Name____ **SSN#**__________________________

EEL 4471 – Electromagnetics

Spring 2005

Test 1 – February 15, 2005

Closed Book/Closed Notes

1 hour and 15 minutes

1. The exam is closed-book/ closed-notes. Only the formula sheet provided with the exam may be used.

2. A calculator may be used to assist with the test. No laptops or PDAs are allowed.

3. You must circle or box your answers to get full credit.

4. Partial credit may be given provided that the grader can clearly follow your work to the extent that an understanding of the problem is demonstrated.

5. No collaboration is allowed on this examination. Only Charles Baylis or the teaching assistant may be consulted for clarification.

6. You may attach extra sheets to the exam if necessary. Each page should contain your name, the problem number, and the page number for that problem.

Please sign the statement below. YOU MUST SIGN THE STATEMENT OR YOU WILL GET A ZERO FOR THIS EXAMINATION!!!

I hereby testify that I have neither provided or received information during the test and that this test is the sole product of my effort.

Signed ____ Date______________________

PROBLEM 1 (15 points) Let V(x,t) describe the height (in meters) of a string at a distance x from the attachment of the transmission line to a generator and a time t. The voltage wave is traveling in the negative x direction. The wave has the following properties:

V_{max} = 1.2 V

λ = 0.4 m

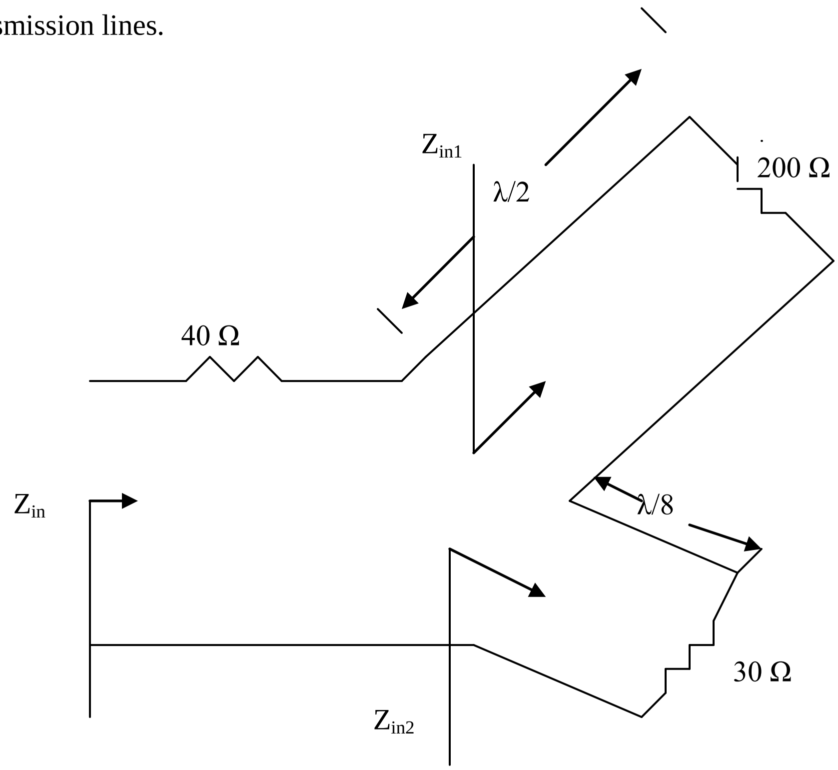
f = 500 MHz

V(x = 0, t = 0) = 0.5

(a) (10 points) Give a valid expression for V(x,t).

(b) (5 points) Using a cosine reference, write this expression as a phasor $\tilde{V}(x)$.

PROBLEM 2 (25 points): Two transmission lines are connected in series with each other and connected in series with a 40 ohm resistor. One transmission line has a length of $\lambda/2$ and is terminated in a 200 Ω load. The other line has a length of $\lambda/8$ and is terminated in a 30 Ω load. $Z_0 = 50\ \Omega$ for both transmission lines.



Find (Do NOT use the Smith Chart for this problem)

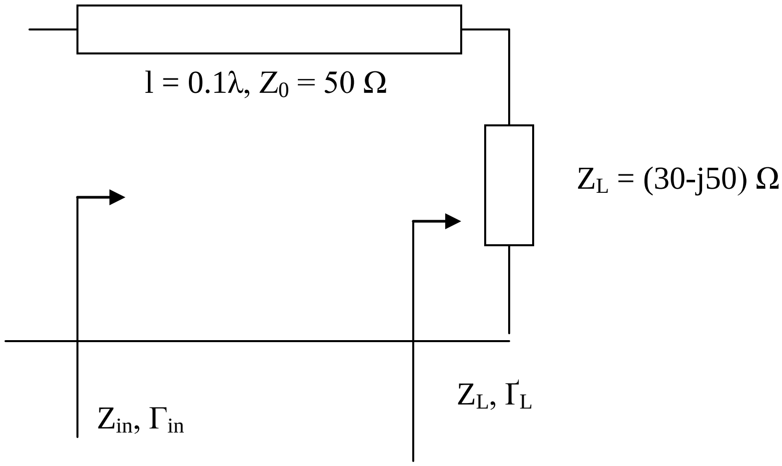
(a) (7 points) Z_{in1}.

(b) (7 points) Z_{in2}.

(c) (6 points) Z_{in}.

(d) (5 points) Γ_{in}.

(PROBLEM 3 (20 points) Consider the following circuit:



Using the Smith Chart on the following page, find

(a) (5 points) Γ_L, the load reflection coefficient (magnitude and phase).

(b) (5 points) the voltage standing-wave ratio.

(c) (10 points) Z_{in}**,** the input impedance to the transmission line.

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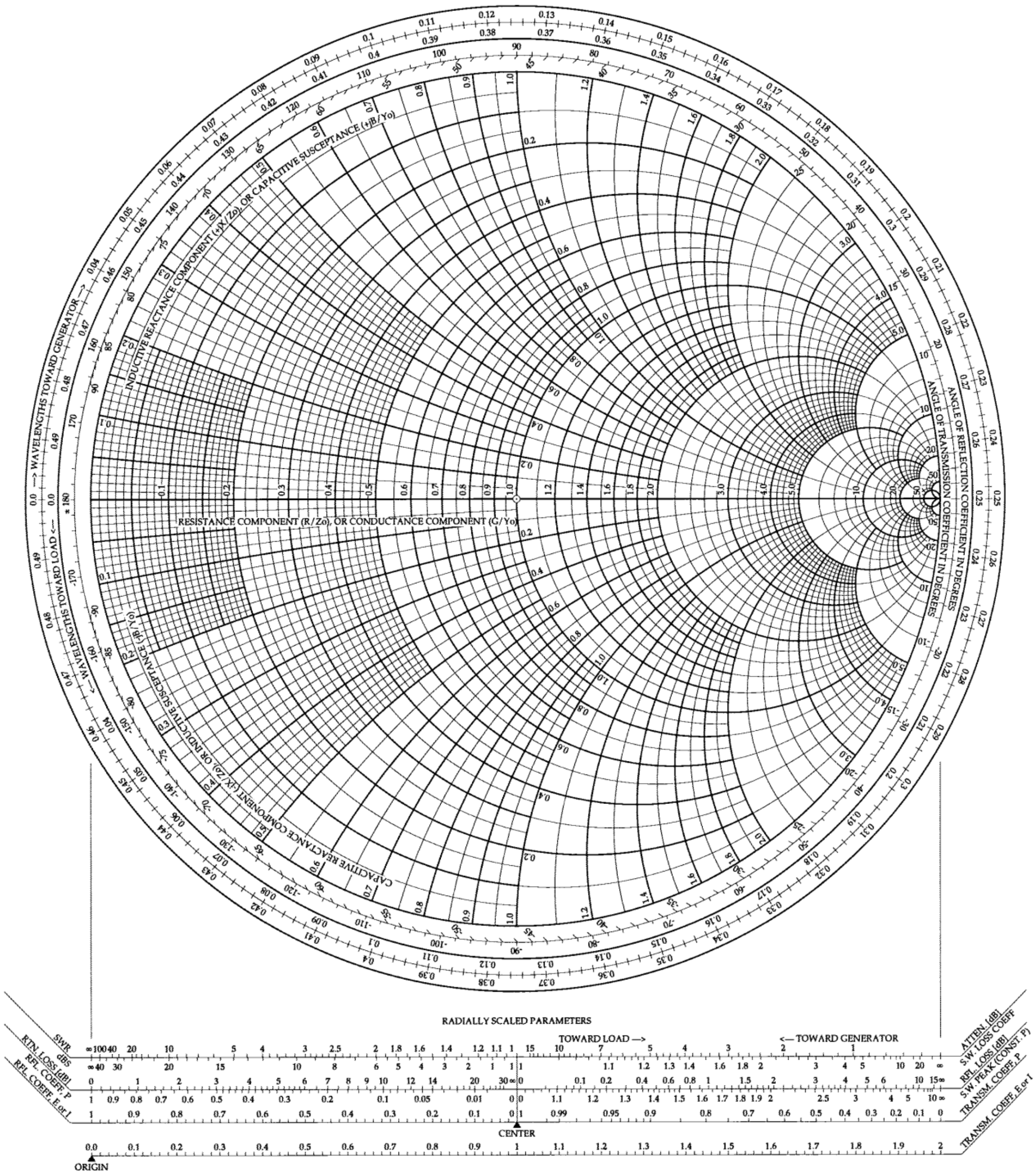
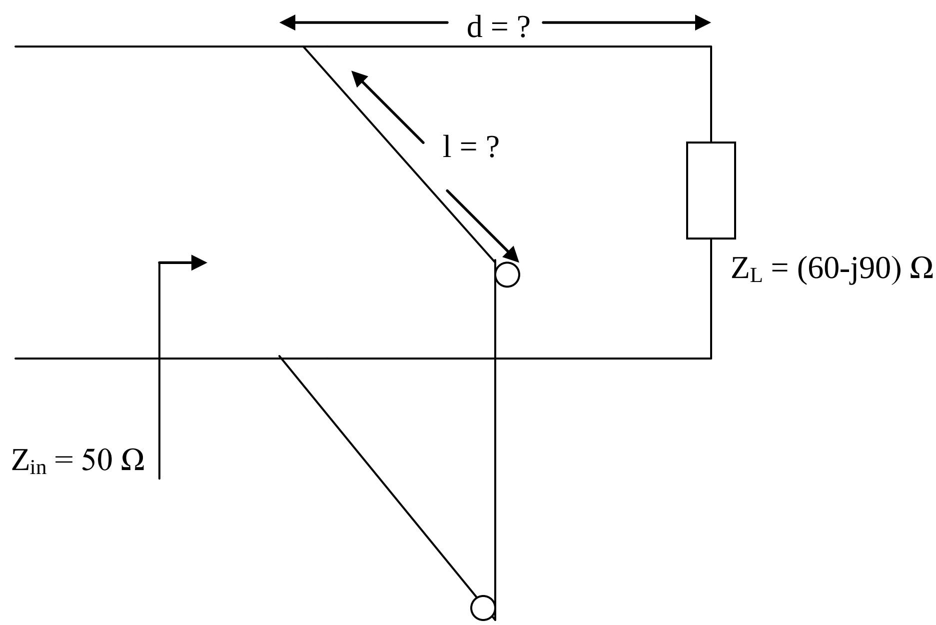
The Complete Smith Chart

Black Magic Design

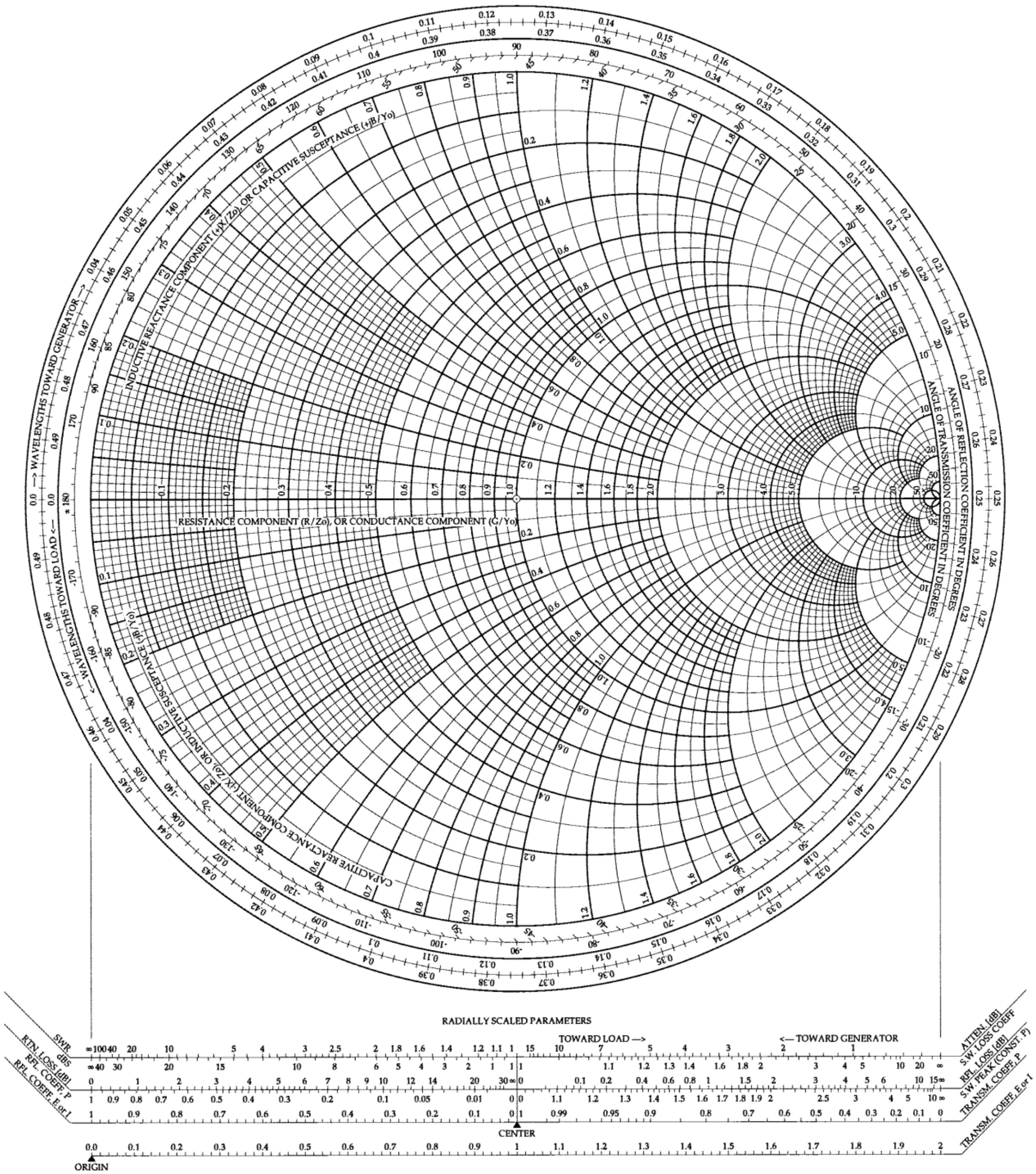


PROBLEM 4 (20 points): Use single-stub impedance matching techniques with the Smith Chart on the following page to provide Z_{in} = 50 Ω. Use a short-circuit stub and find d and l in terms of λ. Use Z_0 = 50 Ω for all transmission lines.



The Complete Smith Chart

Black Magic Design



PROBLEM 5 (20 points): Consider the vector

$$\overline{A} = \hat{r}5r^2 \sin\phi + \hat{\phi}6r^2 \cos\phi + \hat{z}r \tan\phi$$

(a) **(15 points)** Calculate the divergence of $\overline{A}$.

(b) **(5 points)** State Stokes' Theorem.