

Enrollment No.....



Faculty of Engineering
End Sem Examination May-2023
EC3CO16 Microwave Engineering

Programme: B.Tech.

Branch/Specialisation: EC

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

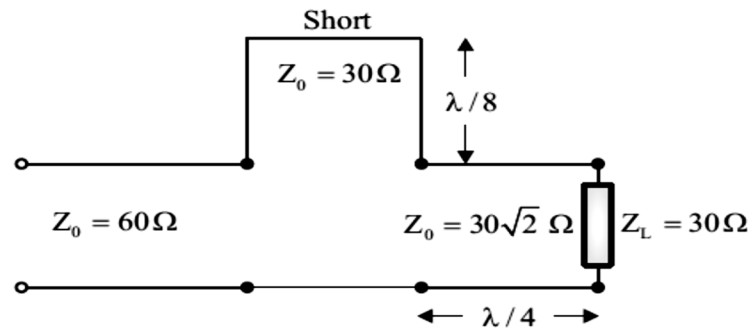
Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

- Q.1 i. In a transmission line terminated by characteristic impedance- 1
 (a) There is no reflection of the incident wave
 (b) The reflection is maximum due to termination
 (c) The incident current is zero for any applied signal
 (d) None of these
- ii. A smith chart is used for solving- 1
 (a) Propagation problem (b) Transmission problem
 (c) Antenna problem (d) Attenuation problem
- iii. The mode of wave propagation in a microstrip line is- 1
 (a) TEM (b) TM (c) Quasi-TEM (d) TE
- iv. The field of slot lines are distributed in- 1
 (a) Air (b) Dielectric
 (c) Both (a) & (b) (d) None of these
- v. Circulators are created by- 1
 (a) Two transmission line (b) Two waveguide
 (c) Two magic tee (d) Two attenuators
- vi. A Bathe-Hole directional coupler has- 1
 (a) Two holes (b) A single hole
 (c) Three holes (d) No hole at all
- vii. Which of the following exhibits transferred electron effect for 1
 generation of microwave?
 (a) Silicon (b) Germanium
 (c) Metal-semiconductor junction (d) Gallium arsenide

P.T.O.

[2]

- viii. The BARITT diode has- **1**
 (a) No drift region (b) Short drift region
 (c) Long drift region (d) None of these
- ix. Filters have characteristic similar to- **1**
 (a) Oscillator (b) Mixer
 (c) Amplifier (d) Periodic structure
- x. Wideband filters are constructed using- **1**
 (a) Microstrip lines (b) Strip lines
 (c) Tightly coupled lines (d) Slot lines
- Q.2 i. Define VSWR and return loss in transmission line. **2**
 ii. Explain the two circles on the smith chart. **3**
 iii. Derive an expression for input impedance of a lossless transmission line. **5**
- OR iv. In the circuit shown, all the transmission line sections are lossless. Determine Voltage Standing Wave Ratio (VSWR) on the 60 Ohm line. **5**



- Q.3 i. Compare micro-strip line and strip line. **2**
 ii. Explain slot lines. **3**
 iii. When the dominant mode is propagated in an air-filled rectangular waveguide, the guide wavelength for a frequency 9000 MHz is 4 cm. Calculate width of the guide. **5**
- OR iv. Derive the Transverse component (E_x , E_y) in terms of longitudinal component (E_z and H_z) using Maxwell's Curl Equation. **5**
- Q.4 i. What are the properties of scattering matrix? **2**
 ii. Define Circulator, Isolator and Gyrator. **3**
 iii. Define Magic Tee. Derive its Scattering matrix. **5**

[3]

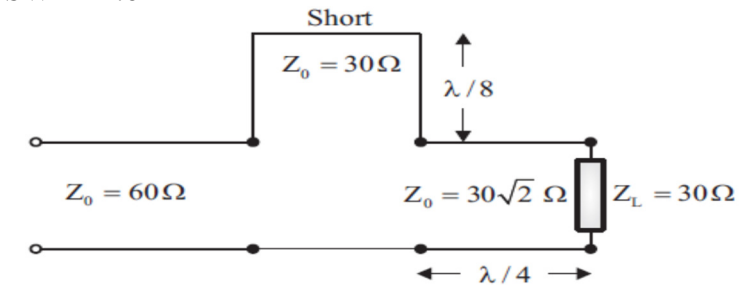
- OR iv. Write short note on the following: **5**
 (a) Rectangular cavity resonator (b) Directional couplers
- Q.5 i. Explain the process of domain formation in the slice of n-type GaAs. **2**
 ii. An IMPATT diode has the following parameters: **3**
 Carrier drift velocity, $v_d = 2 \times 10^7$ cm/sec
 Drift region length, $L = 6 \mu\text{m}$
 Maximum Operating voltage, $V_{\text{omax}} = 100$ V
 Maximum Operating Current, $I_{\text{omax}} = 200$ mA
 Efficiency, $\eta = 15\%$
 Breakdown Voltage, $V_{\text{bd}} = 90$ V
 Compute the following:
 (a) Maximum CW output power in watt
 (b) The resonant frequency in GHz
- iii. Explain working of TRAPATT diode with waveform. **5**
- OR iv. Explain the working of parametric amplifier. Obtain the condition for up conversion and down conversion. **5**
- Q.6 Attempt any two: **5**
 i. Explain periodic structures in detail. **5**
 ii. Explain image parameter method of filter design. **5**
 iii. Explain insertion loss method of filter design. **5**

Marking Scheme

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- Q.1 i. In a transmission line terminated by characteristic impedance, 1
(a) There is no reflection of the incident wave
- ii A smith chart is used for solving 1
(b) Transmission problem
- iii The mode of wave propagation in a microstrip line is 1
(c) Quasi-TEM
- iv The field of slot lines are distributed in 1
(c) Air and Dielectric
- v Circulators are created by 1
(c) Two magic tee
- vi A Bathe-Hole directional coupler has 1
(b) A single hole
- vii Which of the following exhibits transferred electron effect for 1
generation of microwave?
(d) Gallium arsenide
- viii The BARITT diode has 1
(c) Long drift region
- ix Filters have characteristic similar to 1
(d) Periodic structure
- x Wideband filters are constructed using 1
(c) Tightly coupled lines
- Q.2 i Define VSWR and return loss in transmission line. 2
VSWR - 1 mark
Return loss - 1 mark
- ii Explain the two circles on the smith chart. 3
R circle - 1.5 mark
X circle - 1.5 mark

- iii Derive an expression for input impedance of a lossless transmission 5
line.
- OR iv In the circuit shown, all the transmission line sections are lossless. 5
Determine Voltage Standing Wave Ratio (VSWR) on the 60 Ohm line.
VSWR = 1.64



- Q.3 i Compare micro-strip line and strip line. 2
0.5 mark for each comparison
- ii Explain Slot lines. 3
- iii When the Dominant mode is propagated in an air filled rectangular 5
waveguide, the guide wavelength for a frequency 9000MHz is 4cm.
Calculate width of the guide.

Calculation of λ_0 - 1 mark
Calculation of λ_c - 2 mark
Calculation of width - 2 mark

$$a = 3.01 \text{ cm}$$

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

E_x component - 2.5 marks
 E_y component - 2.5 marks

- Q.4 i What are the properties of scattering matrix? 2
-0.5 mark for each property
- ii Define circulator, Isolator and Gyrator. 3
-1 mark for each
- iii Define Magic Tee. Derive its Scattering matrix. 5
-definition -1 mark
Derivation -4 mark

- OR iv Write short note on the following: **5**
- (a) Rectangular cavity resonator -2.5mark
- (b) Directional Couplers -2.5 mark

- Q.5 i Explain the process of domain formation in the slice of n-type GaAs. **2**
- ii An IMPATT diode has the following parameters: **3**

Carrier drift velocity : $v_d = 2 \times 10^7$ cm/sec

Drift region length : $L = 6\mu\text{m}$

Maximum Operating voltage $V_{\text{omax}} = 100$ V

Maximum Operating Current $I_{\text{omax}} = 200\text{mA}$

Efficiency $\eta = 15\%$

Breakdown Voltage $V_{\text{bd}} = 90$ V

Compute:

- (a) Maximum CW output power in 3 watt -1.5 mark
- (b) The resonant frequency in 16.67 GHz -1.5 mark
- iii Explain working of TRAPATT diode with waveform. **5**
- Working -4 mark
- Waveform -1mark

- OR iv Explain the working of parametric amplifier. Obtain the condition for up conversion and down conversion. **5**
- Working -3mark
- Condition -2mark

- Q.6 Attempt any two: **5**
- i Explain periodic structures in detail. **5**
- ii Explain Image parameter method of filter design **5**
- iii Explain Insertion loss method of filter design **5**
