



**MEDICAPS**  
UNIVERSITY

**Faculty of Engineering**  
**End Semester Examination May 2025**  
**EC3CO22 Microwave Engineering**

<b>Programme</b>	: B.Tech.	<b>Branch/Specialisation</b>	: EC
<b>Duration</b>	: 3 hours	<b>Maximum Marks</b>	: 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**

- |            |  |          |          |          |
|------------|--|----------|----------|----------|
| <b>Q1.</b> | A lossless transmission line has a characteristic impedance $Z_0=50\Omega$ . If the line is terminated with a $75\Omega$ load, what is the reflection coefficient ( $\Gamma$ )?  | <b>1</b> | <b>1</b> | <b>1</b> |
|            | <input checked="" type="radio"/> 0.2 <input type="radio"/> 0.5 <input type="radio"/> 0.4 <input type="radio"/> 0.6   |          |          |          |
| <b>Q2.</b> | For a reflection coefficient of $\Gamma=0.5$ , what is the VSWR?   | <b>1</b> | <b>1</b> | <b>2</b> |
|            | <input type="radio"/> 1.5 <input type="radio"/> 2 <input checked="" type="radio"/> 3 <input type="radio"/> 3.5   |          |          |          |
| <b>Q3.</b> | What is the primary advantage of microstrip lines?   | <b>1</b> | <b>2</b> | <b>1</b> |
|            | <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  |          |          |          |
| <b>Q4.</b> | Slot lines are commonly used for which type of wave propagation?   | <b>1</b> | <b>2</b> | <b>2</b> |
|            | <input checked="" type="radio"/> Quasi TEM wave <input type="radio"/> TE waves <input type="radio"/> TM waves <input type="radio"/> Hybrid modes   |          |          |          |
| <b>Q5.</b> | An isolator is typically used to-  | <b>1</b> | <b>3</b> | <b>2</b> |
|            | <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 |          |          |          |
| <b>Q6.</b> | What is the primary function of a circulator in a microwave network?   | <b>1</b> | <b>3</b> | <b>1</b> |
|            | <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                       |          |          |          |
| <b>Q7.</b> | The Gunn effect is based on which phenomenon?  | <b>1</b> | <b>4</b> | <b>2</b> |
|            | <input type="radio"/> Avalanche breakdown <input checked="" type="radio"/> Negative differential resistance <input type="radio"/> Zener tunneling <input type="radio"/> Thermionic emission  |          |          |          |
| <b>Q8.</b> | The main advantage of a TRAPATT diode over an IMPATT diode is-   | <b>1</b> | <b>4</b> | <b>1</b> |
|            | <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  |          |          |          |
| <b>Q9.</b> | A periodic structure in microwave systems is primarily used for-   | <b>1</b> | <b>5</b> | <b>2</b> |
|            | <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))**

Marks CO BL

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

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.

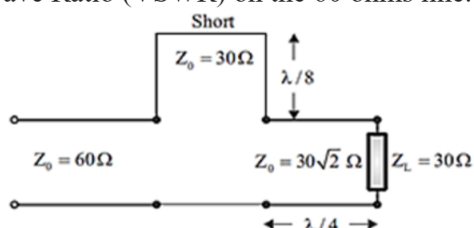
3 1 2

**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))**

Marks CO BL

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

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-

- (i) Effective relative permittivity  
 (ii) 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 i) Effective relative permittivity ii) Characteristics impedance	2

**Section 4 (Answer all question(s))**

Marks CO BL

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

3 3 1

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

### Section 5 (Answer all question(s))

Marks CO BL

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

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))

Marks CO BL

**Q20.** What is unit cell in periodic structure?

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

\*\*\*\*\*