MICROWAVE CIRCUITS & SYSTEMS (SEMESTER - 8)

CS/B.Tech(ECE)/SEM-8/EC-804E/09

1. ....
   Signature of Invigilator

2. ....
   Signature of the Officer-in-Charge

Reg. No.

Roll No. of the Candidate

CS/B.Tech(ECE)/SEM-8/EC-804E/09

ENGINEERING & MANAGEMENT EXAMINATIONS, APRIL – 2009
MICROWAVE CIRCUITS & SYSTEMS (SEMESTER - 8)

Time : 3 Hours]   [Full Marks : 70

INSTRUCTIONS TO THE CANDIDATES :

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **32 pages**. The questions of this concerned subject commence from Page No. 3.
2. a) In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.
   b) For **Groups – B** & **C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.
3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.
4. Read the instructions given inside carefully before answering.
5. You should not forget to write the corresponding question numbers while answering.
6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.
7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**
8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.
9. Rough work, if necessary is to be done in this booklet only and cross it through.

No additional sheets are to be used and no loose paper will be provided

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Marks Obtained

				Group – A						Group – B		Group – C		Total Marks	Examiner's Signature
Question Number															
Marks Obtained															

....
Head-Examiner/Co-Ordinator/Scrutineer

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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 $a \infty b$ and with $a > b$ will be

        a) TM_{01} b) TM_{10}

        c) TM_{12} d) TM_{11} .

    iii) In a transmission line the maximum and minimum values of VSWR obtained under loaded condition are

        a)   1 and 0   b)   infinite and zero

        c)   infinite and 1   d)   – 1 and + 1.

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

        a) $\lambda/2$ b) λ

        c) $3\lambda/4$ d) $\lambda/4$.

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v) Image Parameter Method is used for

   a) antenna design   b) filter design

   c) transmission line design d) impedance matching.
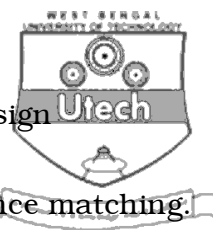
vi) In a reciprocal two-port network the transmission matrix elements are

   a) AC – BD = 1   b) AD – BC = 1

   c) AB – CD = 1   d) BD – CA = 1.

vii) Microwave components can be characterized through measurement by

   a) h-parameter   b) y-parameter

   c) S-parameter   d) Z-parameter.

viii) 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.

ix) If G, D and η is 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) $G = D/\eta$.

x)   Input impedance of a folded dipole used in antenna of TV receiver is

    a)   100 ohm   b)   200 ohm

    c)   300 ohm   d)   400 ohm.

xi)   Microwaves antenna aperture efficiency depends on

    a)   feed pattern   b)   antenna aperture

    c)   surface losses   d)   low side lobe level.

xii)   A disadvantage of microstrip compared with strip line is that microstrip

    a)   does not lend itself rapidly to printed circuit technique

    b)   is more likely to radiate

    c)   is more complex to manufacture

    d)   is bulkier.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.   3 × 5 = 15

2.   What is a power divider ? Design an equal-split Wilkinson power divider for 50 Ω system impedance at frequency f_0 .   1 + 4

3.   Derive the unitary property of scattering matrix for a lossless junction.

4.   Show that the impedance matrix of a reciprocal *N*-port network is a symmetric matrix.

5.   A parabolic reflector antenna used for reception with the Direct Broadcast System (DBS) is 20 $''$ in diameter and operates at 14 GHz. Find the operating wavelength and the far field distance for this antenna.

6.   Write down the steps in designing a microstrip antenna for a given frequency.

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GROUP – C

(Long Answer Type Questions)
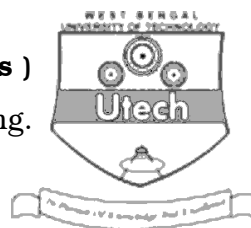
Answer any *three* of the following.   3 × 15 = 45

7. a)   Discuss the operation of a 'Magic T'.

    b)   Derive the scattering matrix of a 'Magic T'.

    c)   Discuss the use of Magic T with suitable examples.   5 + 5 + 5

8. a)   What are the required length and impedance of a quarter wave transformer that will match a 100 Ω load to a 50 Ω line at f = 10000 MHz (air field line) ? What is the frequency band of operation over which the reflection coefficient remains less than 0.1 ?

    b)   Describe an ideal directional coupler. Define 'coupling' and 'directivity' in the context of a directional coupler.

    c)   Explain the working principle of circulators.   5 + 5 + 5
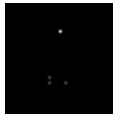
9. a)   Explain analytically the matching techniques with lumped elements.

    b)   Write down the conversion between matrices as given below of arbitrary 2-port networks :

        i)   from Z-matrix to S-matrix

        ii)   from S-matrix to Z-matrix.   7 + 4 + 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* of the following :   3 × 5

a) Industrial application of microwave

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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END