



Electrical Engineering Department
Faculty of Engineering
Alexandria University

Egypt

Year: 4th Communications

SEMESTER: II, 2022/2023

Course: Automatic Control Systems

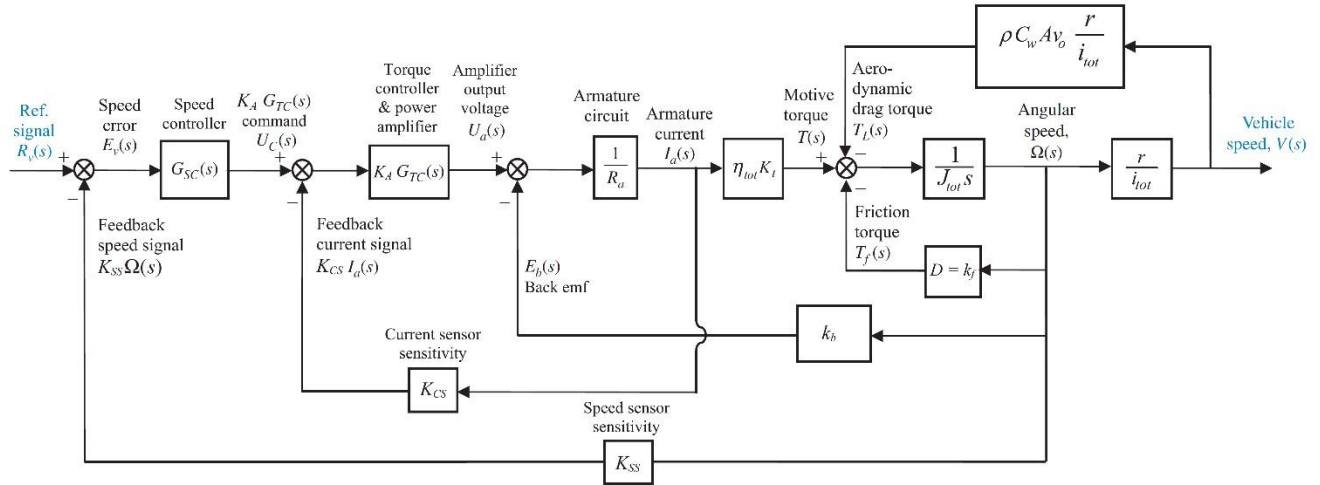
Code: EE 391

Lab Assignment 01: hybrid electric vehicles (HEV)

Objectives

- ☐ To learn to use MATLAB to represent transfer functions
- ☐ To learn to use MATLAB for system reduction
- ☐ To learn to use Simulink to represent transfer functions

Assignment



The Figure shows the block diagram of a possible cascade control scheme for an HEV driven by a dc motor with the following parameters

Parameter name	Parameter symbol and value
speed controller	$G_{SC}(s) = 100 + \frac{40}{s}$
torque controller and power amp	$K_A G_{TC}(s) = 10 + \frac{6}{s}$
current sensor sensitivity	$K_{CS} = 0.5$
Speed sensor sensitivity	$K_{SS} = 0.0433$
motor inertia	$J_{tot} = 7.226$
Motor resistor	$R_a = 1$

viscous friction	$k_f = 0.1$
Back emf constant	$k_b = 2$
Vehicle dynamics	$\frac{r}{i_{tot}} = 0.0615$
	$\rho C_w A v_o \frac{r}{i_{tot}} = 0.6154$
Motor torque	$\eta_{tot} K_t = 1.8$

1. Part 1: Simulink

- Develop a Simulink model for the original system.
- Set the reference signal input using the waveform generator block according to the first digit of your ID as will be explained later.
- Use X-Y graphs to display (over the period from 0 to 8 seconds) the response of the following variables to the step input:
 - car speed (m/s)
 - motor armature current (A)

2. Part 2: MATLAB

- Use MATLAB to obtain the transfer function $\frac{V(s)}{R_s(s)}$

3- Reference signal

- Choose the reference signal according to the first digit of your ID from the right (XXX)

X	Signal type	Parameters
0	Unit step	Step Time=0, Initial value=0, Final Value=2
1	Sin	Amplitude=2, Frequency=300, Phase=0
2	Sawtooth	Amplitude=5, Frequency=1
3	Square	Amplitude=1, Frequency=10, Phase=0, Duty Cycle=50
4	Pulse	Amplitude=1, Trigger Time=1, Duration=2
5	Unit step	Step Time=1, Initial value=0, Final Value=4
6	Sin	Amplitude=4, Frequency=200, Phase=Pi/2

7	Sawtooth	Amplitude=2.5, Frequency=10
8	Square	Amplitude=5, Frequency=5, Phase=0, Duty Cycle=80
9	Pulse	Amplitude=4, Trigger Time=2, Duration=5

Submission

Deadline Date	29 th October 2022 23:59
Submission files	<ul style="list-style-type: none">- MATLAB (.m file)- Simulink (.slx file)- A Report that includes screenshots of the following results:<ul style="list-style-type: none">➤ Part1: Simulink<ul style="list-style-type: none">• Step response of the car speed (m/s)• Step response of the motor armature current (A)➤ Part 2: MATLAB<ul style="list-style-type: none">• transfer function $\frac{V(s)}{R_s(s)}$
Note	Write your full name in ARABIC in the body of your email and your ID
Submission folders	Please upload your files in <u>a compressed folder</u> with your name and ID in this google form according to the first digit of your ID https://forms.gle/c6kkCD1qCN74EkR78