

國立中山大學 104 學年度轉學考招生考試試題

科目名稱：工程數學【光電系三年級】

題號：735003

※本科目依簡章規定「不可以」使用計算機(問答申論題)

共 1 頁 第 1 頁

1. Integrate $\frac{z^n}{(z-a)^{n+1}}$, $|a| > 5$, counterclockwise around the circle $|z| = 5$. (15%)

2. Find an eigenbasis (a basis of eigenvectors) of the matrix \mathbf{A} and diagonalize it.

$$\mathbf{A} = \begin{bmatrix} -98 & 58 \\ -58 & 47 \end{bmatrix}$$

Give your answer in the form of $\mathbf{A} = \mathbf{XDX}^{-1}$, where \mathbf{X} is the eigenbasis and \mathbf{D} is the diagonal matrix. (15%)

3. Find the Fourier transform of $f(x) = \begin{cases} x, & |x| < 6 \\ 0, & \text{otherwise} \end{cases}$. (10%)

4. Find a general solution of the following ODE system. (15%)

$$\begin{aligned} y_1' &= 4y_1 + 3y_2 + 4 \\ y_2' &= -6y_1 - 5y_2 + 4e^{-t} \end{aligned}$$

5. Find the potential in the square $0 \leq x \leq 2$, $0 \leq y \leq 2$, if the upper side is kept at the potential $\sin\left(\frac{3}{2}\pi x\right)$ and the other sides are grounded. (15%)

6. For the ODE, $xy'' - (x+1)y' + y = 0$, find two linearly independent solutions of $y(x)$ about $x = 0$ in the form of power series. (15%)

7. Calculate the line integral $\oint_C \mathbf{F} \cdot \mathbf{r}' ds$ by Stokes' theorem, clockwise as seen by a person standing at the origin, for $\mathbf{F} = [y^2, x^2, -x+z]$ around the triangle with vertices $(0, 0, 5)$, $(5, 0, 5)$ and $(5, 5, 5)$. Assume the Cartesian coordinates to be right-handed. (15%)

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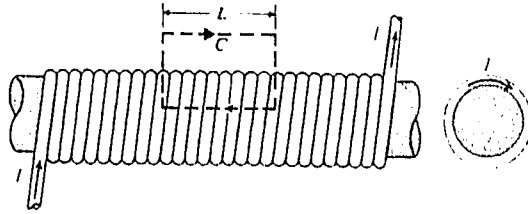
科目名稱：電磁學【光電系三年級】

題號：735004

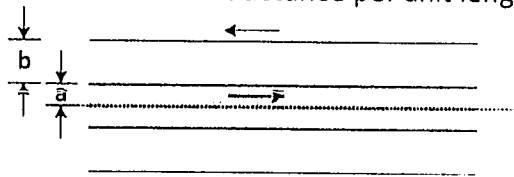
※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（問答申論題）

共 1 頁 第 1 頁

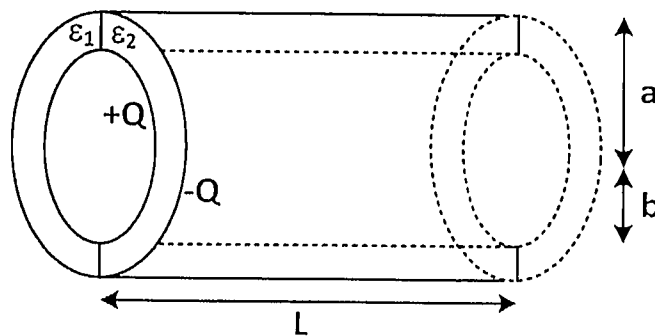
1. Determine the magnetic flux density inside an infinitely long solenoid with air core having n closely wound turns per unit length and carrying a current I . (15%)



2. An air coaxial transmission line has a solid inner conductor of radius a and a very thin outer conductor of inner radius b . Determine the inductance per unit length of the line. (20%)



3. Please write down the Maxwell's equations and their respective physical meaning. (10%)
4. A cylindrical capacitor of length L consists of coaxial conducting surfaces of radii a and b . Charges of magnitude Q are installed in this cylindrical capacitor. Two dielectric media of different dielectric constant ϵ_1 and ϵ_2 fill the space between the conducting surfaces as shown in the below figure. Determine its capacitance per unit length. (20%)



5. Please explain Helmholtz's theorem, Biot-Savart Law, and Faraday's Law. (15%)
6. Given a static electric field $\vec{E} = \hat{a}_x(3y - c_1z) + \hat{a}_y(c_2x - 2z) - \hat{a}_z(c_3y + z)$, please find (a) c_1 , c_2 , and c_3 , (b) the electric potential distribution $V(x,y,z)$. (20%)