EE 344 Electronic Design Lab, 2021-22/II

List of Project Ideas Floated by Faculty

Project No. : PCP-1

Project Title	Differential voltage and current probe as front-end for signal acquisition and oscilloscope
Faculty Mentor	Prof P C Pandey <pcpandey@ee.iitb.ac.in>
Application	Instrumentation: Signal acquisition; Oscilloscope
Brief Description	Signal acquisitions systems and oscilloscopes typically have single-ended voltage inputs. Many practical applications require acquiring or displaying voltages across a pair of terminals with neither of them grounded. Many applications also require acquiring or displaying a current waveform. Inserting a resistor in the circuit for I-to-V conversion can disturb the operation of the circuit under test. For these applications, we can devise an active probe that converts a voltage across two terminals to a single-ended voltage and converts a current between two terminals to a single-ended voltage. The voltage input has very high Rin and the current input has very low Rin. The circuit is to be designed with single supply. The input terminals should have reasonable permitted voltage swing for the selected supply voltage. For example, the circuit may be designed to work with 5 V (say from a power bank) with the permitted peak-to-peak voltage swing of 2 V with reference to a selected reference voltage.
Work expected	Voltage input channel (1): Rin of 10 M ohm from each terminal to ground and inter-terminal Rin of 1 M ohm. Differential voltage gain of 1 and 10, selectable by binary control. Current input channel (1): Rin of 10 M ohm from each terminal to ground and inter-terminal Rin of less than 1 mili ohm. Trans-resistance of 1 k and 10 k V/A, selectable by binary control.
Reference, if any	--
Remarks/other comments	Mixed-signal design. Analog front-end. A microcontroller kit for generating the binary controls, signal acquisition, and display and also for generating the test outputs. A more challenging design can involve automatic level and gain control.

Project No. : PCP-2

Project Title	Clap detector for toy and appliance control
Faculty Mentor	Prof P C Pandey <pcpandey@ee.iitb.ac.in>
Application	Toy and appliance control
Brief Description	Clap is an audio signal that can be generated without any device or vocal effort. Its distinct envelope can be used for discriminating it from other environmental sounds, and a simple code can be devised for using it for controlling toys and appliances. The first part will involve a short investigation by recording multiple claps from a few persons and other commonly occurring sounds. Analyze the waveforms for the characteristics of their envelopes. Second part will involve designing a circuit that generates a pulse when a clap is detected. The third part will involve the clap related pulses and the timing information to generate the control codes.
Work expected	Investigation on the waveform analysis is to be well documented and used to justify the circuit design and the control code. The circuit is to be designed to

	work with single supply (5 V from a power bank). Microphone pre-amplifier is to be designed. In simulation stage, the testing can be done usig pre-recorded signals, bypassing the microphone and pre-amplifier.
Reference	
Remarks, other comments	Mixed-signal design. Analog front-end. A microcontroller kit for inputting the clap detector pulse to generate the control codes with error recovery etc.

Project No. : PCP-3

Project Title	Wideband electret microphone amplifier with automatic bias and gain control
Faculty Mentor	Prof P C Pandey <pcpandey@ee.iitb.ac.in>
Application	Audio systems
Brief Description	Most electret microphones have an internal FET amplifier with two-terminal connection that has to be used for powering the amplifier and receiving the signal. The variability in the FET bias current causes variable dc component, and the signal has to be ac coupled to the external amplifier. It limits the lower cut-off frequency. The objective is to develop a circuit that compensates for the dc bias current in order to amplify the signal without a lower cut-off frequency. In addition, the circuit has to provide an automatic gain control without boosting the noise. The circuit has to use a single supply.
Work expected	Fully operational circuit.
Reference	
Remarks, other comments	The design is possible using purely analog circuit, but better performance can be achieved using mixed-signal circuit with an analog front-end and a microcontroller with on-chip ADC and DAC.