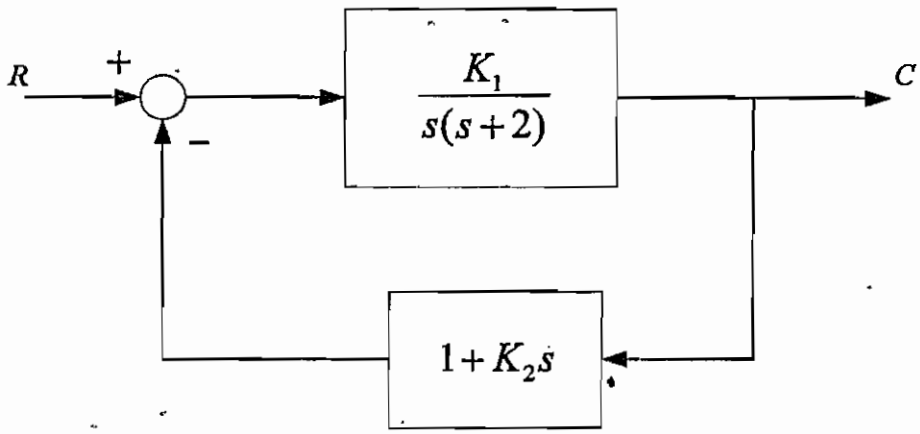

圖 (一)

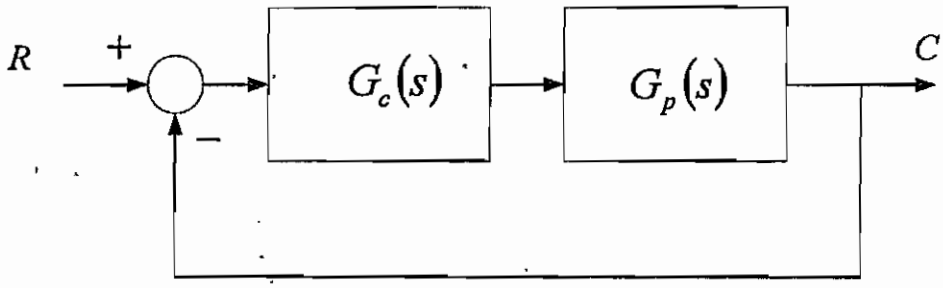

圖 (二)

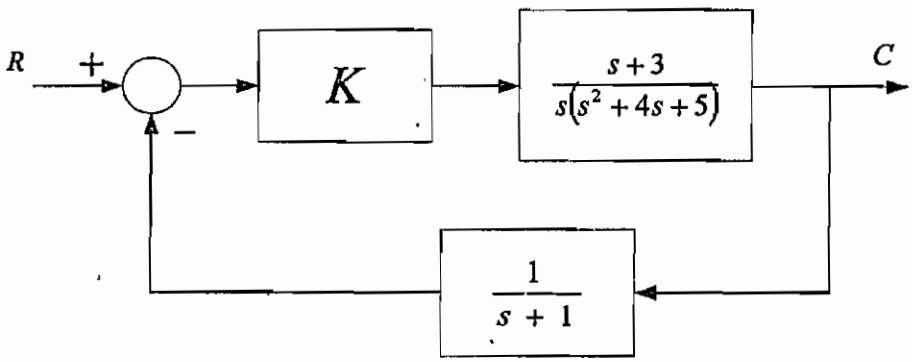

圖 (三)