SYSC 3203: Final Exam

December 12, 2016

Carleton University, Systems and Computer Engineering

Instructions:
- This exam has **13** pages and **12** questions. Answer all questions. All questions have equal marks.
- You have **180 minutes** to complete this exam. Write your answers in the space provided.
- This is a closed book exam; however, you are permitted to bring one 8.5"×11" sheet of notes.
- You are permitted to use a non network-connected calculator.
- All components may be assumed ideal, unless stated otherwise.
- You may need the following table of filter properties.

N	$F_s(40\text{dB})$	$F_s(60\text{dB})$	$F_s(80\text{dB})$	f_n	G	f_n	G	f_n	G	f_n	G
			FILTER = Chebychev 0.10dB								
2	18.11	57.28	181.13	1.820	1.697						
4	3.10	5.41	9.55	0.789	1.384	1.153	2.542				
6	1.81	2.54	3.64	0.513	1.332	0.834	2.249	1.063	2.784		
8	1.43	1.79	2.30	0.382	1.314	0.645	2.155	0.894	2.592	1.034	2.876
			FILTER = Chebychev 0.20dB								
2	15.21	48.08	152.05	1.535	1.745						
4	2.85	4.95	8.75	0.701	1.452	1.095	2.589				
6	1.72	2.40	3.44	0.460	1.402	0.803	2.330	1.038	2.810		
8	1.39	1.73	2.21	0.343	1.386	0.623	2.246	0.878	2.642	1.021	2.892
			FILTER = Chebychev 0.50dB								
2	11.99	37.84	119.67	1.231	1.842						
4	2.55	4.42	7.78	0.597	1.582	1.031	2.660				
6	1.61	2.23	3.19	0.396	1.537	0.768	2.448	1.011	2.846		
8	1.33	1.64	2.09	0.297	1.522	0.599	2.379	0.861	2.711	1.006	2.913
			FILTER = Chebychev 1.00dB								
2	9.95	31.41	99.31	1.050	1.955						
4	2.34	4.03	7.08	0.529	1.725	0.993	2.719				
6	1.54	2.11	3.01	0.353	1.686	0.747	2.545	0.995	2.875		
8	1.29	1.58	2.01	0.265	1.672	0.584	2.489	0.851	2.766	0.997	2.930

Background: After graduation, you get a job with a company which is building exoskeletons to help elderly patients walk. The idea is to provide a power assist to the legs. As shown in the figure below, the device makes EMG measurements on the leg muscles of the device user, and uses them to drive the motors in the exoskeleton which surrounds the patient as they walk.

In this course, you have learned about many of the elements of this design, from the EMG electrodes, amplifiers, to the A/D converters and motors which form part of the design.
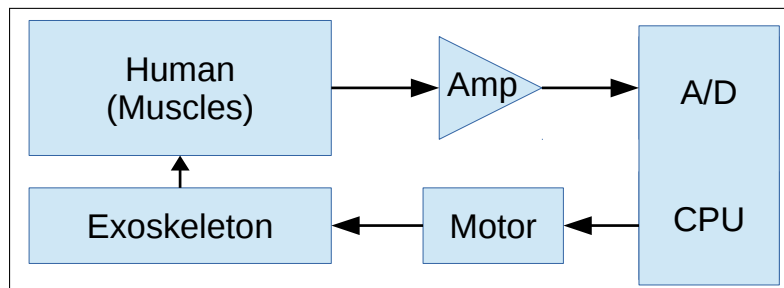

Figure: block diagram of the exoskeleton system which your future employer is asking you to design.