國立臺灣海洋大學一0二學年度研究所碩士班暨碩士在職專班招生考試試題

考試科目： 電磁學及電磁波

系所名稱： 電機工程學系碩士班電波組

1.答案以橫式由左至右書寫。2.請依題號順序作答。

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(1) **Two dimensional Laplace's Equation**: It is known that the potential distribution inside a rectangular region of dimensions $0 \le x \le a$ and $0 \le y \le b$ satisfied Laplace's equation of the form $\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)V(x,y)=0$. (a) Solve for $V(x,y)$ in the region $0 \le x \le a, 0 \le y \le b$ subjected to the boundary conditions $V(x,0)=V(x,b)=V(0,y)=0$ and $V(a,y)=V_1$, where V_1 is a constant. (b) What will be the potential distribution if the boundary conditions are now changed to $V(x,0)=V(x,b)=V(a,y)=0$ and $V(0,y)=V_2$, where V_2 is a constant? (c) From the solutions of (a) and (b), deduce the potential distribution inside the rectangular region with boundary conditions $V(x,0)=V(x,b)=0$, $V(a,y)=V_1$, and $V(0,y)=V_2$. Hint: Let $V(x,y)=X(x)Y(y)$ in the Laplace's equation and solve or $X(x)$ and $Y(y)$. (30%)

(2) (a) A constant current I_0 flows in a circular wire loop of radius a. What is the magnetic flux density ($\vec{B}$) at a distance z from the center and along the axis of the current loop? (8%)

(b) A circular dielectric disc of radius a is deposited with a uniform surface charge density $\rho_s\ C/m^2$. The disc is set to rotate at ω rad/Sec. Find the surface current density vector $\vec{J}_s(r)$ A/m, where $0 \le r \le a$ and hence evaluate the resultant magnetic flux density along the axis and at a distance z from the center of the disc. (20%)

(3) (a) Explain or illustrate the meaning of the terms linear, homogeneous, and isotropic by utilizing well known constitutive relations. (8%) (b) What happen if the medium is nonlinear, inhomogeneous, and anisotropic? (6%) (c) Explain what you mean by a dispersive medium. Give an example of a nondispersive medium. (6%)

(4) What do you mean by (a) dominant mode (2%) (b) cutoff frequency (2%) of a waveguide? (c) What is the cutoff frequency of a conducting parallel plate waveguide? (2%) (d) What is the dominant mode of (i) a coaxial line (2%) (ii) rectangular waveguide with $0 \le x \le a, 0 \le y \le b$ and $a > b$ (2%) and (iii) a cylindrical waveguide with conducting wall (2%) (e) For a rectangular guide with dimension $0 \le x \le a, 0 \le y \le b$ and $a > b$, what will be the three lowest frequency modes. (10%)