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HW # 5

① A 30m. long lossless transmission line with $Z_0 = 50\Omega$ operating at 2MHz is teminated in a load $Z_L = 60 + j40\Omega$. If the phase velocity $u = 0.6c$ (c = velocity of light in vacuum) on the line, find

(a) The reflection coefficient Γ_L.
(b) The standing wave ratio (SWR).
(c) The input impedance Z_{in}.

Solve this problem both with and without using the Smith Chart.

② A lossless 40Ω transmission line is teminated in a 20Ω resistor. Using Smith Chart find the possible values of the lengths of the transmission lines that result in

(a) $Z_{in} = 40 - j28\,\Omega$ at 1 GHz (Assume $\lambda = \lambda_0$)

(b) $Z_{in} = 48 + j16\,\Omega$ at 1 GHz (Assume $\lambda = \lambda_0$)

③

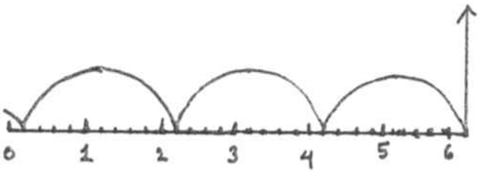

Fig. A

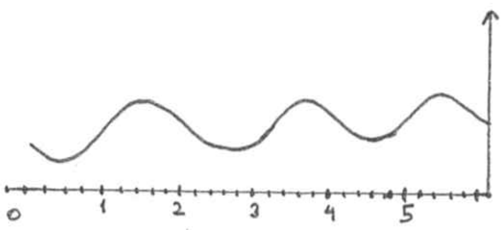

Fig. B

The following two-step procedure has been carried out with a 50Ω slotted line to determine an unknown load impedance:

(i) A short circuit is placed at the load plane, resulting in a standing wave on the line with infinite SWR, and sharply defined voltage minima as shown in Fig A. On the arbitrarily positioned scale on the slotted line, voltage minima are recorded as $z = 0.2$ cm, 2.2 cm, 4.2 cm.

(ii) The short circuit is removed, and replaced with the unknown load. The SWR is measured as 1.5, and voltage minima which are not sharply defined as those in step (i), are recorded at $z = 0.72$ cm, 2.72 cm and 4.72 cm as shown in Fig. B. Using Smith Chart, find the load impedance Z_L.

④ The SWR on a lossless 50Ω transmission line terminated in an unknown load impedance is found to be 3. The distance between 2 successive voltage minima is 20 cm, and the first minimum is located at 5 cm from the load. Determine (a) the reflection coefficient, (b) the load impedance Z_L, (c) the equivalent length and terminating resistance of a line such that the input impedance is equal to Z_L.