CG1111 Engineering Principles and Practice I

Tutorial for Week 10

Filters, Sensors, and Signal Processing Basics

1. Design a bandpass filter for the 4th octave of musical notes, with a pass band from 261 Hz to 493 Hz.

2. LM35 is a commonly used temperature sensor IC chip. It can be powered by 4-30 V power supply, and the output of the sensor varies by 10 mV/°C. For example, if the output of the sensor is 250 mV, then the temperature is 25°C. Design a temperature sensing circuit using LM35, operational amplifier, appropriate resistor values, and LEDs (red and green) as follows:
    a. When the temperature is below 35°C, the green LED is ON and the red LED is off.
    b. When the temperature is above 35°C, the red LED is ON and the green LED is off.

3. A system can sample at a rate of 100 samples per second. Which of the following signals can be perfectly reconstructed after sampling by the system?
    a. $5\cos 500\pi t$
    b. $10\sin 200\pi t$
    c. $5\sin 100\pi t$
    d. $2.5\cos 50\pi t$

4. Find the condition for the sampling period (T_s) to correctly sample the signal $X(t)$, given by

$$X(t) = 5\sin 10\pi t + 2.5\sin 4\pi t + 3\sin 0.1\pi t$$