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**Reg. No. : .....**

**Name : .....**

## Eighth Semester B.Tech. Degree Examination, April 2015
## (2008 Scheme)
## 08.825 (Elective – V) : MICROWAVE DEVICES AND CIRCUITS (T)

Time : 3 Hours Max. Marks : 100

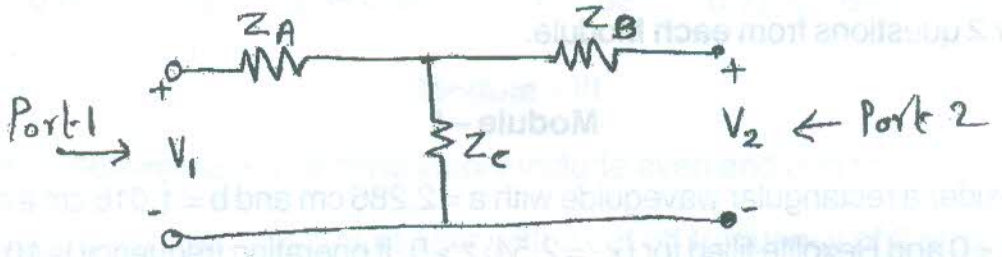
***Instruction** : Provide **Smith** charts to students on their **request**.*



PART – A

Answer **all** questions.

1. Find the Z parameters of the T-Network given below




2. Find the S-matrix of an inductor whose insertion loss is 0.3 dB and isolation 40 dB. Assume that points are well matched.

3. Explain the theory of small reflections.

4. An n-type Ga As diode has the parameters.

   Electron drift velocity, $V_d = 2.5 \times 10^5$ m/s;

   Negative electron mobility, $|\mu_n| = 0.015$ m$^2$/V.S.

   Relative dielectric constant, $\varepsilon_r = 13.1$.

   Determine the criterion for classifying modes of operation.

5. List the applications of IMPATT and TRAPATT diodes.

**P.T.O.**

6. The S parameters for the HP HFET – 102 Ga As FET at 2 GHz with a bias voltage $V_{gs} = 0$ are given as ($z_0 = 50\,\Omega$)
   $S_{11} = 0.894 < -60.6°$; $S_{21} = 3.122 < 123.6°$
   $S_{12} = 0.020 < 62.4°$ ; $S_{22} = 0.781 < -27.6°$
   Determine the stability of transistor using K-$\Delta$ test and $\mu$-test.
7. Find the width for a $50\,\Omega$ copper stripline conductor with b = 0.32 cm and $\varepsilon_r = 2.20$. If the dielectric loss tangent is 0.001 and operating frequency 10 GHz. Calculate attenuation in dB/$\lambda$. Assume a conductor thickness of t = 0.01 mm.
8. Differentiate phase and group velocity.
9. Show that a 3 port circulator can function as an isolator.
10. Write note on PIN diode switches. **(10×4=40 Marks)**

PART – B

Answer **any 2** questions from **each** Module.

**Module – I**

11. a) Consider a rectangular waveguide with a = 2.286 cm and b = 1.016 cm air filled for z < 0 and Rexolite filled for ($\varepsilon_r = 2.54$) z > 0. If operating frequency is 10 GHz. Use an equivalent transmission line model to compute reflection coefficient of a $TE_{10}$ wave incident on the interface from z < 0. **5**

    b) Design a single section quarter wave matching transformer to match a $10\,\Omega$ load to a $50\,\Omega$ line at $f_o = 3$ GHz. Determine the percent bandwidth for which the SWR $\leq$ 1.5. **5**

12. Design a double stub tuner to match a load $Z_L = 60 - j\,80\ \Omega$ to a 50 $\Omega$ line. The stubs are to be open circuited stubs and are spaced $\lambda/8$ apart. Assuming that this load consists of a series resistor and capacitor and that match frequency is 2 GHz. **10**

13. Explain the principle of operation of MESFET. Draw the equivalent circuit of MESFET. **10**

## Module – II

14. Explain the different modes of Gunn diode in detail based on the product of doping and length ($n_0L$) 10

15. A microwave transistor has the following S parameters at 10 GHz with 50Ω reference impedance.

$S_{11} = 0.45 < 150°$; $S_{12} = 0.01 < -10°$; $S_{21} = 2.05 < 10°$

$S_{22} = 0.40 < -150°$. The source impedance is $Z_S = 20\Omega$ and load impedance is $Z_L = 30\Omega$. Compute power gain, available gain and the transducer power gain. 10

16. Design an amplifier for a maximum gain at 4 GHz using single stub matching sections. The GaAs has the S parameters ($Z_0 = 50\Omega$).

| fGHz | $S_{11}$ | $S_{21}$ | $S_{12}$ | $S_{22}$ |
|---|---|---|---|---|
| 3.0 | $0.80 < -89°$ | $2.86 < 99°$ | $0.03 < 56°$ | $0.76 < -41°$ |
| 4.0 | $0.72 < -116°$ | $2.60 < 76°$ | $0.03 < 57°$ | $0.73 < -54°$ |
| 5.0 | $0.66 < -142°$ | $2.39 < 54°$ | $0.03 < 62°$ | $0.72 < -68°$ |

10



## Module – III

17. Explain in detail coupled stripline theory include even and odd mode analysis. 10

18. a) Design a low pass composite filter with a cut off frequency of 2 MHz and impedance of 75Ω. Place the infinite attenuation pole at 2.05 MHz. 7

    b) Write note on attenuators. 3

19. Write notes on microwave integrated circuits and hybrid microwave integrated circuits. 10

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