

**M.TECH. INSTRUMENTATION AND ELECTRONICS ENGINEERING 2024-25
FIRST YEAR FIRST SEMESTER EXAM 2024**

Microwave Integrated Circuits

Time: 3Hrs.

Full Marks: 100

Question No. 2 and 4 are compulsory and answer any 6 from rest.

1. Consider a plane wave normally incident on a half-space of copper. If $f=1$ GHz Compute the propagation constant impedance and skin depth for the conductor. Also compute the reflection and transmission co-efficient. [For copper $\sigma= 5.813 \times 10^7$ s/m] [CO1] 10
2. (a) What is the utility of “Quarter-Wave Transformer” in microwave transmission line? [CO1]
(b) Suppose a load resistance $R_L= 100\Omega$ to be matched to a 50Ω line with a quarter wave transformer. Find the characteristics impedance of the matching section and plot the magnitude of the reflection co-efficient versus normalized frequency. f/f_0 where f_0 is the frequency at which the line is $\lambda/4$ long. [CO1]
5+15
3. An air-filled rectangular wave guide of inside dimensions 7 cm x 7.5cm operations in the dominant TE_{10} mode (a) Find the cut-off frequency (b) Determine the phase velocity of the wave in the guide at a frequency of 3.5 GHz also (c) Determine the guided wavelength at the same frequency. [CO2]
5+5
4. (a) What is a “Magic Tee” ? Derive the 5 parameter representation of a magic tee. 5+5 [CO3]
(b) Draw and explain the working principle of “Rat-Race ring”. [CO4] 5+5
5. A shielded strip-line has the following parameters: [CO1]
Dielectric constant of the insulator (polystyrene) $\epsilon_r=2.56$ width 25 mm, thickness 14mm and depth 70mm, Calculate the (a) The K factor, (b) the fringe capacitance and (c) The characteristic impedance of the line.
10
6. Describe the working principle of a four-part directional coupler. Derive the S-parameter representation of the coupler. [CO2]
5+5
7. With the help of typical attenuation responses diagram compare the responses of “Constant-K”, “m-derived” and composite filter in microwave frequency band. 10 [CO2]

[Turn over

8. Why an IMPATT diode exhibit differential negative resistance. Derive the power output and efficiency representation of an IMPATT diode. [CO4] 5+5
9. (a) Calculate the characteristic impedance of a micro strip line whose $\epsilon_r=5.23$, $h=7$ mm, $t= 2.8$ mm and $w= 10$ mm. [CO3]
- (b) Describe the Lithography process in MMIC Fabrication Technique. [CO3] 5+5

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