Requirements	Verification	Points
NES APU Emulator		
The Emulator must read NES ROM image audio data and communicate with the Raspberry Pi's GPIO interface using the Wiring Pi library at the clock speed of the NES.	1. Set the appropriate linker flags in the MakeFile so that Wiring Pi's code is included in the emulator's address space. 2. Then write a function to strobe the GPIO pin voltages 3. Measure the pin voltages with an oscilloscope 4. Confirm the physical behavior matches the test strobe signal specified by software.	• 2 points
Must use the Simple DirectMedia Layer library as a way of generating multimedia output.	1. View sections of the emulator's source code, specifically areas where the emulated APU is implemented. 2. Verify that the Simple DirectMedia Layer is integrated.	• 1 points
Must execute smoothly within the Raspberry Pi's Linux Environment and accurately reflect the runtime behavior of the NES.	1. Implement a software clock to measure the Emulator's cycle speed, and log clock measurements before and after critical sections. 2. Confirm that the interval displacing the two clocks approximates the same timing measurements made on the NES.	• 5 points
Emulator Media Layer Intermediary		

Must function as a transparent intermediary interface located between APU's audio output and SDL's sound buffer.	1. Measure the performance cost of the intermediary by measuring clock displacement, every time the NES is asked to fetch an instruction. 2. Verify that the intermediary marginal cycle performance cost is 0.05 milliseconds or lower.	• 2 points
The Raspberry Pi environment must have the POSIX thread library available for linking at compile time.	1. Compile the intermediary with the linker flag -lpthread set. 2. Verify that the POSIX threads are supported, when compilation should proceed without returning an error.	• 1 point
Audio Decoder		
Must satisfy frequency operating conditions within the 1 kHz-100 kHz to correctly sample audio data.	1. Directly reference the operational amplifiers datasheet and locate the Gain Bandwidth Product. 2. Check that the specified bounds form a valid subset of the frequency interval formed between 1 kHz and 100 kHz.	• 1 points
Must be able to produce continuous time analog signals of the digital audio signal output by the GPIO pins.	1. Measure the discrete GPIO pin voltages and the analog output signal 2. Capture the behavior of both over a 10 second interval of time. 3. Create plots of the signals.	• 4 points

	4. Verify that the analog output is the correct conversion of the digital input.	
Power Supply Unit		
Be able to handle a high enough frequency to operate at the resonance frequency of the coil	1. Find the resonance frequency of our coil 2. Confirm that the PWM circuit can operate at such a frequency	• 4 points
Be able to supply multiple amps worth of current into our gate (2-3 amps)	1. Select a gate driver based on our FET that we use. 2. Run current through this gate driver using a bench power supply to make sure that it can run at the rated current for the FET.	• 3 points
The MOSFETs must be able to handle at least 300 volts across source terminals without the occurrence of junction breakdown.	1. Apply 300 volts across the MOSFETs with a load that draws the correct amount of current to simulate the coil 2. Verify that MOSFETs behave correctly	• 3 points
The MOSFETs must be able to carry out the switching behavior within 10-15% of the Tesla Coil's resonant frequency.	1. Attempt switching the FETs at the rated frequency and clean the waves. 2. Ensure that MOSFETs operate correctly at resonant frequency	• 3 points

The MOSFETs must be able to remain within their appropriate operating temperature ranges as specified by their datasheet.	1. Operate MOSFETs as specified during previous requirements 2. Verify using a heat gun on the FETs that the temperature does not exceed ratings	• 2 points
Must have access to a 5V rail, and a 12V rail	1. Check that the power supply has a 5V rail and 12V rail 2. Ensure both rails are operating at their respective voltages using oscilloscope	• 1 points
The 12V rail must be able to output 200 W	1. Test the 12V using a power resistor that can withstand 200W of power. 2. Ensure that the power supply will be able to supply its maximum current rating without overheating or varying voltage	• 1 points
Step Up Air Core Transformer		
Must be rated for at least 150 W	1. Check specifications given for the power supply 2. Ensure that it is rated for at least 150W	• 1 points
The transformer should have an air core and step up the secondary terminal voltage 180-220 times the primary terminal voltage.	1. Look at our primary and secondary coil winding ratio to ensure a proper step-up voltage ratio 2. Measure the output voltage 3. Verify that the output voltage 180-220 times the input voltage	• 3 points

The transformer should be helical and the length between the inner and outer radii of the concentric coils should be small enough such that the primary and secondary coils magnetically interact, but far enough such that the primary and secondary coils electrically interact.	1. Measure all defining attributes of the transformer: like magnetizing inductance, DC resistance, primary and secondary line impedance, core resistance 2. Use these measurements to ensure that the transformer will not saturate	• 3 points
The wires used should be able to account for the skin effect when operating at our coils resonant frequency	1. Calculate the current density of copper at the switching frequency to ensure that we our not current saturating our wires 2. Use enough wires in parallel to allow enough space for the current to transfer through	• 3 points
Toroidal Top load		
The toroidal top load should function as a capacitor so it can store and release charge into the air. We want a capacitance in the range of 10-20 pF.	1. Measure the inductance and capacitance value of the coil, along with its parasitics 2. Ensure that we are seeing the capacitance granted by the top load	• 1 points

The Toroidal Top Load's aluminum coating should not noticeably deteriorate as a result of the electrical discharge.	1. Run the coil and look at the top load to ensure it does not break down. 2. After resting for an hour, rerun and verify that it still functions.	• 2 points
The toroidal top load should be the region of emission for the desired electrical discharge creating the arcs from 4-7 inches in length.	1. Run the coil 2. Ensure that the arcs produced are visible at the toroidal top and around 4-7 inches in length	• 2 points
	Heat Sink	
The heat sink must regulate device temperatures such that they stay within their appropriate ranges as indicated by their data sheets throughout the entire Tesla Coil operation cycle.	1. Measure the temperature of all of our sensitive equipment for a 2 minute test at full load and ensure that they stay within specified temperature ranges	• 1 points
The heat sink should cover the devices we want to thermally regulate.	1. Verify that the heatsink has a large surface area with fins on the outside to ensure maximum heat transfer	• 1 points