ECE 521   Fall 2010

Test (11/22/10)

Total # Pages 5
Total # Problems 4

Name_____

1.   **(20 points)**   _____

2.   **(35 points)**   _____

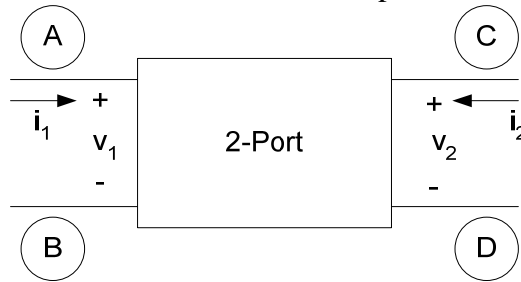**3.**   **(10 points)**   _____

4.   **(35 points)**   _____

Total (100 points)   _____

GOOD LUCK

1. The 2-port shown below is defined in terms of its *s*-parameters.

The *s*-parameters are defined as

$$b_1 = s_{11}a_1 + s_{12}a_2$$
$$b_2 = s_{21}a_1 + s_{22}a_2$$

a_k and b_k are related to v_k and i_k for $k=1,2$ by

$$a_k = v_k + z_0 i_k$$
$$b_k = v_k - z_0 i_k$$

where z_0 is the characteristic impedance. Write the MNA stamp for this element. (**20 points**)

2. Assume that the MOSFET is a 3 terminal device with $I_d = i(V_{gs}, V_{ds})$. Furthermore, assume that the charge in the device can be represented as two nonlinear capacitors from the drain and gate nodes, respectively to ground. The charge for these capacitors is described by (drain) $Q_d = q_d(V_{gs}, V_{ds})$, and (gate) $Q_g = q_g(V_{gs}, V_{ds})$. Use this information to write the Jacobian matrix and RHS stamp for timepoint n at Newton iteration $k+1$. Assume the integration method is described by $\dot{x}_n = \alpha x_n + \beta$. (**35 points**)

D

G

S
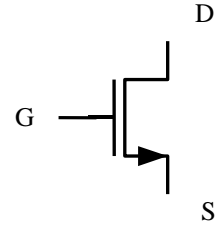
3. The Γ_σ contour for an integration method is shown below. Shade the region of absolute stability. (**10 points**)
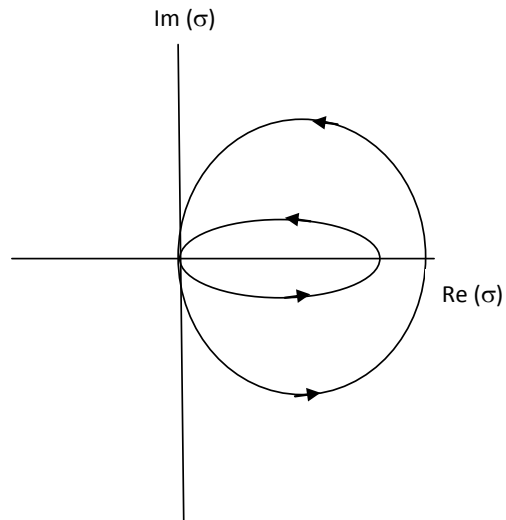
4. A linear multistep integration method is given by

$$x_n = x_{n-1} + \frac{h}{2\theta}\dot{x}_n + \frac{h}{2\theta}(2\theta - 1)\dot{x}_{n-1}$$

a) For what values of θ is this a first-order integration method. (**5 points**)

b) For what values of θ is this a second-order integration method. (**5 points**)

c) For the condition of part (a) what is the local error. (**7 points**)

d) For the condition of part (b) what is the local error. (**8 points**)

e) Write the equation for the region of absolute stability for this integration method. ***You don't need to solve the equation or draw a plot***. (**10 points**)