M.E.(ETC) 2nd Semester Examination, 2013

Advanced Instrumentation (ETC-1014)

Time: 3 hours Full marks: 70

Answer any five questions

1. Develop the hardware and algorithm of a microcontroller based signal conditioning unit to measure the response of an impedance sensor. The specifications are:
   i) Amplitude of applied sine wave:<50mV with a low dc offset within 1mV(to be generated without using any high power sine wave generator)
   ii) Frequency of operation—200Hz, 1kHz and 10kHz.
   iii) Impedance of sensor resistance varies from 1kΩ to 10kΩ
   iv) Minimum impedance change to be measured: 0.1kΩ
   v) Sensitivity maximum at a particular frequency.
   vi) Maximum sensitivity has to be displayed on LCD.

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2a. Design a scheme to measure a wide dynamic range of resistance from 10MΩ to 10kΩ with a resolution of 0.1% in the entire range.
b. Why a Wheatstone Bridge configuration is preferred in the dc measurement of a resistive sensor which is temperature dependent?

(9+5)

3a. What are the different types of electrodes used for biopotential measurements? Draw an equivalent circuit for such electrodes explaining the physical origin of all the components in the circuit.
b. Why isolation is important in bioelectric measurements? Discuss an optical and electrical isolation scheme.

(6+8)

4a. Design an instrumentation scheme for continuous monitoring of systolic and diastolic pressure.
b. Discuss the method of counting the blood cells by impedance technique.

(7+7)

5a. Why MOS transistors are used in the design of ASIC chips?
b. Obtain the small signal voltage gain for the following:
i) Constant current source load common source MOS amplifier.
ii) Diode connected load common source MOS amplifier

(4+10)

6a. Obtain the common mode rejection ratio for a double ended differential amplifier with mismatched load resistances.
b. Indicate the various capacitances associated with a MOS transistor.

(11+3)

7a. Explain physically the reason for higher differential gain in a single ended differential amplifier. Derive the expression of common mode voltage gain of such an amplifier.
b. Sketch V_{out} vs V_{in} as V_{in} varies from 0 to Vdd in Fig.1. Also obtain the small signal gain. (7+7)

8. Assuming no symmetry, calculate the small signal voltage gain in Fig.2. 14

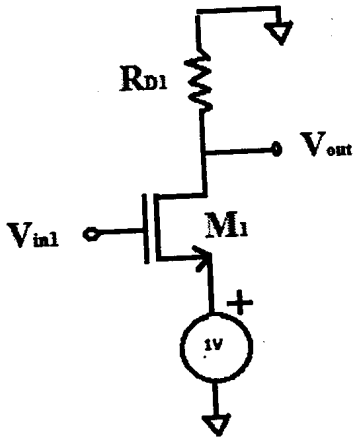

Figure 1

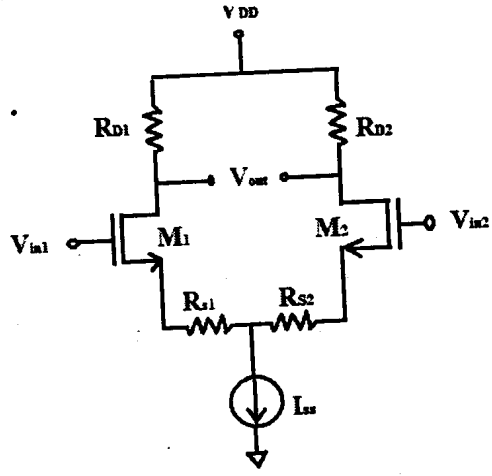

Figure 2