EEL 6936; RF & MICROWAVE CIRCUITS II

EXAMINATION #1 — 2/12/03 Student _____
(Print Clearly)

INSTRUCTIONS

1.) Show all work in detail. You may use CAD techniques (Mathcad, Maple, Matlab, ADS, etc.) as you see fit, but you must supply sufficient detail to allow Prof. Gordon to follow your work if you want to qualify for partial credit.

2.) If you require extra workspace to present your solution, use letter size paper similar to the examination. Do not write on the back side of any sheet. Include any Smith charts and clearly identify each problem and page, placing each page in order. Failure to comply may result in proportionate scoring penalty.

3.) The solutions that you submit must be solely the product of your effort. Don't ask each other questions, offer opinions, etc. Don't consult other people; consult only Prof. Gordon if you need clarification.

4.) The examination is due Monday, February 24, 2003, at 2:00 PM (beginning of class).

5.) Indicate your honorable conduct below. Return the signed sheet with your examination.

This work is solely the product of my effort. I have neither given nor received assistance related to this examination, and I have complied with the requirements of this examination to the best of my knowledge.

_____
(signature)

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#1) (15 Points)
Specify an "L-section" LC (one of each element) network that will match a 15 + *j*35 ohm load at 1.5 GHz to a 50 ohm source.

a) Construct the solution on the Smith chart.

b) Draw the network showing the source, load and network elements.

c) Determine the element values.

Show all work in detail.

#2) (15 Points)
Specify a "Π-section" LC (1 capacitor, 2 inductors) network with maximum node $Q_n = 3$ that will match a 60 + *j*60 ohm load at 1.5 GHz to a 50 ohm source.

a) Construct the solution on the Smith chart.

b) Draw the network showing the source, load and network elements.

c) Determine the element values.

Show all work in detail.

#3) (15 Points)
Specify a microstrip network that will match a 15 + *j*35 ohm load at 1.5 GHz to a 50 ohm source. Use a thruline and λ/4 transformer.

a) Construct the solution on the Smith chart.

b) Draw the network showing the source, load and network elements.

c) Determine the electrical line lengths and characteristic impedances.

Show all work in detail.

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#4) (15 Points)
Construct representative stability diagrams for the conditions listed. Be careful to distinguish between the unit circle and the stability circle. Indicate the stable operating values of the appropriate reflection coefficient.

a) Output stability, potentially unstable, $|S_{11}|<1$, $|S_{22}|<1$.

b) Input stability, potentially unstable, $|S_{11}|<1$, $|S_{22}|>1$.

c) Input stability, unconditionally stable, $|S_{11}|<1$, $|S_{22}|<1$.

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#5) (40 Points)
An MRF901 transistor operating at V_{CE} = 5V and I_C = 5 mA has the following operating parameters (normalized to 50 ohms) at 1.0 GHz:

$S_{11} = 0.53\underline{/178}°$,
$S_{12} = 0.09\underline{/48.0}°$,
$S_{21} = 2.93\underline{/76.0}°$,
$S_{22} = 0.40\underline{/-56.0}°$.

Determine G_T, G_P, G_A, Γ_L, Γ_S, Γ_{in}, Γ_{out}, $|\Gamma_a|$, $|\Gamma_b|$, $(VSWR)_{in}$ and $(VSWR)_{out}$ for the cases where

a) the available power gain is 11 dB,

b) the operating power gain is 9 dB, and

c) the source and load are simultaneous conjugate matched to the transistor.

In each case both $(VSWR)_{in}$ and $(VSWR)_{out}$ must be minimized.

Show all work in detail.