

Concordia University

Department of Computer Science and Software Engineering

SOEN385: Control Systems & Applications

Winter 2016

Theoretical assignment #1

Deadline:	Feb. 15, 2016 @ 23:55
Late submission:	Not accepted
Type of submission	<u>Electronic submission using EAS</u>
Evaluation:	4% of final mark

Important notes: This is an individual assignment and must be submitted electronically. Basically you should type your solutions, however, you are allowed to use your handwriting and scan some parts of your solutions for each question. Make sure your handwriting is readable by our marker. This assignment deals with problems related to Chapters 1 and 2 of the textbook. All answers must be justified.

1) [2 marks] Write the differential equation that is mathematically equivalent to the Transfer function below: $G(S) = \frac{Y(s)}{R(S)}$.

Assume that input $r(t) = t^3 \cdot u(t)$ and all initial conditions are equal to zero. (Do not solve the equation)

$$G(S) = \frac{Y(S)}{R(S)} = \frac{S^4 + 3S^3 - 5S^2 + 2S + 10}{S^6 - 4S^3 + 9S + 34}$$

2) [3 marks] An LTI (Linear Time Invariant) system is described by the following differential equation:

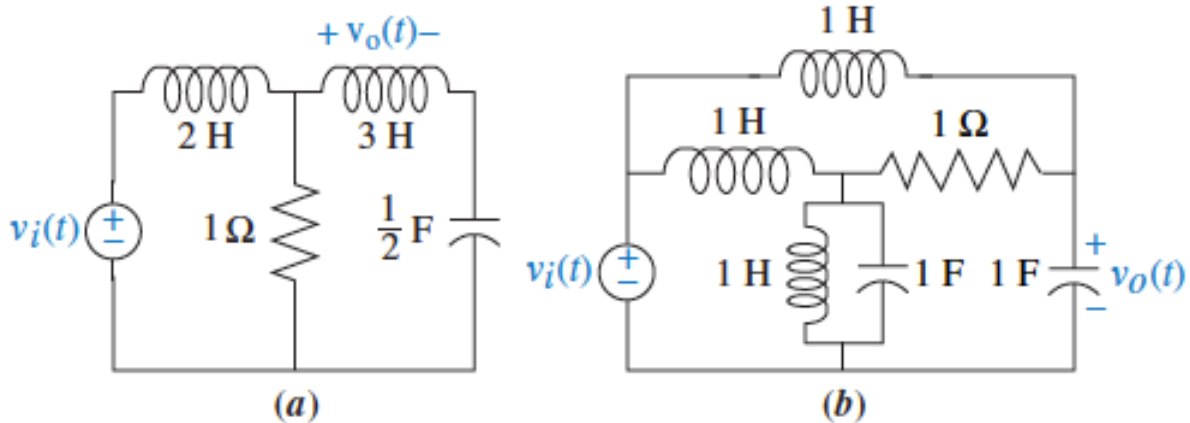
$$\frac{d^3 y}{dt^3} + \frac{d^2 y}{dt^2} + 3 \frac{dy}{dt} - 5y = r(t)$$

Input :

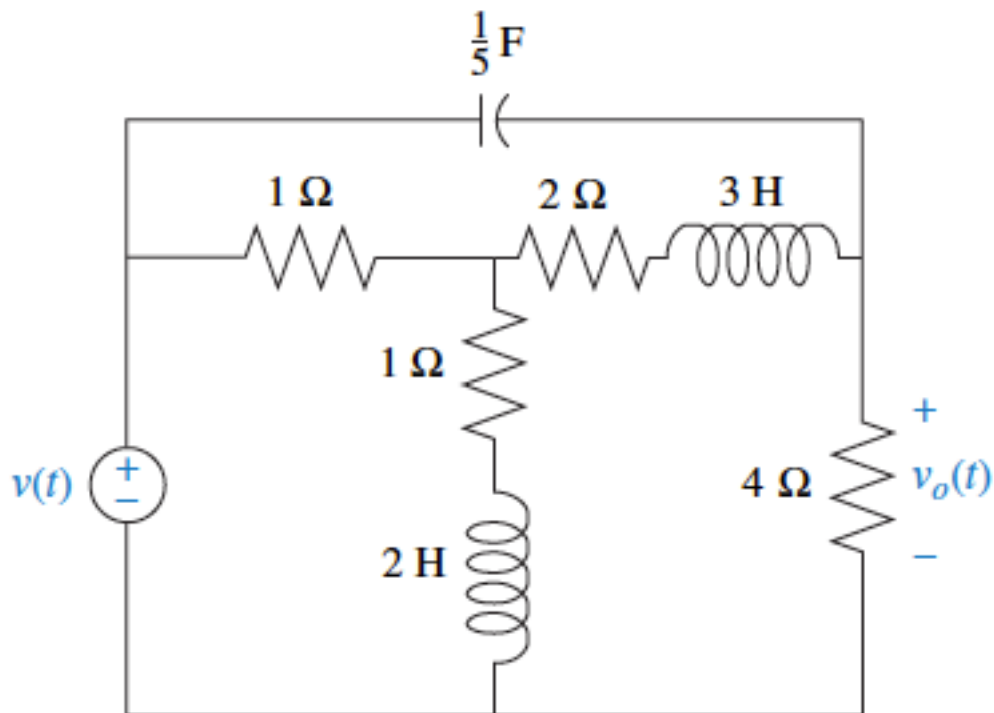
$$r(t) = 2u(t)$$

Consider the initial conditions as zero: $y(0) = 0$, $y'(0) = 0$, $y''(0) = 0$. Find the transfer function of this system as: $G(s) = \frac{Y(s)}{R(s)}$. Show a block diagram of the system. Using Laplace transform find the output of this system ($y(t)$) as a function of time.

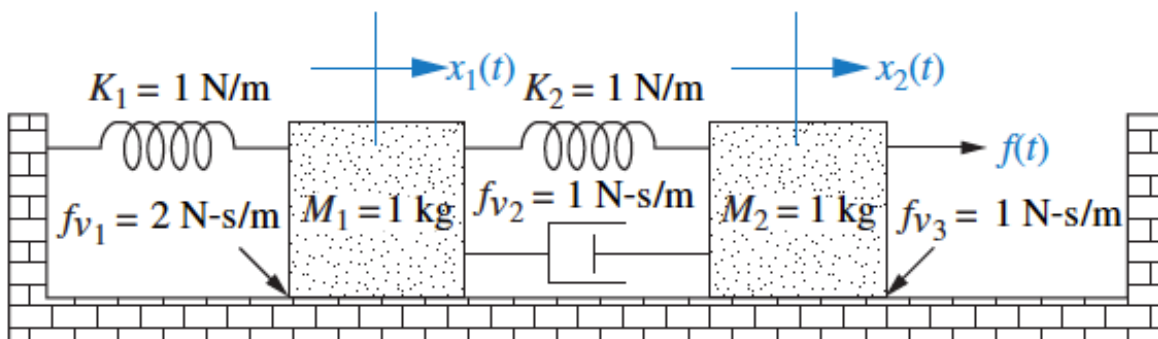
3) [4 marks] Find the transfer function, $G(s) = \frac{V_o(s)}{V_i(s)}$ for each electrical network (a and b) shown in the Figure below (Solve the problem using mesh analysis).



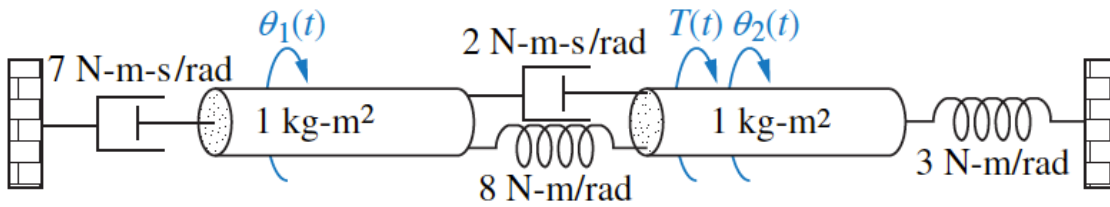
4) [4 marks] (a) Write, (but do not solve) the mesh and node equations for the network shown in figure below. (b) Use MATLAB, the Symbolic Math Toolbox, and the mesh or node equations found in part (a) to solve and find the transfer function $G(S) = \frac{V_o(s)}{V(S)}$



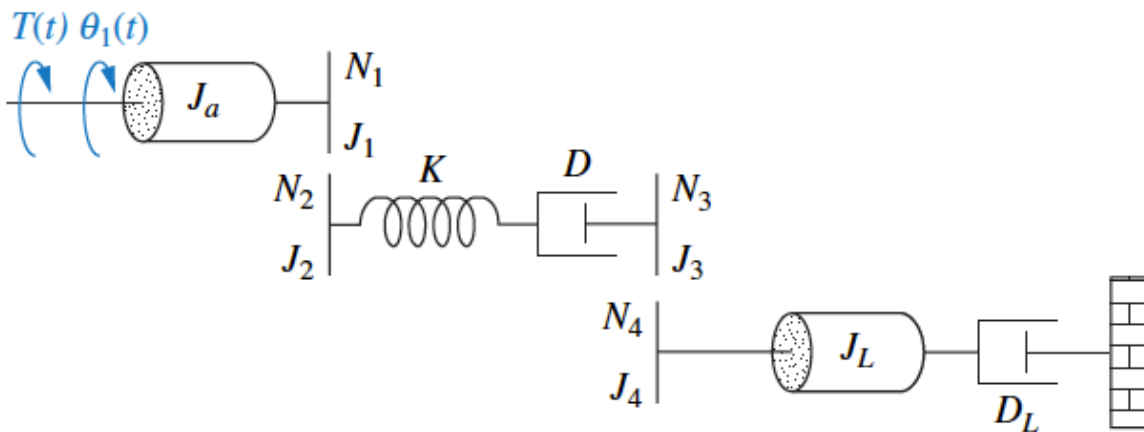
5) [3 marks] For the translational mechanical system shown in figure below, find the transfer function $G(S) = \frac{X_1(s)}{F(S)}$



6) [2 marks] For the rotational mechanical systems shown in figure below, write, but do not solve, the equations of motion.



7) [2 marks] For the rotational mechanical systems shown in figure below, write the equations of motion. Find the transfer function: $G(S) = \frac{\theta_1(s)}{T(S)}$



Deliverables:

See course outline for submission format. More details are also available at the course website. You need to look at these details/instructions prior to submitting your assignment.

Evaluation Criteria:

Marks for each question have been shown.

CEAB Graduate Attributes:

This assignments is primarily evaluating your “Knowledge Base”.

Assignment submission:

Late assignments are not accepted. Email submission of assignments are not accepted. You have to submit your assignment before the due date (**Feb. 15, 2016 @ 23:55**) using the ENCS Electronic Assignment Submission system (EAS) under the category of “Theoretical Assignment 1”.

Academic integrity:

Students are encouraged to study and work in groups and discuss and share their knowledge with each other. However, copying is strictly prohibited and all assignments to be copies would not receive any marks. Also, those students who are found copying will face severe consequences. Students should be aware and observe the academic integrity & the university’s code of conduct. For more information please refer to the course outline.