Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(ECE)/SEM-8/EC-804E/2012

2012

MICROWAVE CIRCUITS & SYSTEMS

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10

i) Waveguide is a

a) band pass filter b) high pass filter

c) low pass filter d) all pass filter.

ii) Magic Tee is

a) two port network b) three port network

c) four port network d) one port network.

iii) In a waveguide the maximum and minimum values of VSWR are

a) 1 and 0 b) infinity and 0

c) infinity and 1 d) 10 and 1.

iv) Scattering parameter can be measured with the help of

a) Spectrum analyzer

b) Network analyzer

c) CRO

d) Bolometer.

v) For matching purpose, waveguide tapers are preferred to transformers because of

a) low cost b) ease of fabrication

c) durability d) all of these.

vi) The uplink and downlink frequencies of satellite communication are

a) 6GHz, 4GHz b) 4GHz, 6GHz

c) 6GHz, 6GHz d) 3GHz, 4GHz.

vii) Microwave components can be characterized by

a) *h*-parameter b) *y*-parameter

c) *s*-parameter d) *z*-parameter.

viii) For measurement of high values of VSWR, the method to be used is

a) double the minima method

b) double the maxima method

c) single minima method

d) both (a) and (b).

ix) Cassegrain feed is used with a parabolic reflector to

a) increase the beam width of the system

b) increase the gain of the system

c) allow the feed to be placed at a convenient point

d) reduce the size of the main reflector.

x) A micro-strip is analogous to a

a) co-axial line

b) parallel line

c) rectangular waveguide

d) circular waveguide.

xi) In a two-hole directional coupler, the distance between two holes in terms of guided wavelength λ_g is

a) λ_g b) $\lambda_g / 2$

c) $\lambda_g / 4$ d) $2\lambda_g$.

xii) If f_c be the cut-off frequency of the waveguide and f be the operating frequency then

a) $f = f_c$ b) $f < f_c$

c) $f > f_c$ d) $f << f_c$.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Derive the expression for the attenuation of the TE_{10} mode of a rectangular waveguide due to imperfect conducting walls.

3. Show that for a reciprocal network the scattering matrix is symmetric.

4. Prove that for a lossless N-port network, sum of the products of any column or row of *s*-matrix with its conjugate is unity.

5. Derive the relation between directivity and effective aperture of a Horn antenna.

6. Derive Friis power transmission formula.

GROUP – C
(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Define the term 'coupling factor' and 'directivity' of a directional coupler.

   b) Derive an expression for scattering matrix of a directional coupler.

   c) The input power in a two-hole directional coupler is 1 MW. The coupler has a coupling factor of 15 dB and directivity of 30 dB. Calculate the power in all the ports. 4 + 6 + 5

8. a) Find an expression for the reflection co-efficient of a truncated periodic structure terminated in a load impedance Z_L.

   b) Derive the design equation in terms of characteristic impedance for band stop and band pass filters using quarter-wave shorted stub resonator.

   c) Derive the expression for image impedance of *m*-derived filter section by using image parameter method. 4 + 7 + 4

9. a) Determine the expression for fractional bandwidth of Binomial transformer.

   b) Design a three-section binomial transformer to match a 50 Ω line to 200 Ω load. Also calculate fractional bandwidth of the designed transformer if the maximum tolerable reflection coefficient is 2%. 5 + 10

10. a) Draw a microstrip and transmission line modelling of Wilkinson power divider.

    b) Explain even-mode and odd-mode analysis of Wilkinson power divider. 5 + 10

11. Write short notes on any *three* of the following : 3 × 5

a) Industrial applications of microwaves

b) Tapered lines

c) Quarter wave transformer

d) RFMEMS

e) Chebyshev transformer.