Enrollment No......................................

Faculty of Engineering
End Sem (Even) Examination May-2019
EC3CO16 Microwave Engineering

Programme: B.Tech. Branch/Specialisation: EC

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated.Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. Two modes with same cut off frequency are said to be **1**
(a) Generate modes (b) Dominant modes
(c) Degenerate modes (d) Regenerate modes

ii. Consider a transmission line of characteristic impedance 50 ohm. **1**
Let it be terminated at one end by $+j$50 ohm. The VSWR produced by it in the transmission line will be
(a) +1 (b) 0 (c) ∞ (d) $+j$

iii. The structure consisting of two ground planes separated by a **1**
dielectric and a metal strip in the centre is
(a) Microstrip line (b) Strip line
(c) Coplanar line (d) Slot line

iv. The mode of propagation in a microstrip line is: **1**
(a) Quasi TEM mode (b) TEM mode
(c) TM mode (d) TE mode

v. In an ideal directional coupler, all the diagonal elements of S-matrix **1**
are
(a) One (b) Two (c) Non-zero (d) Zero

vi. Isolator offers _____ in the reverse direction. **1**
(a) Low attenuation (b) High attenuation
(c) High gain (d) Low gain

vii. GaAs is used in the fabrication of GUNN diodes because: **1**
(a) GaAs is cost effective
(b) Less temperature sensitive
(c) It has low conduction band electrons
(d) Less forbidden energy gap

P.T.O.

viii. The BARITT diode has **1**
    (a) No drift region   (b) Short drift region
    (c) Long drift region   (d) None of these.

ix. An ideal filter have following properties **1**
    I. Zero insertion loss in passband
    II. Finite insertion loss in passband
    III. Linear phase response in passband
    IV. Infinite attenuation in the stopband
    (a) I, II and IV   (b) II, III and IV
    (c) I, II and III   (d) I, III and IV

x. Microstrip Stepped-impedance low pass filters design using **1**
    (a) Low characteristics impedance lines
    (b) High characteristics impedance lines
    (c) Low and high characteristics impedance lines alternative
    (d) None of these

Q.2 i. What is meant by mode of an electromagnetic wave in waveguide? **2**

ii. For an air filled rectangular waveguide of 2 cm x 1 cm, calculate the cut-off wavelength for TE_{11} and TE_{10} modes. **3**

iii. Derive voltage and current equation of transmission line in terms of secondary constants. **5**

OR iv. Derive the Transverse component (E_x, E_y, H_x, H_y) in terms of longitudinal component (E_z and H_z) using Maxwell's Curl Equation. **5**

Q.3 i. What is planar structure? **2**
ii. Differentiate between strip-line and micro-strip line **3**
iii. Explain the construction and field pattern of Strip lines. **5**
OR iv. Draw field lined of Micro-strip line and write the formula of following: **5**
    (a) Effective relative permittivity
    (b) Characteristics impedance

Q.4 i. Calculate the coupling factor of a directional coupler when incident power is 500 mW and power in auxiliary waveguide is 400 µW. **2**

ii. Distinguish between E-plane Tee and H-plane Tee. **3**

iii. Derive the scattering matrix of Magic Tee & write any two application of Magic Tee. **5**

OR iv. Explain the working of circulator and write any two uses of circulator. **5**

Q.5 i. Write any two applications of TRAPATT diode? **2**

ii. Calculate the operating frequency of a silicon based IMPATT diode with drift length of 3 µm and drift velocity of 10^7 cm/sec. **3**

iii. Explain the construction & working principal of Gunn diode. Define transit time and limited space charge accumulation (LSA) mode of Gunn diode **5**

OR iv. Explain the construction & working principal of Parametric amplifier. **5**

Q.6 Attempt any two:
i. Write all design steps of Filter Design by Insertion loss Method. **5**
ii. Write all design steps of Filter using coupled resonators. **5**
iii. Write all design steps of Stepped-Impedance low-pass filter. **5**

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Marking Scheme
EC3CO16 Microwave Engineering

Q.1 i. Two modes with same cut off frequency are said to be   **1**
(c) Degenerate modes

ii. Consider a transmission line of characteristic impedance 50 ohm. Let   **1**
it be terminated at one end by $+j50$ ohm. The VSWR produced by it
in the transmission line will be
(c) ∞

iii. The structure consisting of two ground planes separated by a   **1**
dielectric and a metal strip in the centre is
(b) Strip line

iv. The mode of propagation in a microstrip line is: **1**
(a) Quasi TEM mode

v. In an ideal directional coupler, all the diagonal elements of S-matrix   **1**
are
(d) Zero

vi. Isolator offers _____ in the reverse direction.   **1**
(b) High attenuation

vii. GaAs is used in the fabrication of GUNN diodes because: **1**
(d) Less forbidden energy gap

viii. The BARITT diode has   **1**
(c) Long drift region

ix. An ideal filter have following properties   **1**
I. Zero insertion loss in passband
II. Finite insertion loss in passband
III. Linear phase response in passband
IV. Infinite attenuation in the stopband
(d) I, III and IV

x. Microstrip Stepped-impedance low pass filters design using   **1**
(c) Low and high characteristics impedance lines alternative

Q.2 i. Mode of an electromagnetic wave in waveguide   **2**

ii. TE_{11} 1.5 marks   **3**
TE_{10} modes.   1.5 marks

iii. Voltage equation of transmission line   2.5 marks   **5**
Current equation of transmission line   2.5 marks

OR iv. Transverse component (E_x, E_y, H_x, H_y) in terms of longitudinal   **5**
component (E_z and H_z) using Maxwell's Curl Equation.

Q.3 i. Planar structure definition   **2**

ii. Difference between strip-line and micro-strip line   **3**
1 mark for each difference   (1 mark * 3)

iii. Construction   3 marks   **5**
Field pattern of Strip lines   2 marks

OR iv. Draw field lined of Micro-strip line   3 marks   **5**
Formula of following:
(a) Effective relative permittivity   1 mark
(b) Characteristics impedance   1 mark

Q.4 i. Calculate the coupling factor of a directional coupler   **2**
ii. Distinguish b/w E-plane Tee and H-plane Tee.   **3**
1 mark for each difference   (1 mark * 3)

iii. Scattering matrix of Magic Tee   3 marks   **5**
Any two application of Magic Tee.   2 marks

OR iv. Working of circulator   3 marks   **5**
Any two uses of circulator.   2 marks

Q.5 i. Any two applications of TRAPATT diode   **2**
1 mark for each application   (1 mark * 2)

ii. Calculate the operating frequency of a silicon based IMPATT diode   **3**

iii. Construction of Gunn diode   1 mark   **5**
Working principal of Gunn diode   2 marks
Transit time   1 mark
Limited space charge accumulation (LSA) 1 mark

OR iv. Construction of Parametric amplifier   2 marks   **5**
Working principal of Parametric amplifier. 3 marks

Q.6   Attempt any two:
i. Design steps of Filter Design by Insertion loss Method.   **5**
Steps   3 marks
Design   2 marks

ii. Design steps of Filter using coupled resonators.   **5**
Steps   3 marks
Design   2 marks

iii. Design steps of Stepped-Impedance low-pass filter.   **5**
Steps   3 marks
Design   2 marks

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