Lab	Aspect	Educational value	Final Project Relevance (1-5)	NEW Final Project Relevance (1-5)	time consuming?	Composite score	Reasoning
1	Grashof four-bar linkage	5	5	4	15	10.25	Core actuation concept in robotics. Four-bars are slightly less important in new final project
1	Position analysis for simple mechanisms	5	5	5	20	10	Core robotics/mechanical engineering concept
1	Non-Grashof four-bar	5	4	4	15	9.5	Core actuation concept in robotics. Four-bars are slightly less important in new final project
1	Slider crank	4	4	5	15	9.25	Important option for final project manipulator. Not very intellectually challenging.
1	Building a simple mechanism	3	5	5	15	8.75	Core robotics/mechanical engineering concept
1	SolidWorks/CAD of Six-bar mechanism	5	5	5	30	7.5	Core robotics/mechanical engineering skill
1	MOSFETS (theory)	4	2	2	2	8	Important educationally. Too low level for need in final project.
1	Relays	4	2	2	10	6	Useful physical system to compare with MOSFETs
1	NPN Transistors and their limits	4	1	1	15	3	Important educationally. Too low level for need in final project.
2	ECE experiment design to verify theory	5	4	4	10	10.75	Being able to design circuits to verify theory before moving forward with implementation is important to prevent failures later in development
2	Building simple circuits	4	3	3	5	9	ECE is a major component of Robotics Engineering, and building simple circuits is a basic skill in ECE
2	Using a signal generator	4	3	3	10	7.75	Working knowledge of common bench tools is useful for the various applications that they are useful for
2	Using an oscilloscope	4	3	3	10	7.75	Working knowledge of common bench tools is useful for the various applications that they are useful for
2	Experimental motor analysis-stall and free current	3	1	3	6	6	Useful to help derive data sheets for motors for which there are none, most motor applications will have motor data sheets though
2	Experimental motor analysis - speed/voltage	3	1	3	10	5	Useful to help derive data sheets for motors for which there are none, most motor applications will have motor data sheets though
2	Experimental limitation testing of Arduino Mega 2560 (operation time dependency)	4	3	2	20	4.25	Understanding limitations of hardware is essential to not making fatal design flaws
2	Experimental motor analysis - torque/volt	3	1	3	15	3.75	Useful to help derive data sheets for motors for which there are none, most motor applications will have motor data sheets though
2	Mathcad waveforms	3	1	1	15	1.75	Mathcad is a useful computer program for solving mathematical problems, plotting waveforms is only a small aspect of what is is capable of
2	Using LabView in tandem with Arduino	2	1	1	20	-0.75	LabView is a useful engineering toolbox that is used in industry, for the purpose of this lab students are not required to know much about how the software works
3	Interrupts	5	5	5	10	12.5	Important concept in robotics and control of time dependent systems
3	Experimental verification of position and velocity analysis	4	4	4	15	8.25	Verification of theory is important to help reinforce concepts
3	Building a slider-crank mechanism	3	5	4	15	7.75	Useful actuation mechanism, experience building the structure will provide students with a hands on experience with it providing them insight into common mistakes
3	Use Bluetooth	4	5	1	15	6	New final project does not contain Bluetooth
3	Creating PWM signals in various ways on the arduino	3	2	2	10	4.75	Theory behind different methods of performing the same action is useful to demonstrate the pros and cons of each; PWM is a very commonly used signal type
3	Algodoo	1	1	1	15	-0.75	Not engineering software. Redundant with other software/physical model
4	Implementation of experimental PID values on embedded controller	5	5	5	15	11.25	Programming PID is a core concept in robotics
4	Advanced line following (state machine)	5	5	5	20	10	State machines are a core programming concept in robotics
4	Use of included python program to help tune PID values	5	4	4	20	8.25	Use of other tools to aid in PID tuning will make tuning PID easier in the future
4	Matlab Simulink PID simulation of a physical model	5	3	3	25	5.25	Not directly applicable to final projects but helpful to understanding PID tuning.
4	Wiring H-Bridge	3	2	2	15	3.5	Few teams use an H-Bridge but instead use vex motor controllers. Still has educational value in explaining how motor controllers work.
4	Program a real-time-control system to generate PWM signals	3	2	1	15	2.5	New board will be much faster. Squeezing extra performance out of you PWM isn't as needed
4	Design, build, and test an H-Bridge driver circuit for DC motor control	3	2	2	30	-0.25	Prototyping circuits is a valuable skill. Few teams use the H-bridge as their motor controller
Possible addition	Rack and Pinion	4	2	4	15	6.75	Type of actuation method that does not receive focus
Possible addition	Lead Screw torque and force calculations	4	1	4	15	6	Type of actuation method that does not receive focus
Possible addition	MOSFETS (practical)	4	1	4	15	6	MOSFETS are useful ECE components for controlling the voltage in a circuit, currently receive little focus
Possible addition	Brushless motors	3	1	4	15	4.75	Useful mechanism design knowledge
Possible addition	Pulleys	4	1	3	20	3.75	Type of actuation method that does not receive focus
Possible addition	Pneumatic cylinder force and control	4	1	4	25	3.5	Type of actuation method that does not receive focus, Kevin apparently has them
Possible addition	Gear Train design with worm?	4	2	5	35	2.75	Useful mechanism design knowledge
Possible addition	Stepper motors	3	1	4	25	2.25	Useful mechanism design knowledge
Possible addition	Vacuum	2	1	2	15	1.5	Useful end effector knowledge
Possible addition	Solenoids (electrical)	2	1	2	20	0.25	Actuation method

Lab	Aspect	Educational value	Final Project Relivance (1-5)	NEW Final Project Relivance (1-5)	time consuming?	Composite score	Reasoning
2	Using LabView in tandem with Arduino	2	1	1	20	-1	LabView is a useful engineering toolbox that is used in industry, for the purpose of this lab students are not required to know much about how the software works
3	Algodoo	1	1	1	15	-0.75	Not engineering software. Redundant with other software/physical model
4	Design, build, and test an H-Bridge driver circuit for DC motor control	3	2	2	30	-0.5	Prototyping circuits is a valuable skill. Few teams use the H-bridge as their motor controller
Possible addition	Solenoids (electrical)	2	1	2	20	0	Actuation method
2	Mathcad waveforms	3	1	1	15	1.25	Mathcad is a useful computer program for solving mathematical problems, plotting waveforms is only a small aspect of what is is capable of
Possible addition	Vacuum	2	1	2	15	1.25	Useful end effector knowledge
Possible addition	Stepper motors	3	1	4	25	1.75	Useful mechanism design knowledge
1	NPN Transistors and their limits	4	1	1	15	2.25	Important educationally. Too low level for need in final project.
4	Program a real-time-control system to generate PWM signals	3	2	1	15	2.25	New board will be much faster. Squeezing extra performance out of you PWM isn't as needed
Possible addition	Geartrain design with worm?	4	2	5	35	2.25	Useful mechanism design knowledge
Possible addition	Pneumatic cylinder force and control	4	1	4	25	2.75	Type of actuation method that does not recieve focus, Kevin apparently has them
Possible addition	Pulleys	4	1	3	20	3	Type of actuation method that does not recieve focus
2	Experimental motor analysis - torque/volt	3	1	3	15	3.25	Useful to help derive data sheets for motors for which there are none, most motor applciations will have motor data sheets though
4	Wiring H-Bridge	3	2	2	15	3.25	Few teams use an H-Bridge but instead use vex motor controllers. Still has educational value in explaining how motor controllers work.
2	Experimental limitation testing of Arduino Mega 2560 (operation time dependancy)	4	3	2	20	4	Understanding limitations of hardware is essential to not making fatal design flaws
Possible addition	Brushless motors	3	1	4	15	4.25	Useful mechanism design knowledge
2	Experimental motor analysis - speed/voltage	3	1	3	10	4.5	Useful to help derive data sheets for motors for which there are none, most motor applciations will have motor data sheets though
3	Creating PWM signals in various ways on the arduino	3	2	2	10	4.5	Theory behind different meathods of preforming the same action is useful to demonstrate the pros and cons of each; PWM is a very commonly used signal type
4	Matlab Simulink PID simulation of a physical model	5	3	3	25	4.75	Not directly applicable to final projects but helpful to understanding PID tuning.
Possible addition	Lead Screw torque and force calculations	4	1	4	15	5.25	Type of actuation method that does not recieve focus
Possible addition	MOSFETS (practical)	4	1	4	15	5.25	MOSFETS are useful ECE components for controlling the voltage in a circuit, currently recieve little focus
1	Relays	4	2	2	10	5.5	Useful physical system to compare with MOSFETS
2	Experimental motor analysis-stall and free current	3	1	3	6	5.5	Useful to help derive data sheets for motors for which there are none, most motor applciations will have motor data sheets though
3	Use Bluetooth	4	5	1	15	6.25	New final project does not contain Bluetooth
Possible addition	Rack and Pinion	4	2	4	15	6.25	Type of actuation method that does not recieve focus
1	SolidWorks/CAD of Six-bar mechanism	5	5	5	30	7.5	Core robotics/mechanical engineering skill
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2	Using a signal generator	4	3	3	10	7.5	Working knowlage of common bench tools is useful for the various applications that they are useful for
2	Using an ociliiscope	4	3	3	10	7.5	Working knowlage of common bench tools is useful for the various applications that they are useful for
4	Use of included python program to help tune PID values	5	4	4	20	8	Use of other tools to aid in PID tuning will make tuning PID easier in the future
3	Experimental verification of position and velocity analisys	4	4	4	15	8.25	Verification of theory is important to help reinforce concepts
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4	Advanced line following (state machine)	5	5	5	20	10	State machines are a core programming concept in robotics
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