Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (ECE-N)/SEM-8/EC-804 E/2011

2011
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 : $10 \times 1 = 10$

i) For handling of high microwave power, the best medium is

a) coaxial line b) rectangular waveguide

c) stripline d) microstrip line.

ii) Wavelength of electromagnetic wave in a waveguide

a) is inversely proportional to the phase velocity

b) is greater than that in free space

c) is directly proportional to phase velocity

d) depends only on the waveguide dimensions and free space wavelength.

iii) The advantage of strip line over waveguides is

a) its power handling capacity is higher.

b) smaller size

c) smaller bandwidth

d) low cost.

iv) I watt power is fed to a directional coupler and the power available at the coupled port is 0.01 watt, then coupling constant is

a) 0.1 dB b) 10 dB

c) 20 dB d) 40 dB.

v) The normalized admittance due to matched load is

a) 0 b) 1

c) 377 ohm d) 0.02.

vi) Single stub matching has the drawback of

a) incapability of matching any impedance

b) having a very high loss

c) requiring a variable point for stub location depending upon the impedance to be matched

d) voltage breakdown easily.

vii) The effective aperture area and directive gain of an antenna are related as

a) $G = 4\pi A/\lambda^2$ b) $A = 4\pi G/\lambda^2$

c) $G = A/4\pi\ \lambda^2$ d) $A = G/4\pi\ \lambda^2$.

viii) Side-lobe of an antenna pattern causes

a) reduced bandwidth

b) reduced antenna gain

c) ambiguity in direction finding

d) increase antenna gain.

ix) The maximally flat filter is preferred over the Chebyshev filter, as it

a) needs fewer reactive elements

b) has got a sharper out of band attenuation

c) less delay distortion

d) provides equal ripple response in the pass band.

x) Impedance transformation over a broad band in microwave is effected with

a) a quaterwave transformer

b) an isolator

c) a tapered transmission line

d) an iron-core transformer.

xi) An example of a lossless, symmetrical, non-reciprocal microwave component is

a) an attenuator

b) a circulator

c) a Magic-T

d) a Horn Antenna.

xii) In an ideal isolator

a) $S_{12} = S_{21} = 0$

b) $S_{12} = 0$

c) $S_{12} = 0, S_{21} = 1$

d) $S_{12} = S_{21} = 1$.

GROUP – B

(Short Answer Type Questions)

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

2. What is Ferrites ? Explain the operation of a 3-port ferrite circulator. 1 + 4

3. Explain the operation of Wilkinson power divider.

4. Briefly discuss the Binomial transformer used in Impedance matching techniques.

5. Discuss different types of discontinuities in rectangular waveguide using their equivalent circuit.

6. Establish the relationship between S-parameter and ABCD parameter.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Give a neat sketch of electric and magnetic field lines in transverse plane of a microstrip line. 2

   b) Discuss what is meant by 'effective dielectric constant' in the context of a microstrp line. 3

   c) A microstrip line has 1 mm thick substrate with a relative dielectric constant, $\in_r$ = 10 if the strip width W = 2mm, find the $\in_{r,eff}$. 5

   d) Draw curves to illustrate how the characteristic impedance of a microstrip line varies with W/H and $\in_r$. Discuss how one can use this chart to design a microstrip line. 5

8. Discuss the method of Even and Odd mode analysis and illustrate your answer with the help of a suitable example.

9. a) A load impedance of 200 ohms is to be matched to the generator of 50 ohm impedance using a quarter wave transformer. Find the characteristic impedance and length of the transmission line, if the frequency of operation is 1GHz. 4

   b) State the inherent drawback of this type of impedance matching. 1

   c) Discuss how this limitation can be overcome. 4

   d) Discuss the steps involved in single stub matching load impedance to the system of a generator and transmission line. 6

10. a) Derive the Friis power transmission formula. 7

    b) A microwave terrestrial link of 30km long is operating at 4GHz with radiated power of 100W through a parabolic dish having maximum gain of 40 dB. The receiver uses similar antenna. Find the 'free space loss' and the 'received power'. 8

11. a) Discuss the steps involved in mapping the low-pass prototype to a bandpass filter. 10

b) Find the element values of a 3-section maximally flat bandpass filter, with lower and upper band edge frequencies as 10 GHz and 11 GHz respectively for 50 ohm termination.

Given : g0 = 1, g1 = 1, g2 = 2, and g3 = 1 where symbols have their usual meanings. 5