Common to CO, AE

Reg. No. : | | | | | | | | | | | |

K 6103

M.E. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Elective

Communication Systems

CO 1621 — RF SYSTEM DESIGN

(Common to ME – Applied Electronics)

(Regulation 2005)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Calculate the intrinsic wave impedance and phase velocity of an electromagnetic wave in a homogenous medium with relative permeability and permittivity are 1 and 4 respectively.

2. Write down the scattering matrix of an ideal lossless transmission line of length 'l' units.

3. State two important differences between a binomial filter and a Chebyshev filter.

4. Compute the loaded quality factor of a band pass filter that passes the S band frequencies.

5. State the important property of Schottky diode that makes it suitable for the RF usage (in comparison with a *pn*-junction diode).

6. Compare HEMT device with the MESFET.

7. Under what condition, the transducer power gain will become operating power gain?

8. Represent the 1 dB compression point of RF high power amplifier pictorially.

9. Draw the electrical equivalent of a quartz resonator.

10. Define conversion loss of a mixer.

PART B — (5 × 16 = 80 marks)

11. (a) W.r.t. 'RF behaviour of passive components' explain the significance of

(i) Skin depth

(ii) Current density

(iii) Surface mounted devices

(iv) Lead Inductance

(v) Series loss tangent

(vi) Equivalent series resistance

(vii) RF Impedance response of RFC

(viii) Distributed capacitance and series resistance of an inductor coil.

Or

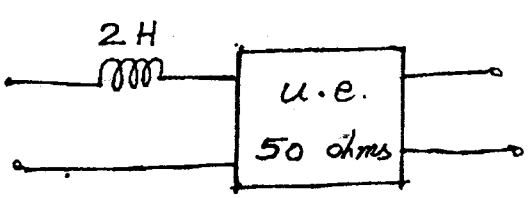
(b) (i) State and prove the phase shift property of scattering parameters.

(ii) Obtain the equation of R circles of a Smith chart.

(iii) Write down the expression of S_{11} interms of ABCD parameters.

(iv) A 5 dB waveguide attenuator is specified as having a VSWR of 1.1. Assuming that it is reciprocal, find its *S*-parameters.

12. (a) (i) Obtain the equivalent Kuroda's identity of the following circuit. (Derive the relationships)



(ii) Obtain the coefficients (g_1, g_2, g_3) of third order maximally flat filter.

(iii) Give the transformations of low pass to high pass and low pass to band pass.

Or

(b) (i) W.r.t. coupled line filters derive the expressions for Z_{oo} and Z_{oe} (odd mode and even mode characteristic impedances) interms of J invertors.

(ii) A third order filter has $g_1 = 0.7618 = g_3$ and $g_2 = 4.5381$. Assuming the fractional band width (normalized bandwidth) to be 1.5, calculate the corresponding odd mode and even mode characteristic impedances.

13. (a) (i) Draw the electrical equivalent diagram of an IMPATT diode. Explain how the 180° phase difference between the current and the voltage is obtained.

(ii) Write down the characteristic features of TRAPATT and BARRITT.

Or

(b) (i) Explain how series and shunt elements of input and output matching networks are designed from the normal Smith Chart and also from an inverted Smith Chart.

(ii) W.r.t. matching networks, explain loaded Q factor and nodal Q factor and their significance. Obtain the circle equation of the nodal Q factors to be drawn on Smith Chart.

14. (a) A micro wave transistor has the following S parameters at 10 GHz, with a 50 Ω reference impedance. The source impedance is $Z_S = 20$ ohms and the load impedance is $Z_L = 30$ ohms. Compute the transducer power gain and the stability factor

$S_{11} = 0.45 \angle 150°$
$S_{12} = 0.01 \angle -10°$
$S_{21} = 2.05 \angle 10°$
$S_{22} = 0.4 \angle -150°$.

Or

(b) (i) From the first principle, derive the expressions for the centre and radius for constant gain circles of a microwave amplifier.

(ii) Hence or otherwise obtain the centre and radius for the source gain circle of gain 2 dB. [Use the parameters given in question 14 (a)]

15. (a) (i) State and prove the conditions for the high frequency oscillator (in terms of reflection coefficients) .

(ii) With suitable theory explain dielectric resonator oscillator.

Or

(b) From the first principles derive the relationships of scattering parameters and impedances of series and shunt arms of 3 dB 90° branch line microstrip coupler. Draw the layout of the same.
