

Faculty of Engineering

End Semester Examination May 2025

EC3CO22 Microwave Engineering

Programme	:	B.Tech.	Branch/Specialisation	:	EC
Duration	:	3 hours	Maximum Marks	:	60

Note: All questions are compulsory. Internal choices, if any, are indicated. Assume suitable data if necessary.

Notations and symbols have their usual meaning.

- | Section 1 (Answer all question(s)) | | | Marks CO BL |
|--|-------------|---|--------------------|
| Q1. A lossless transmission line has a characteristic impedance $Z_0=50\Omega$. If the line is terminated with a 75Ω load, what is the reflection coefficient (Γ)? | 1 1 1 | <input checked="" type="radio"/> 0.2 <input type="radio"/> 0.4
<input type="radio"/> 0.5 <input type="radio"/> 0.6 | |
| Q2. For a reflection coefficient of $\Gamma=0.5$, what is the VSWR? | 1 1 2 | <input type="radio"/> 1.5 <input checked="" type="radio"/> 2
<input checked="" type="radio"/> 3 <input type="radio"/> 3.5 | |
| Q3. What is the primary advantage of microstrip lines? | 1 2 1 | <input type="radio"/> High power handling <input checked="" type="radio"/> Low manufacturing cost and ease of integration
<input type="radio"/> Superior isolation <input type="radio"/> High bandwidth | |
| Q4. Slot lines are commonly used for which type of wave propagation? | 1 2 2 | <input checked="" type="radio"/> Quasi TEM wave <input type="radio"/> TE waves
<input type="radio"/> TM waves <input type="radio"/> Hybrid modes | |
| Q5. An isolator is typically used to- | 1 3 2 | <input checked="" type="radio"/> Prevent signal reflection from the load to the source <input type="radio"/> Split power equally between two ports
<input type="radio"/> Change the phase of the signal <input type="radio"/> Combine multiple signals | |
| Q6. What is the primary function of a circulator in a microwave network? | 1 3 1 | <input type="radio"/> Isolate components <input type="radio"/> Provide bidirectional coupling
<input checked="" type="radio"/> Route the signal from one port to the next sequentially <input type="radio"/> Split power equally | |
| Q7. The Gunn effect is based on which phenomenon? | 1 4 2 | <input type="radio"/> Avalanche breakdown <input checked="" type="radio"/> Negative differential resistance
<input type="radio"/> Zener tunneling <input type="radio"/> Thermionic emission | |
| Q8. The main advantage of a TRAPATT diode over an IMPATT diode is- | 1 4 1 | <input type="radio"/> Higher frequency operation <input type="radio"/> Lower noise level
<input checked="" type="radio"/> Higher power efficiency <input type="radio"/> Simpler fabrication process | |
| Q9. A periodic structure in microwave systems is primarily used for- | 1 5 2 | <input type="radio"/> Power amplification <input checked="" type="radio"/> Filtering and frequency selection
<input type="radio"/> Oscillation generation <input type="radio"/> Impedance matching | |

Q10. In the Image Parameter Method for filter design, the parameters are based on-

1 5 1

- Voltage ratios
- Impedance and propagation constant
- Power and phase constants
- Reflection coefficients

Section 2 (Answer all question(s))

Q11. What is the range of microwave frequency? Write any two applications of microwave frequencies.

Marks CO BL
2 1 1

Rubric	Marks
What is the range of microwave frequency.	1
Write any two applications of microwave frequencies.	1

Q12. Derive relation between reflection coefficient and voltage standing wave ratio of transmission line.

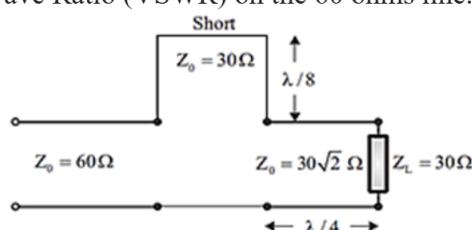
3 1 2

Q13. (a) Derive the voltage and current equation of transmission line using distributed parameter model.

5 1 1

(OR)

- (b)** In the circuit shown, all the transmission line sections are lossless. Determine Voltage Standing Wave Ratio (VSWR) on the 60 ohms line.



Section 3 (Answer all question(s))

Q14. Why Microstrip lines are suitable for high-frequency applications?

Marks CO BL
2 2 2

Q15. (a) Compare the structural and operational characteristics of coplanar waveguides (CPW) and slot lines. Draw their field distribution, applications, and advantages in planar circuits.

8 2 2

Rubric	Marks
Compare the structural and operational characteristics of coplanar waveguides (CPW) and slot lines	5
Draw their field distribution, applications, and advantages in planar circuits. 1 Mark each.	3

(OR)

- (b)** Compare planar structure and non planar structure. Draw construction & field lines of Microstrip line. Write the formula of following-
- Effective relative permittivity
 - Characteristics impedance

Rubric	Marks
Compare planar structure and non planar structure	4
Draw construction & field lines of Microstrip line.	2
Write the formula of following	2
i) Effective relative permittivity	
ii) Characteristics impedance	

Section 4 (Answer all question(s))

Marks CO BL
3 3 1

Q16. Write any three properties of scattering [S] parameters.

Rubric	Marks
Each properties one marks	3

Q17. (a) Derive the scattering matrix of Magic Tee & write any two application of Magic Tee in detail.

7 3 1

Rubric	Marks
Derive the scattering matrix of Magic Tee.	5
two application of Magic Tee in detail.	2

(OR)

- (b)** A directional coupler has a coupling factor of $C=15$ dB, an isolation of $I=25$ dB, and an input power of $P_{in}=2$ W at the main line. Determine-
- The power delivered to the coupled port.
 - The power delivered to the isolated port.
 - The power delivered to the output port.

Rubric	Marks
(i) The power delivered to the coupled port. 2 Marks (ii) The power delivered to the isolated port. 2 Marks	4
(iii) The power delivered to the output port. 3 Marks	3

Section 5 (Answer all question(s))

Q18. What is negative resistance region? Write three differences between conventional transistor and TEDs devices. **Marks CO BL** 4 4 4

Rubric	Marks
What is negative resistance region?	1
Write three differences between conventional transistor and TEDs devices.	3

Q19. (a) Explain the construction & working principle of IMPATT diode. Compare GUNN diode, IMPATT diode and TRAPATT diode. **6 4 2**

Rubric	Marks
Explain the construction & working principle of IMPATT diode.	3
Compare GUNN diode, IMPATT diode and TRAPATT diode.	3

(OR)

- (b)** Explain parametric amplifier & draw its equivalent circuit. What is pumping frequency? How it is used in parametric amplifier for up and down converter?

Rubric	Marks
Explain parametric amplifier & draw its equivalent circuit. 2 Marks each	4
What is pumping frequency and how it is used in parametric amplifier for up and down converter?	2

Section 6 (Answer all question(s))

Q20. What is unit cell in periodic structure?

Marks CO BL

2 5 1

Q21. Explain stepped impedance Filter design technique for designing of LPF.

3 5 1

Q22. (a) Explain Steps for design of microwave filter using insertion loss method.

5 5 1

Rubric	Marks
1 mark on each step	5

(OR)

- (b)** Calculate inductance and capacitance values for a maximally flat LPF that has a 3dB bandwidth and attenuation of 20 dB at 1 GHz. The filter is to be connected to 50 ohm source and load impedances.

Rubric	Marks
Calculate inductance and capacitance values.2.5 Marks each	5
