Name : .....

Roll No. : .....

Invigilator's Signature : .....

2013

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 line

      c) Strip line 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 the phase velocity

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

   iii) The advantage of strip line over waveguide is

      a) its power handling capacity is higher

      b) smaller size

      c) smaller bandwidth

      d) low cost.

iv) Mode in a Microstrip line is a

a) TEM mode b) Quasi TEM mode

c) TE mode d) TM mode.

v) An E-plane Tee is a waveguide in which the axis of its side arm is

a) parallel to the E-field

b) perpendicular to the E-field

c) parallel to H-field

d) none of these.

vi) For a distortionless transmission line

a) $R/C = L/G$ b) $R/L = G/C$

c) $G/C = L/R$ d) $R = G = L = C = 0$.

vii) λ distance on a transmission line corresponds to a

a) 90° movement on the Smith chart

b) 180° movement on the Smith chart

c) 360° movement on the Smith chart

d) 720° movement on the Smith chart.

viii) The effective aperture area and the 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) $A = G/4\pi\lambda^2$

ix) Side lobe of an antenna pattern causes

a) reduced bandwidth

b) reduced antenna gain

c) ambiguity in direction finding

d) increase antenna gain.

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

a) needs fewer reactive elements

b) has got sharper out of band attenuation

c) has less delay distortion

d) provides equal ripple response in the pass band.

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

a) a quarter wave transformer

b) an isolator

c) a tapered transmission line

d) an iron-core transformer.

GROUP – B
(Short Answer Type Questions)

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

2. a) What are the advantages of microstrip line over strip line ?

b) Draw the Electric and Magnetic field lines of a strip and microstrip line. 2 + 3

3. Determine the generalized *S* matrix of an *N* port network.

4. Mention the steps to design the microwave filter using image parameter method.

5. Compute the mathematical expression for location and length of a single shunt short circuited stub using analytical solution.

6. Write down and explain the *S* matrix of 90° hybrid and 180° hybrid directional coupler. $2\frac{1}{2} + 2\frac{1}{2}$

GROUP – C
(Long Answer Type Questions)

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

7. a) Define periodic structure.
   b) Describe passband and stopband characteristics of periodic structure.
   c) Explain the k-β diagram of periodic structure. 3 + 7 + 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 ohm 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 1 GHz.
   b) State the inherent drawback of this type of impedance matching.
   c) Discuss how this limitation can be overcome.
   d) Discuss the steps involved in single stub matching load impedance to the system of a generator and transmission line. 4 + 1 + 4 + 6

10. a) Derive Friis power transmission formula.
    b) A microwave terrestrial link of 30 km long is operating at 4 GHz with radiated power of 1000 W through a parabolic dish having maximum gain of 40 dB. The receiver uses similar antenna. Find the 'free space loss' and the 'received power'. 7 + 8

11. Write short notes on any *three* of the following : 3 × 5
    a) Magic Tee
    b) Microwave filter
    c) *S* parameter
    d) Directional coupler
    e) Circulator.