Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.TECH(ECE)/SEP.SUPPLE/SEM-8/EC-804E/2012

2012

MICROWAVE CIRCUITS AND 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)   The dominant mode in a waveguide is characterised by
   a)   longest cutoff wavelength
   b)   shortest cut off wavelength
   c)   infinite attenuation
   d)   zero attenuation.

ii) The lowest TM mode in a rectangular waveguide of cross-section $a \propto b$ and with $a > b$ will be

   a) TM_{01} b) TM_{10}
   c) TM_{12} d) TM_{11} .

iii) The distance between maxima and minima of a standing wave is

   a) $\dfrac{\lambda}{2}$ b) λ
   c) $\dfrac{3\lambda}{4}$ d) $\dfrac{\lambda}{4}$.

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iv) Image Parameter Method is used for
   a) antenna design
   b) filter design
   c) transmission line design
   d) impedance matching.

v) In a reciprocal two-port network the transmission matrix elements are
   a) $AC - BD = 1$
   b) $AD - BC = 1$
   c) $AB - CD = 1$
   d) $BD - CA = 1$.

vi) Fields are said to be circularly polarized if their magnitudes are
   a) equal and they are in phase
   b) equal and they differ in phase by ± 90°
   c) unequal and they differ by ± 90°
   d) not equal but they are in phase.

vii) If G, D and η are the gain, directivity and efficiency of an antenna respectively, which relation is true ?
   a) $G = \eta D$
   b) $G = \eta / D$
   c) $\eta G = D$
   d) $G = D / \eta$.

viii) Power of 1 W is
   a) 30 dBm
   b) 60 dBm
   c) 0 dBm
   d) 1 dBm.

ix) The transmission line is used as
   a) Antenna
   b) Stub
   c) Oscillator
   d) Filter.

x) If VSWR = 1, then reflection coefficient is
   a) 0
   b) 1
   c) – 1
   d) ∞ .

xi) For increasing channel capacity always use
   a) MIMO MATRIX A
   b) Beamforming
   c) MIMO MATRIX B
   d) all of these.

xii) When polarization of the receiving antenna is unknown, to ensure that it receives at least half the power (except in particular situation), the transmitted wave should be
   a) horizontally polarization
   b) vertically polarization
   c) circularly polarization
   d) elliptically polarization.

GROUP – B
(Short Answer Type Questions)
Answer any *three* of the following. $3 \times 5 = 15$

2. What are the different types of dielectric materials are used as substrate for making microstrip line as well as an antenna ? Which one is the most useful for obtaining small size, large bandwidth and omni-directional radiation pattern ? Justify with necessary schematic sketches. 2 + 3

3. What is a dominant mode ? Draw the field orientations of TE_{01} and TM_{01} mode in a waveguide. Justify your answer with sketches. 1 + 2 + 2

4. What is a microwave isolator ? What is a microwave phase shifter ? Why these microwave components are very much useful in microwave applications ? Briefly explain. 1 + 1 + 3

5. Calculate the position and length of a short circuited stub designed to match a 200 Ω load to a transmission line whose Ch. Impedance is 300 Ω and operating frequency is 1 GHz.

6. Write down the steps for filter design by insertion loss method.

GROUP – C
(Long Answer Type Questions)
Answer any *three* of the following. $3 \times 15 = 45$

7. a) How will you represent the Scattering and Impedance Matrix representation of microwave junctions ? Justify mathematically with sketches if necessary.
   b) Define the following terms with a brief note :
      i) Transmission coefficient of a transmission line.
      ii) Aperture and antenna height of a loop antenna.
      iii) Stub matching in a transmission line. 9 + 6

8. a) If 100 kW of energy are radiated from an aerial of 100 m effective height at a frequency of 60 kHz, what is the strength of the electric field at a distance of 100 km ? Assume that no absorption effects are present.

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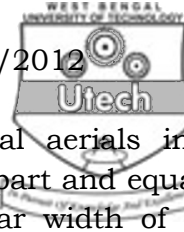
    b)   An aerial array consists of 10 vertical aerials in a straight line spaced half a wavelength apart and equally energized in phase. Deduce the angular width of the forward beam in the horizontal plane.

    c)   How will you calculate the VSWR in an waveguide on using slotted transmission line ?   5 + 5 + 5

9.   a)   Find out S parameter of four-port directional coupler.

    b)   A lossless T junction power divider has a source impedance of 50 Ω. Find the output Ch. impedance so that the input power is divided in 2 : 1 ratio.

    c)   Using Even and Odd mode analysis find out S parameter of Wilkinson power divider.   6 + 5 + 4

10.   a)   What is the difference between gain and directivity of an antenna ?

    b)   Derive the Friis power transmission formula for Microwave communication systems.

    c)   A microwave radio link at 4·9 GHz uses transmit and receive antennas with gains of 30 dB. If the distance between transmitter and receiver is 27 km and it is desired to have a minimum received power level of – 60 dBm, what is the required transmitter power ?

                                          4 + 7 + 4

11.   Write short notes on any *three* the following : $3 \times 5 = 15$

    a)   MIMO Antenna

    b)   FIN lines

    c)   Principles and applications of RF MEMS

    d)   Ricard's transformation in lumped element filter design

    e)   Usefulness of Transmission Matrix Method.

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