Dr. Chandra Shekhar Prasad — 8/5/2023

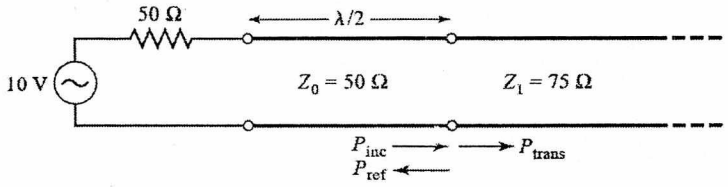
180 (12)

End-Semester Examination (May-2023)

RF and Microwave Engineering (EC-710), 8Th sem. (Each question carries 5 marks)

[Q1] A 75Ω coaxial transmission line has a length of 2.0 cm and is terminated with a load impedance of $37.5 + j75\ \Omega$. If the relative permittivity of the line is 2.56 and the frequency is 3.0 GHz, find the input impedance to the line, the reflection coefficient at the load, the reflection coefficient at the input, and the SWR on the line.

[Q2] Consider the transmission line circuit shown in the accompanying figure. Compute the incident power, the reflected power, and the power transmitted into the infinite 75Ω line. Show that power conservation is satisfied.



[Q3] Design a quarter-wave matching transformer to match a 40Ω load to a 75Ω line. Plot the SWR for $0.5 \le f/f_o \le 2.0$, where f_o is the frequency at which the line is $\lambda/4$ long.

[Q4] A two-port network is driven at both ports such that the port voltages and currents have the following values ($Z_0 = 50\Omega$):

$$V_1 = 10\angle 90°, \quad I_1 = 0.2\angle 90°,$$
$$V_2 = 8\angle 0°, \quad I_2 = 0.16\angle -90°.$$

Determine the input impedance seen at each port, and find the incident and reflected voltages at each port.

[Q5] Consider two two-port networks with individual scattering matrices [S^A] and [S^B]. Show that the overall S_{21} parameter of the cascade of these networks is given by

$$S_{21} = \frac{S_{21}^A S_{21}^B}{1 - S_{22}^A S_{11}^B}.$$

[Q6] Design a rectangular microstrip antenna using a substrate (RT/duroid 5880) with dielectric constant of 2.2, $h = 0.1588$ cm so as to resonate at 10 GHz.

[Q7] A transmission line resonator is fabricated from a λ/4 length of open-circuited line. Find the unloaded Q of this resonator if the complex propagation constant of the line is $\alpha + j\beta$.

[Q8] A lossless T-junction power divider has a source impedance of 50 Ω. Find the output characteristic impedances so that the output powers are in a 2:1 ratio. Compute the reflection coefficients seen looking into the output ports.

[Q9] Write a short note on ferrite.

[Q10] Draw the equivalent circuit of the following microstrip line discontinuity