國立雲林科技大學 108 學年度 碩士班招生考試試題

系所：電子系

科目：工程數學(3)

1. (15%) Please solve for *y=y(x)*.

   (a) (5%) $y'' + 2y' + y = 0, y(0) = 4, y'(0) = -6$

   (b) (5%) $x^2y'' - 5xy' + 9y = 0$

   (c) (5%) $y + 5 = \ln(y')$

2. (15%) The ODE equation: $(3x^2y + 6xy + \frac{y^2}{2})dx + (3x^2 + y)dy = 0$

   (a) (5%) Verify the ODE is not exact.

   (b) (5%) Find the integrating factor *I(x,y)*.

   (c) (5%) Find the solution of the ODE.

3. (10%) Given the equation $y'' - 6y' + 9y = \frac{e^{3x}}{x^2}$ find the general solution.

4. (10%) If (a) $f(t) = (t + \frac{1}{2})^2$, Find $L[f(t)]$, (b) $F(S) = \frac{1}{S(S^2 + 5)}$, Find $L^{-1}[F(S)]$.

5. (15%) Consider the equations

$$\begin{vmatrix} x & + & 2y & + & 3z & = & 4 \\ x & + & ky & + & 4z & = & 6 \\ x & + & 2y & + & (k+2)z & = & 6 \end{vmatrix}$$

   where k is an arbitrary constant.

   (a) (5%) Find the reduced row echelon form (rref) of the augmented matrix of this system.

   (b) (5%) For which values of the constant k does this system have infinitely many solutions? In addition, find these infinitely many solutions.

   (c) (5%) For which values of the constant k does this system have no solution?

6. (20%) Consider the vector $\mathbf{v} = \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix}$ and a transformation $T(\mathbf{x}) = \mathbf{v} \cdot \mathbf{x}$ from $\mathcal{R}^3$ to $\mathcal{R}$ in which the notation $\cdot$ denotes the inner product.

   (a) (10%) Prove $T(\mathbf{x})$ is linear and find the transformation matrix of T.

   (b) (10%) Explain $T(\mathbf{x})$ is invertible and find its inverse transformation.

7. (15%) A data set has three points $(x, y) = (0, 6), (1, 0),$ and $(2, 0)$.

   (a) (5%) Find the closest line $y(x) = a + bx$ to these points.

   (b) (5%) Find the closest quadratic function $y(x) = c + dx + ex^2$ to these points.

   (c) (5%) Which function gives better data fitting? Explain your reason.

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系所：電子系

科目：半導體元件

1. Describe the energy band gap differences in the insulator, semiconductor, and metal materials. (15%)

2. Describe briefly the formation of the build-in potential in a p-n junction diode. (15%)

3. Describe the crystal structure of the poly-crystalline silicon. (20%)

4. Explain
   (a) Low injection for pn junction (5%)
   (b) Zener breakdown (5%)
   (c) One-sided pn junction (5%)
   (d) Diffusion length (5%)

5. Explain the reasons of the dominant current component are electron or hole current of p^+n, n^+p, Np and Pn junction, where + and N (or P) mean high doping concentration and wilder band gap material, respectively. (15%)

6. How to make metal/n-type (or p-type) semiconductor to be a Schottky Diode? (15%)

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系所：電子系

科目：計算機概論(1)

1. Convert the following hexadecimal representations of 2's complement binary numbers to decimal number. (10 points)

(a) xF0

(b) x7FF

(c) x16

(d) x8000

(e) x1

2. Without changing their values, convert the following 2's complement binary numbers into 8-bit 2's complement numbers. (10 points)

(a) 1010

(b) 011001

(c) 1111111000

(d) 01

(e) 110

3. Implement a 4-to-1 mux using only 2-to-1 muxes making sure to properly connect 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. (10 points)

4. Given the following truth table, generate the gate-level logic circuit, using the Programmable Logic Array (PLA). Remember that this circuit have 3 inputs and 2 outputs. (20 points)

A	B	C	F_0	F_1
0	0	0	1	1
0	0	1	0	1
0	1	0	0	0
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	1
1	1	1	0	0

國立雲林科技大學 108 學年度 碩士班招生考試試題

系所：電子系

科目：計算機概論(1)

5. Give the definition of the von Neumann model of a computer. Describe a robot with the von Neumann model. (10 points)

6. Prove there are infinite prime numbers. (10 points)

7. Write an algorithm, with a positive input integer n, to list all prime numbers less than n. (10 points)

8. What is supervised learning in machine learning? Describe how a neural network does supervised learning. (10 points)

9. Describe three instructions of an assembly language that you know. Describe how an assembly language program is assembled into machine code. (10 points)

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科目：電子學

本試題共六題，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. The amplifier in Fig. P1 is biased to operate at I_D = 1 mA and g_m = 1 mA/V.
   (a) (10 分) find the midband gain when neglecting r_O.
   (b) (10 分) find the value of C_S that places f_L at 10 Hz.

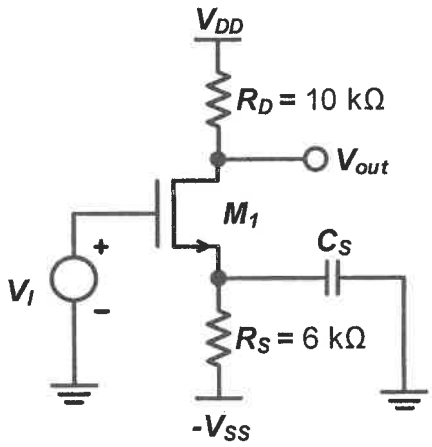

Fig. P1

2. Consider the operational rectifier or superdiode circuit of Fig. P2, with R= 1 kΩ. Assume that the op-amp is ideal and that its output saturates at ±12 V. The diode has a 0.7 V drop at 1 mA current, and the voltage drop changes by 0.1 V per decade of current change. What are the voltages that result at the rectifier output V_{out} and at the output V_A of the op-amp A?
   (a) (5 分) when V_I = 10 mV
   (b) (5 分) when V_I = 1.0 V.
   (c) (5 分) when V_I = -1.0 V.

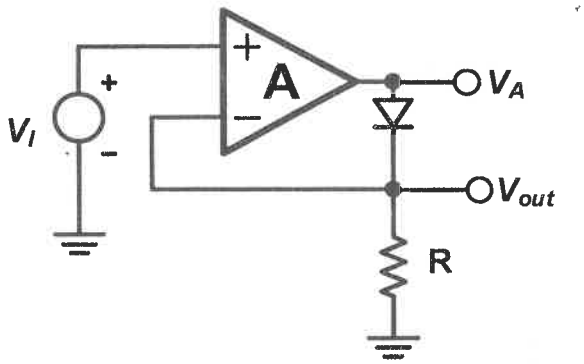

Fig. P2

3. Negative feedback having four basic topologies (Shunt-Series, Series-Series, Shunt-Shunt, and Series-Shunt) is to be used to modify the characteristics of a particular amplifier for various purpose. Identify the feedback topology to be used if:
   (a) (5 分) Input resistance is to be lowered and output resistance raised.
   (b) (5 分) Both input and output resistance are to be raised.
   (c) (5 分) Both input and output resistance are to be lowered.

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4. (20 分) (a) If the op-amp is ideal except the voltage gain A=1200 V/V, calculate V_{out}. (b) If the op-amp is ideal except A=1200 V/V and input offset voltage $V_{os} = 20\ mV$, calculate V_{out}.

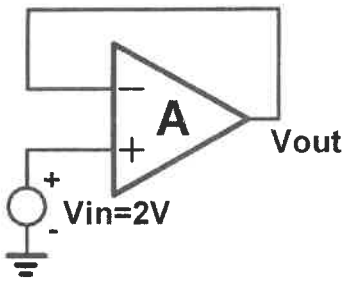

Fig. P4

5. (10 分) The op-amp is ideal except its slew rate Slew Rate = $200\,V/\mu s$. While $V_{in}(t) = V_1 \times \sin(\omega t)$, calculate the full-power bandwidth (a) if $V_1 = 1V$ and (b) if $V_1 = 10V$.

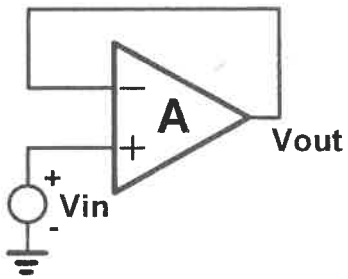

Fig. P5

6. (20 分) The input is a voltage step of 0.1V arriving at t=0. C=1μF and R=1kΩ. $V_{out}(t = 0) = 0V$. Note that the output can swing from -15V to +15V. Calculate $V_{out}(t = 100ms)$,
   (a) if the op-amp is ideal and
   (b) if the op-amp is ideal except A=1000 V/V.

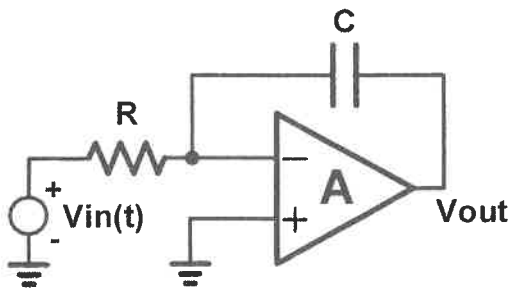

Fig. P6

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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. 電子的帶電量是(-1.6×10^{-19})庫侖，質量是(9.1×10^{-31})公斤。在某一個只利用均勻電場控制電子水平移動方向的裝置中，經測量得知單一電子在此均勻電場中的加速度為(8)公尺/秒^2，正 X 軸方向。計算上述均勻電場的大小與方向。(10%)
2. 將一有串聯內阻的電池兩極接上 7 歐姆電阻，其電池端電壓為 2.8 伏特；若改接 17 歐姆的電阻，其電池端電壓變為 3.4 伏特。若再改接一 37 歐姆的電阻，則此時流經電阻的電流為多少豪安培？(10%)
3. 某一各向同性且線性的介質，$\varepsilon_r = 10.0$，在其中測得電位場的分布為 $V(x,y,z) = 12\,xz^2$ (V)。 請計算此介質內分布的電場 **E**、電極化強度 **P**、電通量密度 **D**、電極化率 χ_e、與束縛電荷 ρ_b。(15%)
4. 某一圓柱形介面，在 $\rho \le 2$m， $\varepsilon_{r1} = 2$，電場 $\mathbf{E}_1 = 3\mathbf{a}_\rho + 6\mathbf{a}_\phi + 9\mathbf{a}_z$ (V/m)。在 $\rho > 2$m， $\varepsilon_{r2} = 3$，求此區域之電場 $\mathbf{E}_2$。(5%)
5. 請分別寫出積分形式與微分形式的 Maxwell's equations，並說明其物理意義。(10%)
6. 一電磁波的電場函數為 $20\cos(2\pi\times10^7\,t - 0.2\pi\,z)\,\mathbf{a}_x$，其中 $\mathbf{a}_x$ 為單位向量，
   (a) 求此電磁波的頻率；
   (b) 說明此電磁波的傳遞方向；
   (c) 求此電磁波的傳遞速度。
   (30%)
7. 在 *x*-*y* 平面上有一環形導線，其電流 *I* 方向如箭頭所示，
   (a) 請說明 *z* 軸上的點 (0, 0, *h*)其磁場方向；
   (b) *h* = +5 cm 和 *h* = –5 cm 時，其磁場大小與方向有何差異？
   (20%)