Carleton UNIVERSITY

FINAL EXAMINATION Fall 2006

DURATION: 3 HOURS **No. Of Students:**

Department Name & Course Number: **Systems and Computer Engineering SYSC 3600: Systems and Simulation**

Course Instructor (s): Professor H.M. Schwartz, Professor J. Bryant

AUTHORIZED MEMORANDA

CLOSED BOOK, ONE 8.5"X11.0" AID SHEET ALLOWED, CALCULATORS, AID SHEET MUST BE HANDED IN WITH THE EXAM.

Students MUST count the number of pages in this examination question paper before beginning to write, and report any discrepancy to a proctor. This question paper has 18 pages + 1 cover page = 19 pages in all

This examination question paper may not be taken from the examination room.

In addition to this question paper, students require: an examination booklet no
Scantron Sheet no

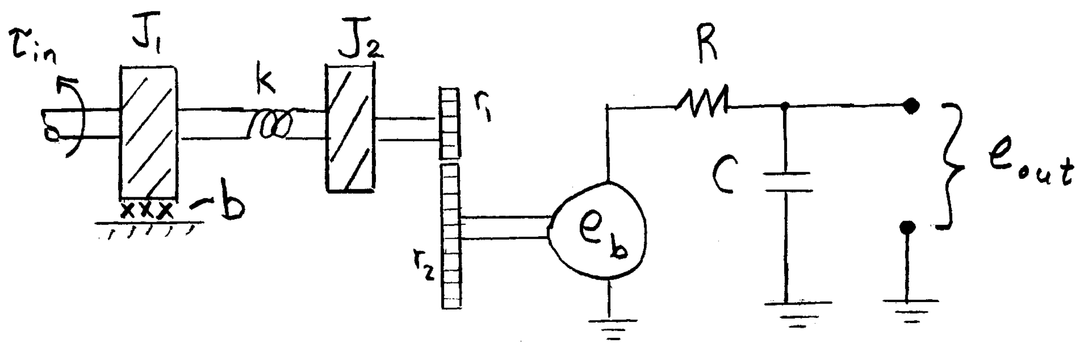
Name: ______________________________

Student Number: ______________________________

Question	Value	Score
1	10	
2	10	
3	20	
4	20	
5	10	
6	10	
7	20	
Total	100	

Question 1 (10 marks)

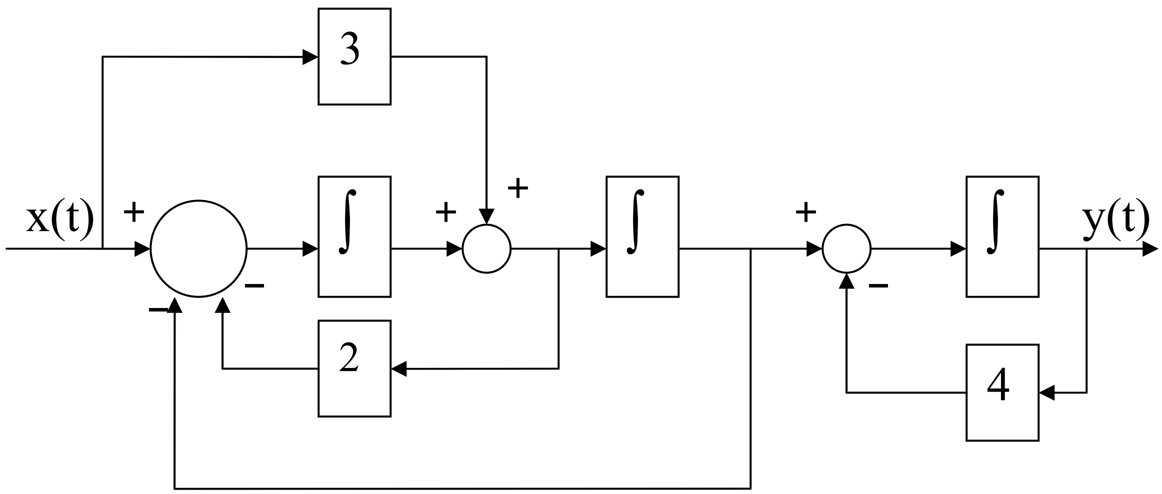
Model the following system in state variable form. Clearly indicate the state variables. The output is the voltage e_{out}. Do not draw the simulation diagram.



Question 1 extra work space

Question 2 (10 marks)

A dynamic system has the following simulation diagram. Using block diagram reduction techniques find the system transfer function $Y(s)/X(s)$.



Question 2 extra workspace

Question 3 (20 marks)

A dynamic system has the following transfer function. Find the unit step response. Show your work (while you are welcome to use a calculator to compute residues, having a programmable calculator do everything for you in one step is worth zero marks).

$$H(s) = \frac{100(s+40)}{(s+20)(s^2+40s+800)}$$

Compute the solution to the unit step response at t = 0.02 seconds and t = 1.0 seconds. Do you think your answer is correct and why?

Question 3 extra work space...

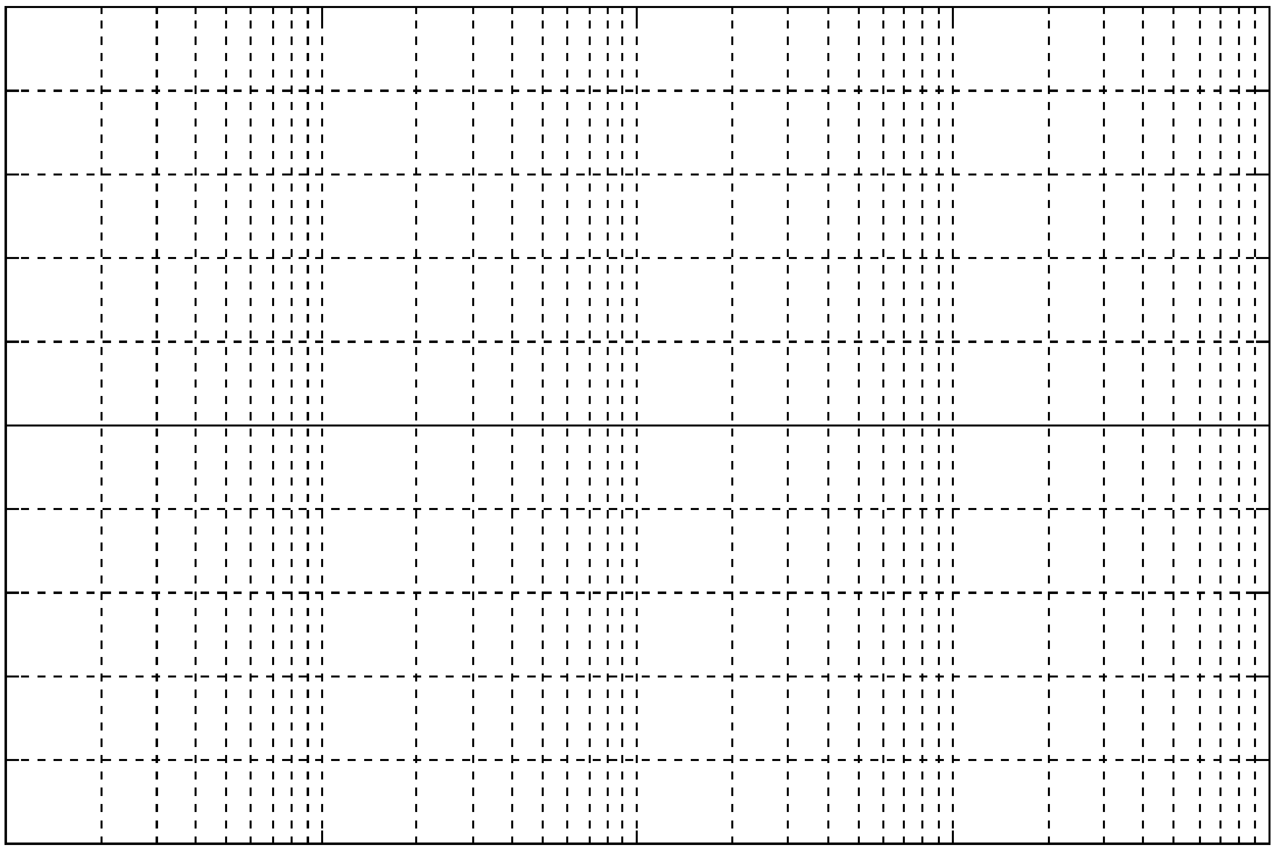
Question 4 (20 marks)

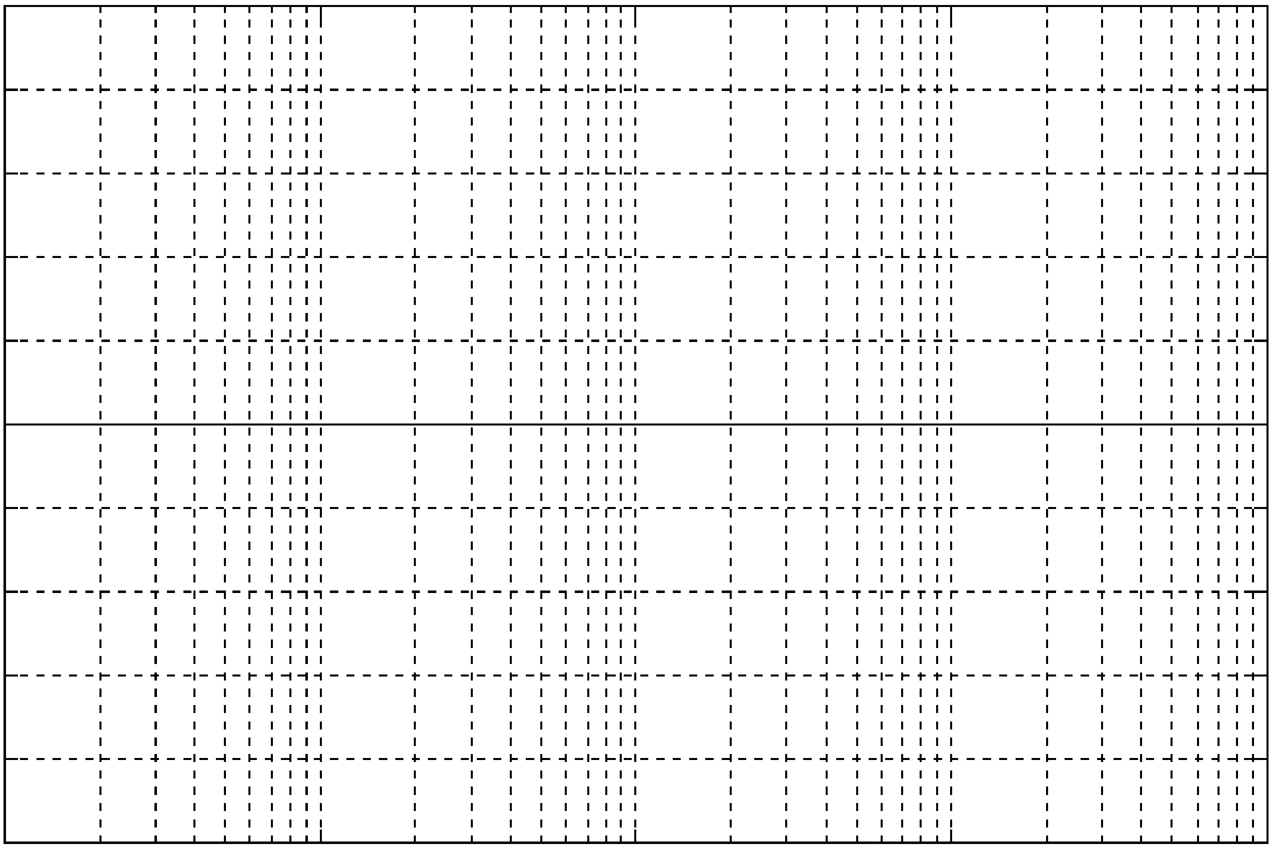
Plot the bode diagram of the following transfer function. Clearly show the slopes of the asymptotes and the height of any peaks.

$$H(s) = \frac{4000}{(s+20)(s^2+s+40000)}$$

Determine the exact phase and magnitude at the frequencies ω= 20 r/s, ω = 200 r/s. Make an accurate plot of the bode diagram on the enclosed graph paper.

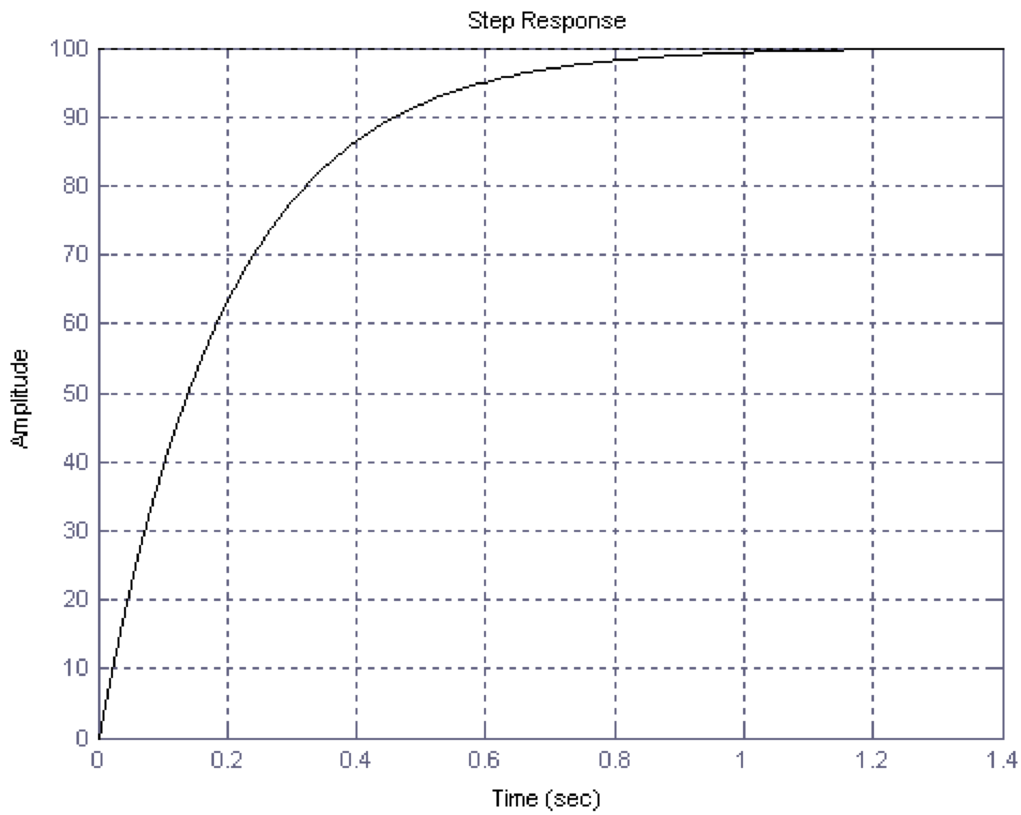
Question 4 extra work space





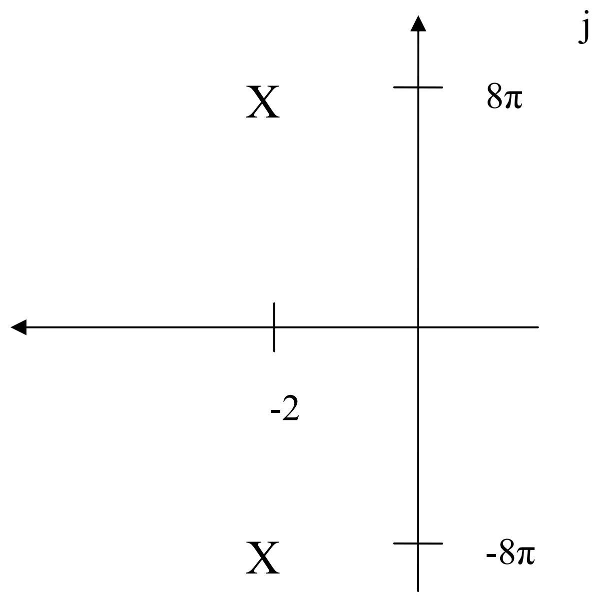
Question 5 (10 marks)

a) You are given the following unit step response for a first order system.



What is the transfer function of the system?

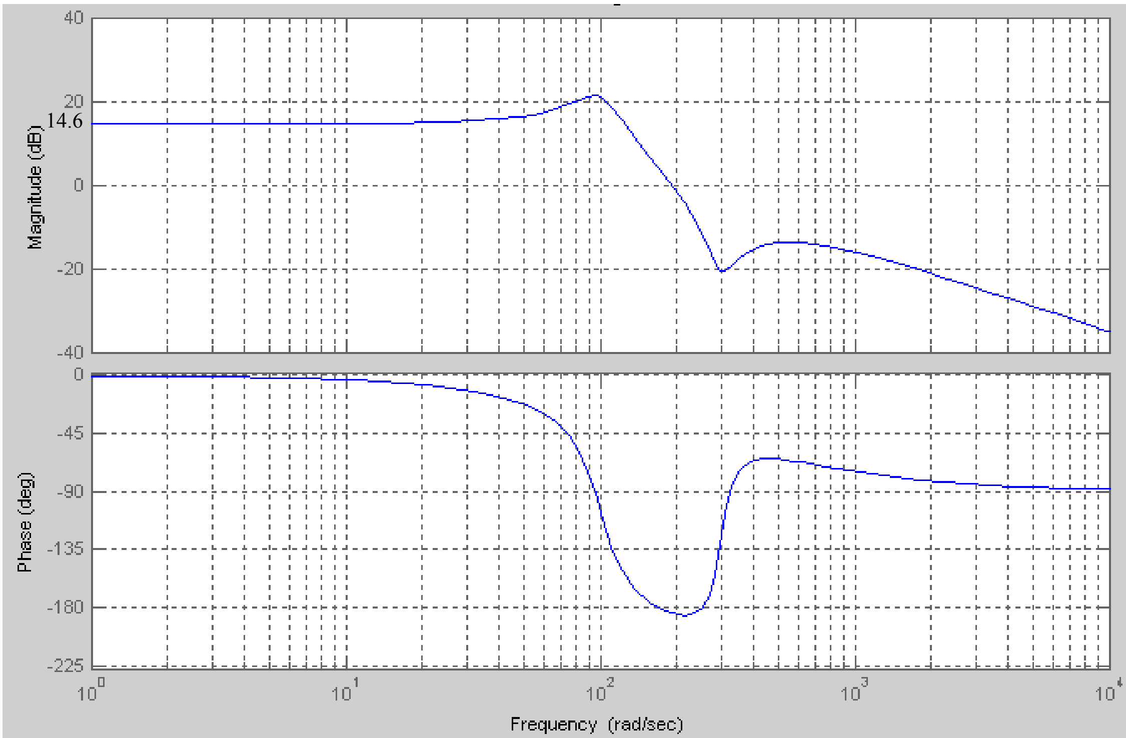
Question 5b)
You are given the following pole locations for a unity gain system (static gain equals one), there are no zeros. Roughly sketch the unit step response. Clearly indicate and explain your choice of time scale. What is the transfer function?



Question 5 extra work space...

Question 6 (10 marks)

You are given the following Bode diagram of a dynamic system.



a) What will the steady state response of the system be if the input is 20cos(300*t*)? Plot the steady state output. Clearly indicate the scaling on the axes.

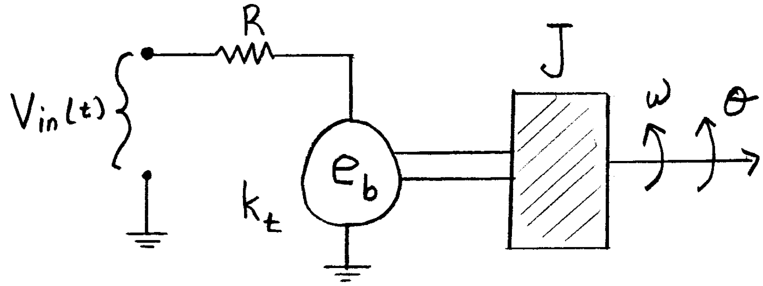
b) What will the steady state response of the system be if the input is 10*u*(t)?

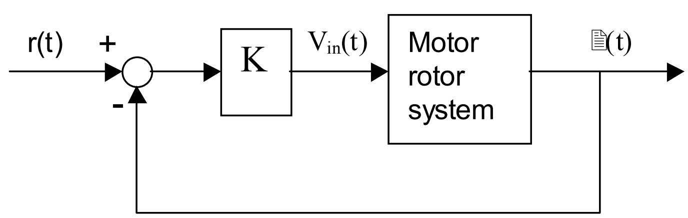
c) What will the steady state response of the system be if the input is 2cos(300*t*) + 5*u*(*t*)?

Question 6 extra space...

Question 7 (20 marks)

Consider that the following motor/rotor system is being controlled by the following position control system (similar to laboratory 2). The position of the rotor is given by angle 2 and the angular velocity is T.





a) Determine the closed loop transfer function $H(s) = 2(s)/r(s)$.

b) For R= 5 Σ, J= 0.1 kgm^2 and k_t = 1 Nm/amp, what value of feedback gain K will make the system critically damped (i.e. a damping ratio of . = 1)?

Question 7 extra work space...

Extra work space...