Second Class Test *for* ***Industrial Instrumentation*** **(EE60031/EE41001)**

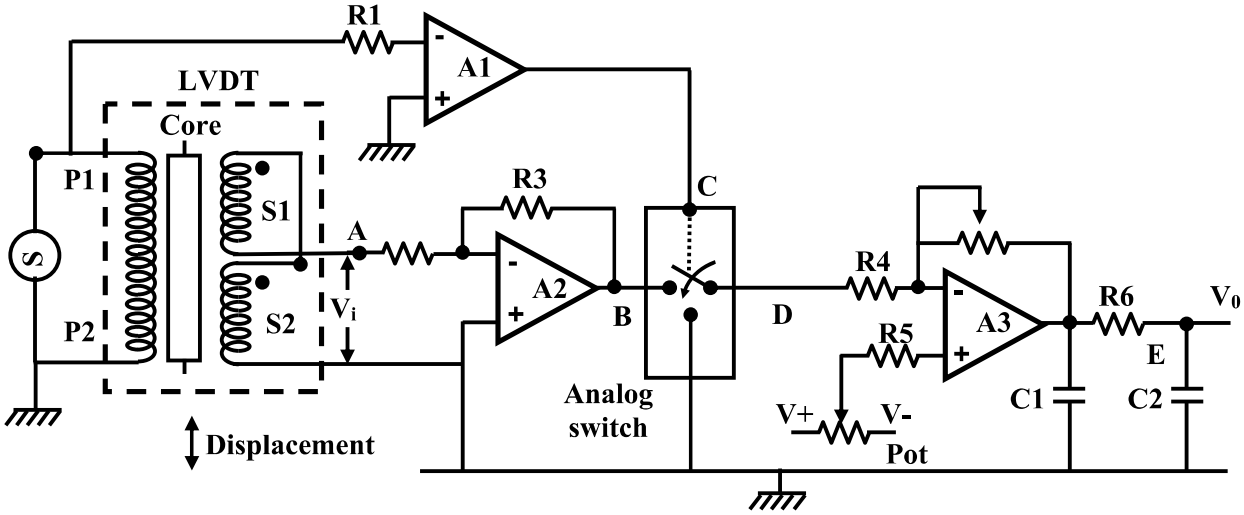
Date: October 07, 2021 **Time:** 05:00PM – 06:30PM **Full Marks:** 90

Answer ALL questions. State your assumptions. Follow the instructions provided.

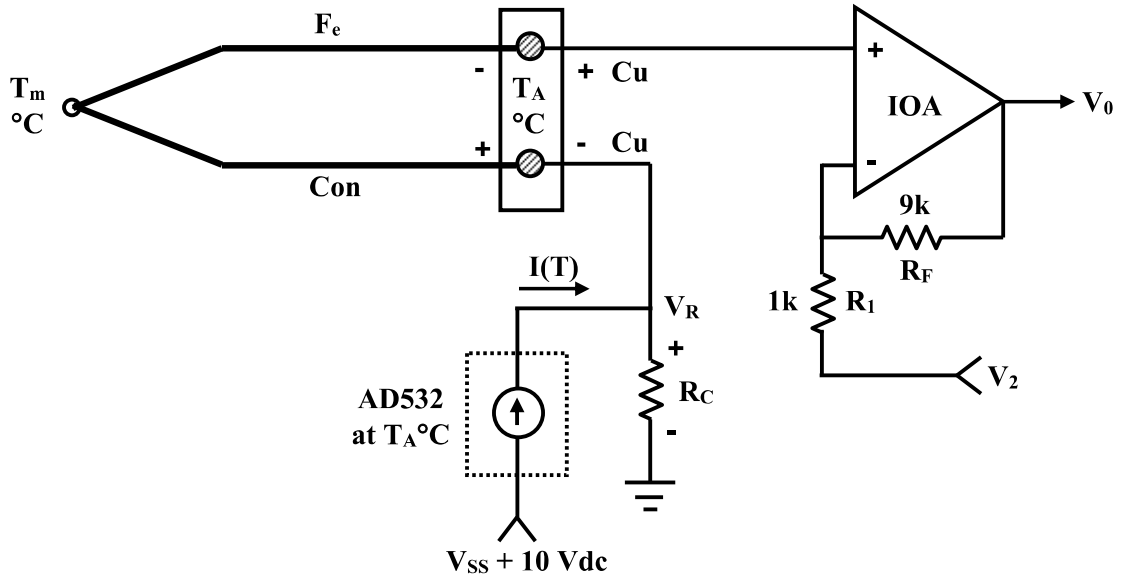
---

1. **(a)** Explain the operation of an LVDT and the need for phase sensitive demodulation of its output **[10+10]**

(b) The circuit in the figure below is for phase sensitive demodulation of the LVDT output. Sketch the waveforms at A, B, C, D and E assuming sinusoidal high frequency (ω_s) excitation at the LVDT primary, for a displacement function which is sinusoidal at a low frequency (ω_m) **[25]**



2. The circuit of figure below uses an AD532 temperature-to-current sensor instead of an ice bath as a temperature reference for an Iron-Constantan thermocouple. For $V_{SS} > 4V$, the dc current sourced by the AD532 IC is given by: $I(T) = (T + 273)10^{-6}$ A. T is in °C. Assume the op-amp is ideal. $R_F = 9\,k\Omega$, $R_1 = 1\,k\Omega$, The thermoelectric sensitivities of the various materials involved in the circuit below are given as : $S_{Fe} = 18.5\,\mu V/°C$, $S_{Con} = -35.0\,\mu V/°C$, $S_{Cu} = 6.5\,\mu V/°C$, which may be assumed to be constant over the range of measurement. Assume all components of the electronic circuit and the copper wires to be at temperature T_A.



(a) Derive a general algebraic expression for $V_0 = f(T_m, T_A,$ circuit parameters). **[15]**

(b) Find numerical values for R_C and V_2 that will make the expression of $V_0 = KT_m$ exactly, that is proportional to T_m and independent of T_A. **[15]**

(c) Find the numerical value of K. **[15]**

End of Question Paper