Tutorial 3

Question 1 A clinical engineer has determined that there can be common-mode noise on their patients with amplitudes as large as 100 mV. What must the minimum CMRR of their ECG be so that an ECG signal of 25 uV amplitude has no more than 1% common-mode noise?

Question 2. A clinical engineer has determined that there is a leakage current of 400 nA flowing through the patient body. The ECG instrument is grounded through the right leg of the patient. The lower body resistance is 37.5 kΩ. The ECG instrument had a common mode rejection ratio (CMRR) of 70 dB. The amplitude of the patient's ECG was 12 uV. Will this leakage current significantly interfere with the ECG signal?

Question 3 A clinical staff member has attached a patient to an ECG machine. This staff member accidently used two different types of electrodes for the ECG lead, and each electrode had a different source impedance. One had a relatively low impedance of 1500 Ω, while the other had a higher impedance of 4700 Ω . A ground electrode having an impedance of 2500 Ω was placed at the right leg of the patient which also serves as the ground of the ECG instrument. The input impedance of each differential input of the ECG machine to ground was 10 MΩ, and the instrument had a CMRR of 80 dB. The power-line displacement current to the patient was measured at 400 nA. The amplitude of the patient's ECG was 12 uV.

a. How much common-mode voltage will be seen on this patient and will it significantly interfere with the ECG signal?

b. How much power-line interference will be seen on the patient's ECG?

Question 4. Standard angiography can underestimate or overestimate coronary artery narrowing, because it only visualizes morphology of a vessel. Fractional Flow Reserve (FFR) is a complementary technique to determine the likelihood that the stenosis impedes oxygen delivery to the heart muscle (myocardial ischemia). Studies have shown that an FFR value less than 0.80 corresponds to inducible ischemia, and most likely will require interventional treatment.

1) Briefly describe the working principle of FFR;

2) If measured distal end coronary pressure is 60 mmHg and the proximal end is 85 mmHg, does this plaque require interventional treatment? Why?