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：光電所
科目：工程數學

1. (10%)Solve the differential equation: $\dfrac{dy}{dx}+xy=\dfrac{2x}{y}$.

2. (10%)Solve the differential equation: $y''-5y'+6y=4\sin 4x$.

3. (15%)Find the eigenvalues and eigenvectors of the matrix: $\begin{bmatrix} 2 & 0 & 1 \\ -1 & 4 & -1 \\ -1 & 2 & 0 \end{bmatrix}$.

4. (15%)Find the Fourier series for the periodic function defined by $f(t)=\dfrac{2}{\pi}t+2$ for $-\pi \le t \le \pi$, and $f(t+2\pi)=f(t)$.

5. (10%)Please use the separation of variables to find the solution of the partial differential equation $y\dfrac{\partial^2 u}{\partial x \partial y}+u=0$.

6. (15%)Please solve the wave equation $a^2\dfrac{\partial^2 u}{\partial x^2}=\dfrac{\partial^2 u}{\partial t^2}, 0<x<L, t>0$, subject to $u(0,t)=0$, $u(\pi,t)=0$, $u(x,0)=0$, $\dfrac{\partial u}{\partial t}\Big|_{t=0}=\sin x$.

7. (10%)Please solve (1) $\ln(3-2i)$,(2) $\sin(2i)$.

8. (15%)Please solve the integral value of $\oint_c \dfrac{\cos \pi z}{(z-1)^5}dz$, where the contour C is the circle: $|z|=r>1$.

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系所：光電所
科目：半導體元件

1. Explain or define the following terms:
   (a) Ionization energy of donor impurities in a semiconductor (5%)
   (b) Built-in potential of p-n junction (5%)
   (c) Fermi-Dirac distribution of electrons in a semiconductor (5%)
   (d) Effective mass of holes (5%)

2. Make a comparison between the abrupt and the graded p-n junctions. (15%)

3. Describe the basic electrical properties of a Schottky-barrier junction. (15%)

4. Selection problem set: (15%)
   (1) The turn-on voltage of an Al-Si Schottky diode may be
   (A) 0.05V (B) 0.35V (C) 0.75V (D) 2.5V。
   (2) When the temperature is increased from 50°K to 200°K, the conductance of a doped semiconductor is
   (A) increased (B) decreased (C) unchanged (D) undecided
   (3) Mobility of carrier is not dependent on
   (A) temperature (B) doping concentration (C) electrical field (D) defect
   (4) What semiconductor parameter can't be obtained by Hall measurement?
   (A) conductive type (B) minority carrier mobility
   (C) minority carrier concentration (D) majority carrier mobility
   (5) What may decrease when temperature is increased?
   (A) intrinsic concentration (B) mobility
   (C) Fermi-Dirac distribution function (D) energy band gap

5. A set of parameters of silicon npn common-emitter BJT are given as $N_B = 5\times10^{16}$, $N_E = 5\times10^{18}$, $N_C = 5\times10^{15}$, $\mu_E = 250$, $\mu_B = 1000$, $\tau_{B0} = 5\times10^{-7}$ s, $x_B = 0.25$ μm, x_C and x_E are long.
   (a) V_{BE} is hold constant voltage about 0.6V. If V_{BC} is changed from 0V to 10V, find the changed percentage of I_C? (10%)
   (b) I_B is hold constant under $V_{BE} = 0.6$V and $V_{BC} = 0$V. If V_{BC} is changed from 0V to 10V, find the changed percentage of I_C? (10%)

6. Explain (a) flat band voltage, (b) short channel effect and (c) Zener breakdown. (15%)

[$n_i = 1.5\times10^{10}$, $V_t = 26$mV, $\varepsilon_s = 11.7\varepsilon_o$, $\varepsilon_o = 8.85\times10^{-14}$, ϕ_m (Al) $= 4.28$V]

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：光電所
科目：電磁學

1. A spherical distribution of charge $\rho = \rho_0 [1 - (R^2/b^2)]$ exists in the region $0 \le R \le b$. This charge distribution is concentrically surrounded by a conducting shell with inner radius R_i (> b) and outer radius R_0. Determine **E** everywhere (10%) and the surface charge density at the inner and outer surfaces of the conductor. (10%)

2. Two infinitely long coaxial cylindrical surfaces, $r = a$ and $r = b$ ($b > a$), carry surface charge densities ρ_{sa} andρ_{sb}, respectively. Determine **E** everywhere. (15%)

3. Two blocks of conducting materials are in contact at the y = 0 plane. At a point P in the interface, the current density is $\mathbf{J}_1 = 10\,(\mathbf{a}_y 4 + \mathbf{a}_z 3)$ (A/m^2) in medium 1 (conductivity σ_1). Determine $\mathbf{J}_2$ at P in medium 2 if $\sigma_2 = 2\sigma_1$. (15%)

4. Assume the *xy*-plane is the interface between two media. If the magnetic field intensity $\mathbf{H}_1$ in medium 1 (permeability μ_1) is $-3\mathbf{a}_x - 4\mathbf{a}_z$ (A/m) at the interface, find the magnetic field intensity $\mathbf{H}_2$ in medium 2 (permeability μ_2). Assume that $\mu_1 = 2\mu_2$, and the surface current density at the interface = $-\mathbf{a}_y$ 2 A/m. (15%)

5. Determine the magnetic force per unit length between two infinitely long, thin, parallel conducting wires carrying I_1 and I_2 in the same direction. The wires are separated by a distance d. (10%)
   Also determine the direction of the force (attraction or repulsion). (5%)

6. The instantaneous expression for the magnetic field intensity of a uniform plane wave propagating in the $+y$ direction in air is given by

   $$\mathbf{H} = \mathbf{a}_z\, 4\times10^{-6} \cos(2\times10^7 \pi t - k_0 y + \frac{\pi}{4}) \qquad \text{(A/m)}$$

   (a) Determine k_0. (10%)
   (b) Write the instantaneous expression for **E**. (10%)