本試題是否可以使用計算機：　☑可使用　，　□不可使用　（請命題老師勾選）

Problem 1: (10 Points)

Compare the electromagnetic waves (a) propagating in a coaxial cable, (b) propagating in a uniform metallic waveguide, and (c) radiated by an antenna, in terms of (1) the wave impedances, (2) the phase velocities, and (3) group velocities, and (4) the propagation losses.

Problem 2: (10 Points)

Derive the expressions of the wave impedances for TE and TM modes of electromagnetic waves.

Problem 3: (20 Points)

A uniform plane wave propagating in air given by $\bar{E}_i(x) = 30e^{-j20\pi x}(\hat{y} - j\hat{z})$　V/m is normally incident on a perfectly conducting plane located at $x = 0$. (a) Find the frequency and wavelength of the wave. (b) Find the corresponding magnetic field $\bar{H}_i(x)$. (c) Find the electric and magnetic field vectors of the reflected waves [i.e., $\bar{E}_r(x)$ and $\bar{H}_r(x)$]. (d) Compare the polarizations of the incident and reflected waves.

Problem 4: (20 Points)

What length of 0.4- by 0.9-in waveguide is required to introduce a signal delay of 2 μs at 10 GHz?

Problem 5: (20 Points)

(1) The current distributions of infinitesimal ($L << \lambda$) dipole antenna A and B are given as $I_A = 2I_0(L/2 - |z|)/L$ and $I_B = I_0 \cos(\pi z/L)$, for $-(L/2) \le z \le (L/2)$. Find the ratio of the radiation resistance of these two antennas. (2) Find the main beam direction for a uniform linear antenna array of isotropic elements, with the spacing and phase difference between the adjacent elements are $\lambda/6$ and $30°$, respectively.

（背面仍有題目，請繼續作答）

本試題是否可以使用計算機：☑可使用　，□不可使用　（請命題老師勾選）

***Problem 6*: (20 Points)**

A load on a transmission line, with a characteristic impedance of 1 Ω, consists of a variable L and R series combination such that $|Z_L|=5$. (a) As one proceeds toward the generator, which does he encounter first, a voltage maximum or a voltage minimum? Show why. (b) A single short-circuited stub is to be used for matching. What value of the load will require the shortest distance to the stub? What will be the length of the stub? (Note: you may use the Smith chart below, temporarily. But don't forget to write down important procedures and results on your answer sheet. Otherwise it will not be graded.)