Model Question Paper

Second Semester M. Tech Degree Examination in

Electronics and Communication Engineering

Stream: Telecommunication Engineering (2013 Scheme)

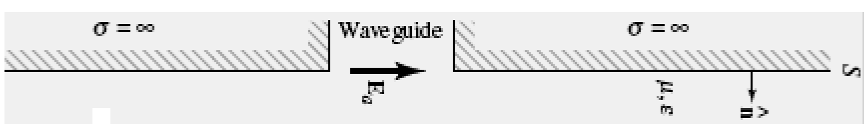
TTC 2001: Antenna Theory Analysis And Design

Time: 3 hours Max. Marks: 60

Instructions: *Answer any 2 questions from each module (Each Carries 10 Marks)*

Module I

1. (a) State field equivalence principle. A waveguide aperture is mounted on an infinite ground plane, as shown in figure below. Assuming that the tangential components of the electric field over the aperture are known, and is given by $\mathbf{E_a}$, find an equivalent problem that will yield the same fields **E, H** radiated by the aperture to the right side of the interface. (6)



(b) Explain the types of feeding methods in microstrip Antennas. (4)

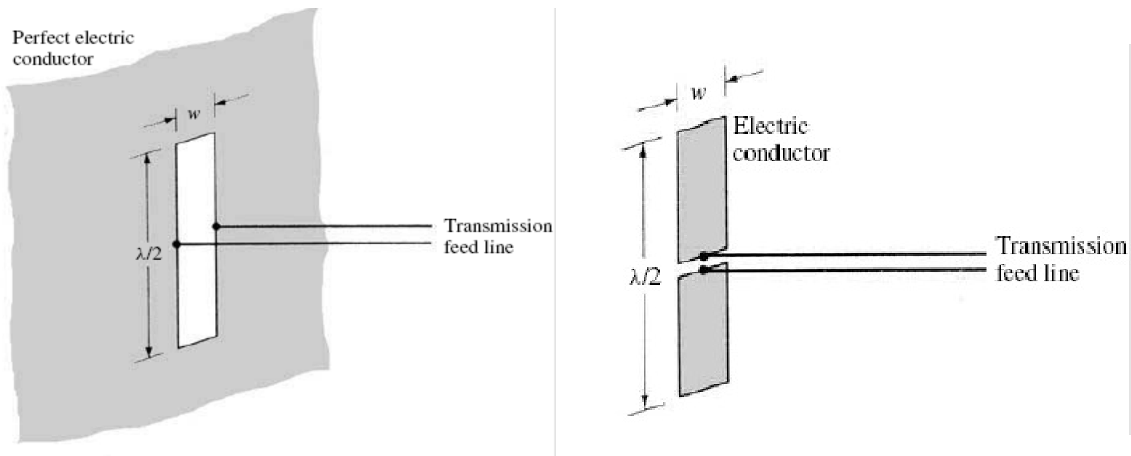
2. (a) Analyze the transmission line model of a rectangular patch microstrip antenna and derive expressions for (i) Fringing effects (ii) Effective length. (5)

(b) Based on the above expressions, design a rectangular patch antenna using a substrate (RT/duroid 5880) with dielectric constant of 2.2, h= 0.1588 cm (0.0625 inches) so as to resonate at 10 GHz. (5)

3. (a) Given a rectangular aperture with a constant field distribution with a= 3λ and b= 2λ, which is mounted on an infinite plane, compute the (a) FNBW in the E plane (b) HPBW in the E plane (c) FSLBW in the E plane (d) Directivity. (5)

(PTO)

(b) State and explain Babinet's Principle. A very thin half-wavelength slot is cut on an infinite, planar, very thin, perfectly conducting electric screen as shown in figure below. Find its input impedance. Assume it is radiating into free-space. (5)



Module II

4. Which are the different types of uniform linear arrays? Derive the expression for array factor of an N-element linear array having uniform amplitude and spacing. (10)

5. (a) Explain a technique of array synthesis in which patterns exhibit nulls in desired directions. (6)

(b) Design a linear array with a spacing between the elements of $d = \lambda/4$ such that it has zeros at $\theta = 0°$, $90°$ and $180°$. Determine the number of elements, their excitation and plot the derived pattern. (4)

6. (a) For a 10-element binomial array with a spacing of $\lambda/4$ between the elements, calculate the half-power beamwidth in degrees and the maximum directivity in dB. (5)

(b) Explain the concept of space factor with respect to rectangular and circular continuous aperture sources. (5)

(PTO)

Module III

8. (a) Compare switched beam and adaptive array schemes with illustrations. (5)

(b) Determine the complex weights of an adaptive 2-element linear array, $\lambda/2$ apart, to receive a desired signal at $\theta_0 = 0°$, while tuning out an interferer at $\theta_1 = 30°$. (5)

9. How is interference nulling achieved in a multi-path scenario? Explain adaptive array processing with respect to flat fading and frequency selective fading channels. (10)

10. Discuss the concept of Antenna beam-forming. Explain the following in the context of smart antennas: (i) Minimum Mean Square Error (MMSE) (ii) Least Mean Square (LMS) algorithms for optimal beam-forming. (10)