國立雲林科技大學
98學年度碩士班入學招生考試試題

系所：電子系
科目：工程數學

1. The policewoman is killed by murder and her body is located in a room that is kept at a constant 68 degrees Fahrenheit. Assuming that the victim's temperature was a "normal" 98.6 at the time of death. The lieutant arrived at 9:40 P.M. and immediately measured the body temperature, obtaining 94.4 degrees. A long time later, at 11:00 she find the body temperature is 89.2 degrees. Could you help the lieutant estimate the time of the murdering ? (15%)

2. Find the solution of the following equation：

   (a) $\left(y^2\cos x-3x^2y-2x\right)dx+\left(2y\sin x-x^3+\ln y\right)dy=0$ ， $y(0)=e$ (10%)

   (b) $x\dfrac{dy}{dx}+y=x^2y^2$ (10%)

   (c) $y''+y=2t$ ， $y(\frac{\pi}{4})=\frac{\pi}{2}$ ， $y'(\frac{\pi}{4})=2-\sqrt{2}$ (15%)

3. $x(t)$ is a periodic rectangular pulse with period $T_0=4$ second and amplitude $A=1$ V as shown in Fig. 1.
   (a) Find the exponential Fourier series of $x(t)$. (10%)
   (b) Find the values of the DC term and the 2nd harmonic term of this signal, respectively. (10%)

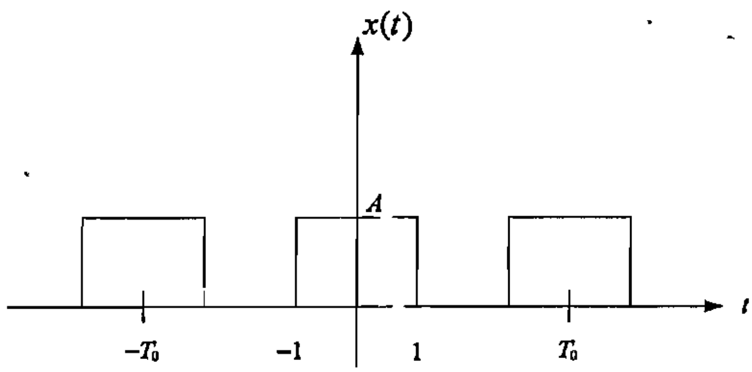

Fig. 1

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4. Consider the linear transformation T: $\mathbb{R}^3 \to \mathbb{R}^3$ that rotates the yz-plane by 45° in a counterclockwise direction, and reflects the x-axis about the yz-plane. Represent $T(\mathbf{x}) = \mathbf{Ax}$ and it is known that

$$\mathbf{A} = \left[T\left(\begin{bmatrix}1\\0\\0\end{bmatrix}\right) \quad T\left(\begin{bmatrix}0\\1\\0\end{bmatrix}\right) \quad T\left(\begin{bmatrix}0\\0\\1\end{bmatrix}\right) \right]$$

(a) Find the matrix **A** corresponding to T. (10%)
(b) What is det(**A**)? (5%)
(c) Is **A** orthogonal? Why, or why not? (5%)
(d) Find $\mathbf{A}^{-1}$. (5%)
(e) If there is any real eigenvalue for the matrix **A**? Why, or why not? (5%)

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1. (12%) Answer the following questions.
   (a) What are the conduction carriers in semiconductor?
   (b) What is the mass-action law?
   (c) Describe the Hall effect.
   (d) What will be the key components of current in diode, BJT, FET and metal? Drift current, diffusion current or else?

2. (8%) Answer Yes/No for the following questions.
   (a) The higher the reverse-bias of diode, the larger the capacitor value.
   (b) The switching time of Schottky diode is faster than pn diode.
   (c) The zener breakdown voltage of pn diode is usually lower than avalanche breakdown voltage.

3. (10%) (a) If a BJT is forward biased in active region, it may be biased as:
   (1) B-E conducts and $V_{BC}=0$.
   (2) B-E and B-C junctions conduct.
   (3) B-E conducts and B-C is reverse biased.
   (4) Both of B-E and B-C are reverse biased..

   (b) From the following statements, choose a best cause which results in a small Early voltage of a BJT.
   (1) small base width.
   (2) large reverse bias of C-E junction.
   (3) low impurity concentration in collector.
   (4) the BJT is biased in saturation.

4. (20%) Both the MOSFETs in Fig. P4 have the same parameters k and absolute values of the threshold voltage.
   (a) Find the expression for output voltage v_O.
   (b) For a large value k or resistive load R_L, draw the large signal $v_I - v_O$ transfer characteristics.

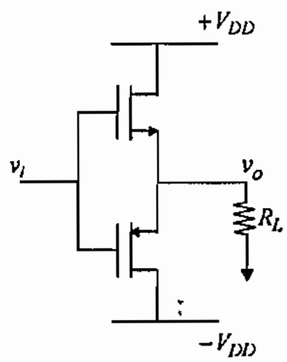

Fig. P4

5. (20%) A low-pass amplifier has a DC gain of 60dB and a 3-dB frequency of 100kHz. Please calculate

   (a). the gain-bandwidth product in Hz

   (b). the phase shift between the input and output signals, if the input is a sinusoid with a frequency of 100kHz.

6. (10%) For the amplifier shown in Fig. P6, the small-signal gain is -10 V/V. The biased gate-to-source voltage of MN is 1V. What is the allowed output-voltage swing.

   $V_{tn} = |V_{tp}| = 0.7V. \quad \lambda_n = \lambda_p = 0.$

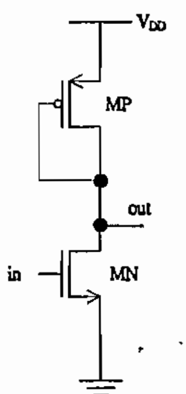

Fig. P6

7. (20%) For the amplifier shown in Fig. P7, both transistors are biased in the saturation region. Neglect the body effect of the MOS transistor. $I_0 = 100\mu A$, $\mu_n C_{ox} = 60\mu A/V^2$, $\lambda_n = 0.1V^{-1}$, $(W/L)_{M1,M2} = 10$, $V_{DD} = 5V$, $C_x = 0.1pF$.

   (a). What is the output resistance?

   (b). Sketch the output impedance of the amplifier as a function of frequency.

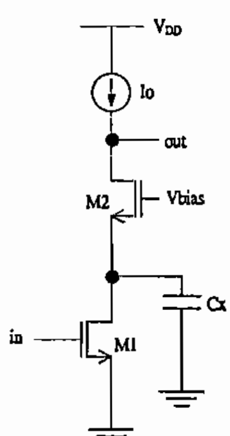

Fig. P7

國立雲林科技大學
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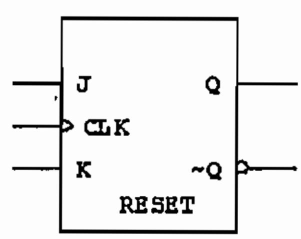
系所：電子系
科目：計算機概論

1. Prove that deterministic finite state machines and non-deterministic finite state machines accept the same kind of languages. Give examples to illustrate your proof. (10%)
2. Describe an algorithm X to find the greatest common factor of two given natural numbers. Using the algorithm X, give an algorithm to enumerate all prime numbers. Prove that the number of prime numbers is not finite. (15%)
3. What is mutual exclusion? What is a semaphore? Give a sample problem in an operating system that involves these concepts. Use the concepts to describe an algorithm to solve the problem. (10%)
4. What are breadth-first search and depth-first search? What data structures do they use? What are their time and space complexities? Compare their advantages and disadvantages? Consider the knight tour problem. Given an n by n chessboard that has n*n squares. A knight can move in eight directions, jumping one square in one dimension and two squares in the other dimension in a single move (similar to how a horse moves in Chinese chess). The knight tour problem is to find a path where each square on the chessboard is visited only once. Which of the above two search algorithms should be used to solve this problem? Describe your algorithm that solves the knight tour problem in detail. What is the major disadvantage of your algorithm? Describe one way your algorithm can be improved. (15%)

5. (A) Please use four 2-input NOR gates to implement a 2-input NAND gate. (5%)
   (B) Please design a 4-bit asynchronous counter from $0_{(10)}$ to $11_{(10)}$ then return to $0_{(10)}$, and uses four J-K Flip-Flops, and one AND gate. (15%)



6. (A) Please convert the decimal number $(43969.75)_{10}$ to hexadecimal $(?)_{16}$ (10%)
   (B) Please convert the binary number $(11)_2$ to 4-bit Gray code. (8%)

7. Given the boolean functions, F1= Σ (3, 4, 6, 7), F2= Σ (6, 7), and F3= Σ (3, 7), minimize the number of product terms for each function. (12%)