國立雲林科技大學 113 學年度 碩士班招生考試試題

系所：電子系

科目：工程數學(2)

1. (10%) About classifying differential equations.
   (a) (4%) How do we know if a differential equation is linear? And why do we need to confirm whether a differential equation is linear?
   (b) (6%) Identify the order, linearity, and homogeneity of each differential equation below,

$$5y''' + 3y' - 4\sin(y) + \cos(x) = 0$$
$$4y''' + 2y' = e^x y$$

2. (10%) Solving $(3xy - y^2)dx + x(x - y)dy = 0$
3. (15%) Solving $y'' - 2y' + y = \frac{e^x}{x^2}$
4. (15%) A system of differential equation is as follows,

$$\begin{cases} y_1' = +1y_1 + 2y_2 \\ y_2' = +3y_1 + 2y_2 \end{cases}$$

   (a) (5%) Find the solutions
   (b) (5%) Draw the phase portrait of this system
   (c) (5%) Identify the stability of this system and give your reasons.

5. (15%) Perform the indicated operation, give that

$$A = \begin{bmatrix} 1 & 0 & -1 \\ 2 & 3 & 1 \end{bmatrix} \quad B = \begin{bmatrix} 1 & 2 & 0 \\ 0 & 4 & 3 \end{bmatrix} \quad C = \begin{bmatrix} 0 & 1 \\ -1 & 0 \\ 2 & 1 \end{bmatrix}$$

   (a) $(A+B)^T$ (b)(2A-B)C (c) If $2X+4(A-B)=0$, Find X

6. (10%) Find the eigenvalues and eigenvectors of A.

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

7. (15%) If $\vec{A} = 2\vec{i} + \vec{j} - \vec{k}$, $\vec{B} = \vec{i} + 3\vec{j} - \vec{k}$, Find (a) $\vec{A} \bullet \vec{B}$ (b) $\vec{A} \times \vec{B}$ (c) The projection of $\vec{A}$ on $\vec{B}$

8. (10%) Find the normal vector of the surface $z^2 = 2(x^2 + y^2)$ at the point P: (1, 0, 1)

國立雲林科技大學 113 學年度 碩士班招生考試試題

系所：電子系

科目：電子學

本試題共 5 題，每題得分如各題中所示，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.(10 分) Suppose in Fig. P1, the diodes carry a current of 4 mA and the load, a current of 18 mA. If the load current increases to 19 mA, what is the change in the total voltage across the three diodes? Assume R_1 is much greater than $3r_d$ and the thermal voltage (V_T) is 26 mV.

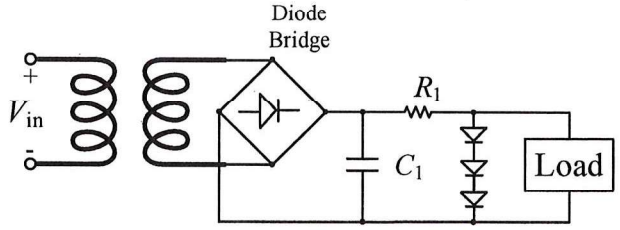


Fig. P1

2. Compute the input resistance of the circuits depicted in Fig. P2. Assume $V_A = \infty$.

(a) (5 分) find the input resistance of R_{in1}

(b) (10 分) find the input resistance of R_{in2}

(c) (10 分) find the input resistance of R_{in3}

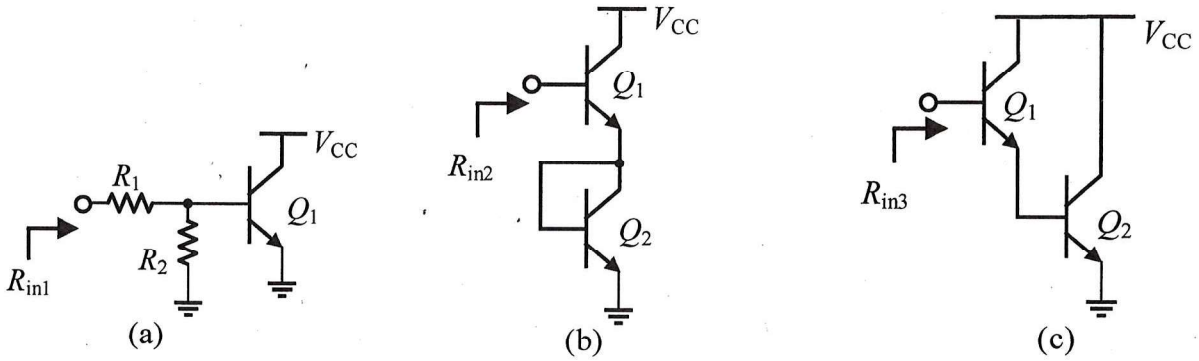


Fig. P2

3. (15 分)The integrator of Fig. P3 must operate with frequencies as low as 1.2 kHz while providing an output offset of less than 19 mV with an OPA offset of 3 mV. Determine the required values of R_1 and R_2 if $C_1 \leqq$ 120 pF.

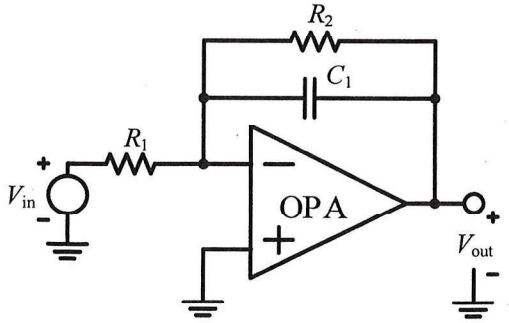


Fig. P3

國立雲林科技大學 113 學年度 系所：電子系
碩士班招生考試試題 科目：電子學

4. Fig. P4 shows a negative feedback loop circuit.

(a) (10 分) Find the loop gain $A\beta$ for which the sensitivity of closed-loop gain to open loop gain $(1+A\beta)^{-1}$ is -20 dB.

(b) (10 分) What is the $A\beta$ value when the sensitivity becomes 1/2?

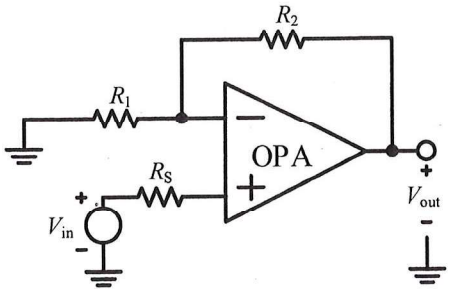


Fig. P4

5. As shown in the circuit diagram in Fig. P5, if its voltage gain is 0.8, the transistor channel's width-to-length ratio is 200 (W/L =200). Its transistor parameters are: $\mu_n C_{ox} = 200\ \mu A/V^2$, $R_S = 0.5\ k\Omega$, and $V_{TH} = 0.4$ V, $\lambda = 0$, then:

(a) (10 分) What is the name of this circuit?

(b) (10 分) What should the transconductance g_m from the MOS small signal model be?

(c) (5 分) What should the I_D current be in this case?

(d) (5 分) What should be the appropriate V_{Bias}?

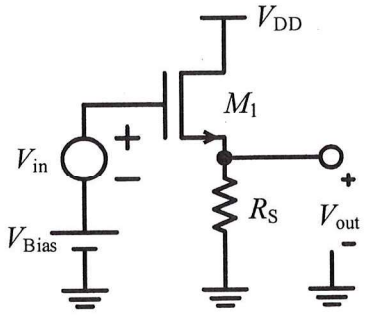


Fig. P5

國立雲林科技大學 113 學年度 碩士班招生考試試題

系所：電子系

科目：計算機概論(3)

本試題共 9 題，每題得分如各題中所示，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. (10pt.) Convert the following hexadecimal representations of 2's complement binary numbers to decimal number.

(a) xF0

(b) xF77

(c) x16

(d) x8000

(e) x1

2. (10pt.) Convert these decimal numbers to 8-bit 2's complement binary numbers.

(a) 102

(b) 64

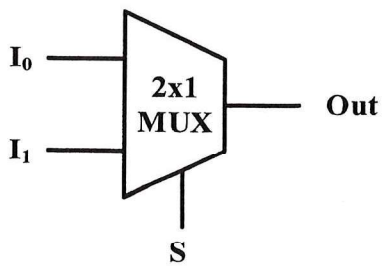
(c) 33

(d) -128

(e) 127

3. (20pt.) Implement a 4-to-1 mux using only 2-to-1 muxes making sure to properly connected all of the terminals. Remember that you will have 4 inputs, 2 control signals, and 1 output. Write out the truth table for this circuit.

4. (10pt.) A symbol of 2-to-1 mux is listed below. Please draw the gate-level circuit of 2-to-1 mux.



國立雲林科技大學 113 學年度 碩士班招生考試試題

系所：電子系

科目：計算機概論(3)

5. (10pt.) Assume that the scheduling of a processor is shown in the following table. There are three procedures to be done. The scheme of the shortest job first (SJF) for procedure arrangements is adopted. The procedure P1 first arrives, and then the procedure P2. Finally, the procedure P3 arrives. The execution times of the procedures are 7, 3, and 5 milliseconds (ms), respectively. What is the average waiting time for a processor?

Procedures	Orders of arrival	Execution time
P1	1	7
P2	2	3
P3	3	5

6. (8 pt.) Show the single precision representation to the decimal number $250.125_{10)}$

7. (20 pt.) William always encrypts texts using the RSA encryption when communicating with Judy. At this time, William selects two distinct prime numbers p =7, q = 17, and the public key e =5

(a). (10 pt.) Assume d is between 75 and 80; what value is modular multiplicative inverse d ?

(b). (10 pt.) Assume that the encrypted information(ciphertext) is 3, what is the original information?

8. (6 pt.) What is the difference between SRAM and SDRAM?

9. (6 pt.) How does the CPU use the pipeline technique in the operating system to decode a series of instructions?

國立雲林科技大學 113 學年度 碩士班招生考試試題

系所：電子系

科目：半導體元件

$h = 6.63 \times 10^{-34}$ J-s, $k = 8.62 \times 10^{-5}$ eV/K, $m_e = 9.11 \times 10^{-31}$ kg, $q = 1.6 \times 10^{-19}$ C,

$\ln 10 \approx 2.3$, $n_i = 10^{10}$ cm^{-3}, $\varepsilon_{si} = 12 \times 8.85 \times 10^{-14}$F/cm

1. Consider a simple cubic lattice structure. Draw the following lattice planes: (a) (100), (b) (110), and (c) (111). **(10%)**
2. Consider a single-crystal silicon lattice.
   (a) What is its crystal structure? **(3%)**
   (b) For any silicon atom in the crystal, how many nearest neighboring atoms does it have? **(3%)**
   (c) What is the bonding type between two neighboring silicon atoms? **(4%)**
3. Assume that $f_F(E)$ is the Fermi-Dirac probability function and $g_c(E)$ is the density of quantum states in the conduction band.
   (a) What is the distribution of electrons $n(E)$ as a function of energy E in the conduction band? **(5%)**
   (b) What is the total electron concentration n_0 in the conduction band? **(5%)**
4. The Fermi-Dirac probability function can be expressed as:

$$f_F(E) = \frac{1}{1 + \exp\left(\frac{E - E_F}{kT}\right)}$$

   (a) What is the form of the Boltzmann approximation? **(5%)**
   (b) What is the probability that a quantum state at the energy E will not be occupied by an electron? **(5%)**
5. Consider a silicon semiconductor, where the intrinsic carrier concentration is $n_i = 10^{10}$ cm^{-3}. Impurities have been added with the acceptor concentration being $N_a = 10^{16}$ cm^{-3} and the donor concentration being $N_d = 10^{15}$ cm^{-3}.
   (a) Is it an n type or a p type semiconductor? **(2%)**
   (b) What is the majority carrier? **(2%)**
   (c) Calculate the electron and hole concentrations. **(6%)**

國立雲林科技大學 113 學年度 碩士班招生考試試題

系所：電子系

科目：半導體元件

6. Explain or define the following terms:
   (a) Shockley-Read-Hall Recombination **(5%)**
   (b) Fixed oxide charge **(5%)**
   (c) Duality properties **(5%)**

7. For a silicone p-type with $N_a=10^{15}cm^{-3}$ and $n_i=10^{10}\,cm^{-3}$ find Quasi-Fermi levels for electrons and holes refer to intrinsic Fermi-level, if $10^{14}cm^{-3}$ excess carriers are introduced. **(15%)**

8. The charge distribution of a pn diode is given as in Fig.1. (a) Draw the field and voltage distributions. (b) Find the built-in voltage and the applied voltage. ($q=1.6\times10^{-19}C$, $n_i=10^{10}/cm^3$, kT=0.025eV, ln10=2.3) **(20%)**

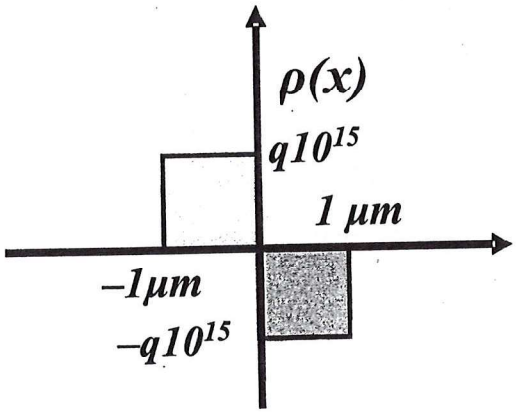


Fig. 1

國立雲林科技大學 113 學年度 碩士班招生考試試題

系所：電子系

科目：電磁學

Useful physical constants: $\varepsilon_0 \approx \frac{10^{-9}}{36\pi}$ (F/m); $\mu_0 = 4\pi \times 10^{-7}$ (H/m)

1. 分別求 $\mathbf{A}\times\mathbf{B}$：(a) $\mathbf{A} = 5\mathbf{a}_x + 12\mathbf{a}_z$, $\mathbf{B} = 13\mathbf{a}_y$;
   (b) $\mathbf{A} = \mathbf{a}_r + 4\mathbf{a}_\theta + 2\mathbf{a}_\phi$, $\mathbf{B} = 2\mathbf{a}_r + 8\mathbf{a}_\phi$ 。 (10 分)

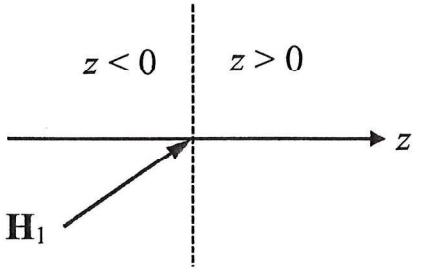
2. 無限長帶電荷直線的線電荷密度為 $\rho_L = 10$ nC/m，位於 Y 軸。計算此電荷分布在位置 (0.0, 0.0, 4.0 m) 造成的電場強度 **E**，包括大小與方向。(10 分)

3. 解下列靜電問題。分開很遠的兩個實心球型良好導體，半徑各為 R_1 與 R_2 ($R_1 < R_2$)，各帶有總正電荷 Q。
   (a)計算這兩個實心球的表面電荷密度 ρ_s，體電荷密度 ρ_v 各為多少？
   (b)計算這兩個實心球各別的表面電場強度 **E** 的大小與方向。
   (c)假設將此兩個實心導體球用良好的導線接在一起，使電荷產生流動達至平衡。請說明電荷的流動方式、達致平衡的條件、平衡後這兩個實心導體球上各別的總電荷 Q_1、Q_2。(20 分)

4. 請寫出電磁學的 4 個 Maxwell's equations 的積分與微分型式，並解釋其物理意義。(10 分)

5. 假設磁場強度的函數為 $\mathbf{H} = 2xy^2\,\mathbf{a}_z$ (A/m)，請計算在 (3 m, 1 m, 2 m) 位置的電流密度。(答案需寫單位) (15 分)

6. 假設介質 1 的磁導率 (permeability) $\mu_{r1} = 6000$，介質 2 的磁導率 $\mu_{r2} = 2000$。兩個介質的邊界為 $z = 0$ 平面。介質 1 在 $z < 0$ 處，其磁場強度為 $\mathbf{H}_1 = 6\mathbf{a}_x + 3\mathbf{a}_y + 2\mathbf{a}_z$ (A/m)。請計算在 $z > 0$ 處的介質 2 的磁場強度 $\mathbf{H}_2$。(20 分)



7. 假設一有限長的導線，其電感 L 為 10^{-6} (H)，電流為 10^{-3} (A)。請計算這段導線上儲存的磁能。(答案需寫單位) (15 分)