ME 132 Dynamic Systems and Feedback
Summer 2025 George Anwar

HW4

Due: Monday, July 14 at 11:59 pm

- Homework 4 is a written assignment with 3 coding question; **Please read Nise Chp. 4 and 5**.
- For coding questions, attach a screenshot of the script and output.
- Please write neatly and legibly, because if *we can't read it, we can't evaluate it.* **Box** your final answer.
- In all of the questions, **show your work**, not just the final answer. Unless we explicitly state otherwise, you may expect full credit only if you explain your work succinctly, but clearly and convincingly.
- If you are asked to provide a "sketch," it refers to a *hand-drawn* sketch, well-labeled to indicate all the salient features—not a plot generated by a computing device.
- If you have a confirmed disability that precludes you from complying fully with these instructions or with any other parameter associated with this problem set, please alert us immediately about reasonable accommodations afforded to you by the DSP Office on campus.
- **Start early. Some of the material is prerequisite material not covered in lecture; you are responsible for finding resources to understand it.**

Deliverables Submit a PDF of your homework to the Gradescope assignment entitled "{Your Name} HW1". You may typeset your homework in LaTeX or any word-processing application (submit PDF format, not .doc/.docx format) or submit neatly handwritten and scanned solutions.

1 Honor Code

I will adhere to the Berkeley Honor Code: specifically, as a member of the UC Berkeley community, I act with honesty, integrity, and respect for others. Failure to comply with these guidelines can be considered an academic integrity violation. Please email Professor Anwar ganwar@berkeley.edu or post on Ed if you have any questions!

- **List all collaborators. If you worked alone, then you must explicitly state so.**
- **Declare and sign the following statement**:

  "I certify that all solutions in this document are entirely my own and that I have not looked at anyone else's solution. I have given credit to all external sources I consulted."

Signature : _____ *Date* : _____

While discussions are encouraged, *everything* in your solution must be your (and only your) creation. Furthermore, all external material (i.e., *anything* outside lectures and assigned readings, including figures and pictures) should be cited properly. We wish to remind you that consequences of academic misconduct are *particularly severe*!

- Violation of the Code of Conduct will result in a **zero** on this assignment and may also result in disciplinary action.

2 Questions

1. Solve for $x(t)$ in the system shown in Figure P4.5 if $f(t)$ is a unit step.

$M = 2$ kg
$K_s = 6$ N/m
$f_v = 2$ N-s/m
$f(t) = u(t)$ N

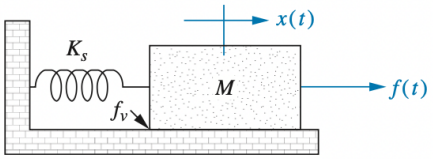

FIGURE P4.5

2. For each of the second-order systems that follow, find $\zeta, \omega_n, T_s, T_p, T_r$, and $\%OS$

   a. $T(s) = \frac{16}{s^2+3s+16}$

   b. $T(s) = \frac{0.04}{s^2+0.02s+0.04}$

c. $T(s) = \frac{1.05\times10^7}{s^2+1.6\times10^3 s+1.05\times10^7}$

3. Repeat Problem 20 using MATLAB. Have the computer program estimate the given specifications and plot the step responses. Estimate the rise time from the plots.

4. Use MATLAB's LTI Viewer and obtain settling time, peak time, rise time, and percent overshoot for each of the systems in Problem 20.

5. For each pair of second-order system specifications that follow, find the location of the second-order pair of poles.

   a. $\%OS = 12\%$; $T_s = 0.6$ seconds

   b. $\%OS = 10\%$; $T_s = 5$ seconds

c. $T_s = 7$ seconds; $T_p = 3$ seconds

6. For the system shown in Figure P4.7, do the following:

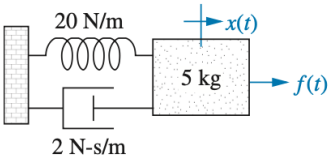

FIGURE P4.7

a. Find the transfer function $G(s) = X(s)/F(s)$.

b. Find $\zeta, \omega_n, \%OS, T_s, T_p, T_r$, and C_{final} for a unit-step input.

7. Reduce the block diagram shown in Figure P5.1 to a single transfer function, $T(s) = C(s)/R(s)$. Use the following methods:

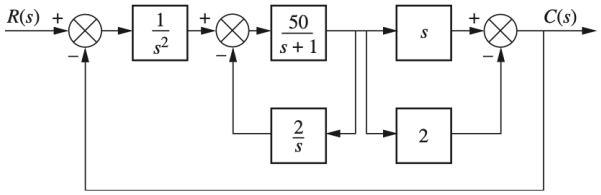

FIGURE P5.1

a. Block diagram reduction

b. MATLAB

8. Find the equivalent transfer function, $T(s) = C(s)/R(s)$, for the system shown in Figure P5.3.

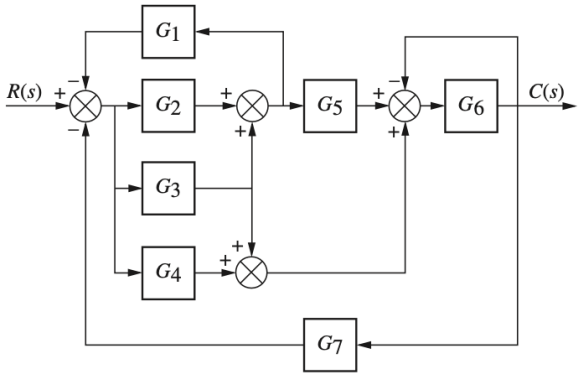

FIGURE P5.3

9. Find the unity feedback system that is equivalent to the system shown in Figure P5.7.

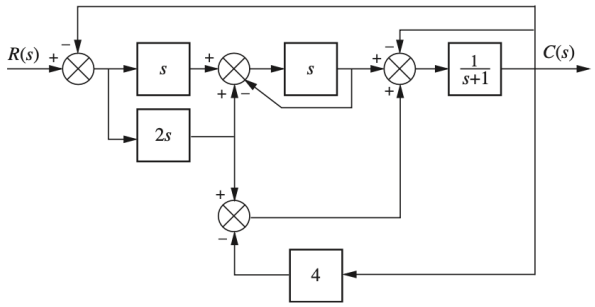

FIGURE P5.7

10. Find the value of K that yields 10% overshoot for a step input.

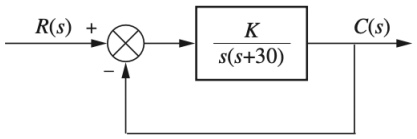

FIGURE P5.14