

En-core 1.0 Analog Hardware Hackathon

Problem Statement

Background for DC Motor Speed Control

Motors are actuators whose input power is always electrical, while their output power is mechanical. DC motors are widely adopted in the market due to their simplicity in handling and control. One key feature of DC motors is that their shaft RPM is linearly proportional to the input voltage, and their shaft torque is directly proportional to the input current.

Problem Statement

Design an analog circuit that generates a pulse-width modulation (PWM) signal using an operational amplifier (op-amp). The PWM frequency should be 500 Hz, and the circuit must be capable of producing a duty cycle between 20% and 90%, with the ability to adjust the duty cycle as needed.

This PWM signal will then be used to switch a MOSFET to control the speed of a DC motor.

Instructions

- Teams are expected to design the schematic in KiCad and simulate the results before 3:30 PM. No PCB design is required.
- The proposed solution must be implemented on a breadboard, and teams should demonstrate unidirectional speed control of the DC motor by the deadline. Bidirectional control is optional, if teams feel confident.
- All teams will be provided with 12V DC motors, each having a no-load current of approximately 100 mA.
- Students may use all resources available in the Electronics and Telecommunication (EXTC) department laboratories to achieve their objectives.
- No digital ICs or embedded controller boards/chips are allowed.
- The use of the internet, GPTs, books, or eBooks is permitted.
- Unnecessary accumulation of components will result in a penalty.

Assessment

- Assessments will begin at 3:30 PM and may conclude by 5:30 PM.