School of Engineering and Applied Science (SEAS), Ahmedabad University

Name: _____ Roll no.: _____

B. Tech. Electrical and Electronics Engineering
EEE302 Engineering Electromagnetics
Mid Term Exam (Winter 2026);
Marks: 30, wt. 30 %
26, February, Thursday, 8.00 AM – 9.00 AM

Instructions:

1. *Answer all the questions.*
2. *No electronics objects are allowed except calculators.*
3. *Closed book exam. Access to internet is not allowed.*
4. *All acronyms carry their usual meaning.*
5. *Answer the questions in the space provided. No extra sheets or supplementary will be provided.*

Q-1. Answer the following MCQs by selecting the correct option. Each question carries 1 mark. (10 marks)

1. Why does lumped circuit theory fail at microwave frequencies?
A. Resistance becomes zero.
B. Circuit dimensions become comparable to the wavelength
C. Current becomes very small.
D. Power loss increases exponentially

Answer:

2. S-parameters are preferred at microwave frequencies because they are based on:
A. Voltage and current
B. Power and energy waves
C. Electric field only
D. Magnetic field only

Answer:

3. If a lossless line is terminated in an open circuit, the reflection coefficient at the load is:
A. $\Gamma_L = -1$ with voltage minimum
B. $\Gamma_L = +1$ with voltage maximum
C. $\Gamma_L = 0$ with no standing waves
D. $\Gamma_L = +1$ with voltage maximum

Answer:

4. Why is TE the dominant mode in a rectangular waveguide?
A. It has the highest field intensity
B. It requires both dimensions to vary
C. It has the lowest cut-off frequency
D. It carries maximum current

Answer:

5. Which Smith Chart movement corresponds to moving toward the generator on a lossless line?
A. Clockwise rotation
B. Counter-clockwise rotation
C. Radial movement toward the centre
D. Vertical movement along the reactance arc

Answer:

6. A quarter-wave transformer fails to provide perfect matching when:
A. The load is purely resistive
B. The operating frequency shifts from the design frequency
C. The line is lossless
D. The source impedance equals 50 Ω

Answer:

7. Which parameter remains constant along a lossless transmission line?
A. Voltage magnitude
B. Current magnitude
C. Reflection coefficient magnitude
D. Phase of reflection coefficient

Answer:

8. For a lossless transmission line, the phase velocity, V_p, is given by:
A.
B. 1/
C.
D.

Answer:

9. Why does microstrip not support true TEM mode?
A. Fields are partly in the air and dielectric
B. Only one conductor exists
C. Cut-off frequency is non-zero
D. The magnetic field is longitudinal

Answer:

10. Which S-parameter represents reverse isolation in a two-port network?
A. S_{11}
B. S_{21}
C. S_{12}
D. S_{22}

Answer:

Q-2. Answer the following short questions briefly in the space provided. Each question carries equal marks. Each question carries 1 mark. (10 marks)

1. Define the reflection coefficient and state its values for open circuit, short circuit, and matched load.
   Answer:

2. What is a quarter-wave transformer?
   Answer:

3. State the field condition for TE and TM modes.
   Answer:

4. What is a lossless transmission line?
   Answer:

5. What is the construction of the E-plane tee?
   Answer:

6. A lossless transmission line has L = 250 nH/m and C = 100 pF/m. Find the characteristic impedance Z_0.
   Answer:

7. A quarter-wave transformer is used to match a 50 Ω line to a 120 Ω load. Find the characteristic impedance of the transformer.
   Answer:

8. Define Q-factor. Give the bandwidth relation of Q.
   Answer:

9. What Do S-Parameters Indicate?
   Answer:

10. Write a scattering (S) parameter matrix for a two-port network:
    Answer:

Q-3. Use the provided Smith Chart to perform all necessary constructions and calculations, and write the final answers clearly in the space provided. (10 marks)

A load $Z_L=30-j40\ \Omega$ is connected to a transmission line with $Z_0=75\ \Omega$. The load is to be matched to the line using a **quarter-wave transformer**.

1. The reflection coefficient Γ at the load.
2. The Standing Wave Ratio (SWR) on the 75-Ω line.
3. The input resistance Rin is seen at a distance $\lambda/4$ from the load.
4. The characteristic impedance Z_T of the quarter-wave transformer is required for matching.
5. The distance from the load where the transformer must be placed to achieve matching.

Answer:

The Complete Smith Chart

Black Magic Design

