Homework #1

1) The standard resistor arm of the bridge shown in Fig. P-1 has a range from 0 to 100 Ω with a resolution of 0.001 Ω. The galvanometer has an internal resistance of 100 Ω and can be read to 0.5 μA. When the unknown resistance is 50 Ω, what is the resolution of the bridge in both ohms and percent of the unknown? (Ans. 0.01 Ω)

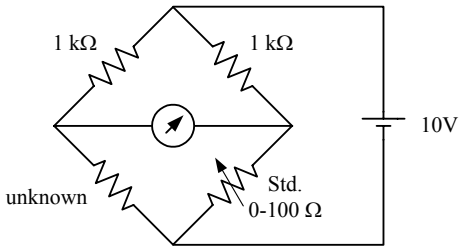

Fig. P-1

2) The ratio arms of the Kelvin bridge of Fig. P-2 are 100 Ω each. The galvanometer has an internal resistance of 500 Ω and a current sensitivity of 200 mm/ μA. The unknown resistance R_x = 0.1002 Ω and the standard resistance is set a 0.1000 Ω. A dc current of 10 A is passed through the standard and the unknown form a 2.2 V battery in series with a rheostat. The resistance of the yoke may be neglected. Calculate (a) the deflection of the galvanometer, and (b) the resistance unbalance required to produce galvanometer deflection of 1 mm. (Ans. (a) 400 mm, (b) 0.5 μΩ)

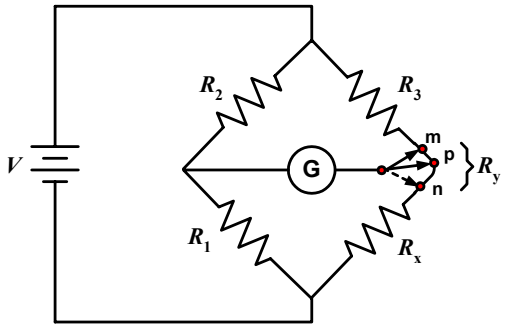

Fig. P-2

3) A bridge as shown in Fig. P-3 is balance at 1,000 Hz and has the following constants: AB, 0.2 μF pure capacitance; BC, 500 Ω pure resistance; CD, unknown; DA, R = 300 Ω in parallel with C = 0.1 μF. Find the R and C or L constants of arm CD, considered as a series circuit. (Ans. R = 34.3 Ω L = 29 mH)

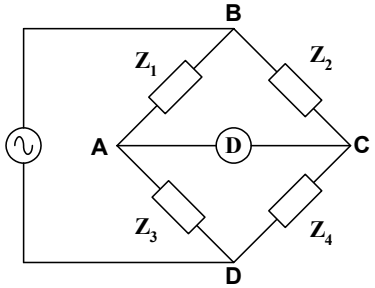

Fig. P-3

4) Verify that the ac bridge (Anderson bridge) in Fig. P-4 can be used to find the components of a given coil, L_x and R_x as follows.

$$R_x = \frac{R_2}{R_1} R_3$$

$$L_x = C\left[R_2 \left(R_1 + R_5 \right) + R_1 R_5 \right] \frac{R_3}{R_1}$$

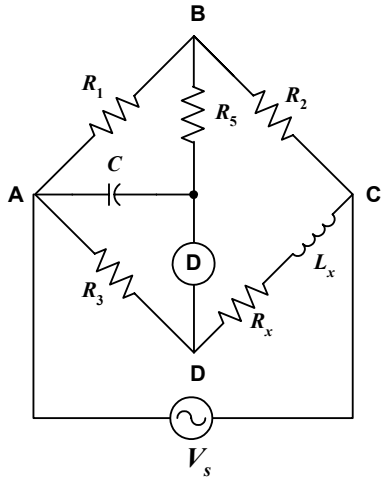

Fig. P-4

5) Campbell bridge in Fig. P-5 can be used to find the inductance and mutual inductance of coils. Under the balance condition, prove that the following equations can be obtains.

$$M = C_1 (R_2 R_3)$$

$$\frac{L}{M} = (1 + \frac{R_1}{R_3})$$

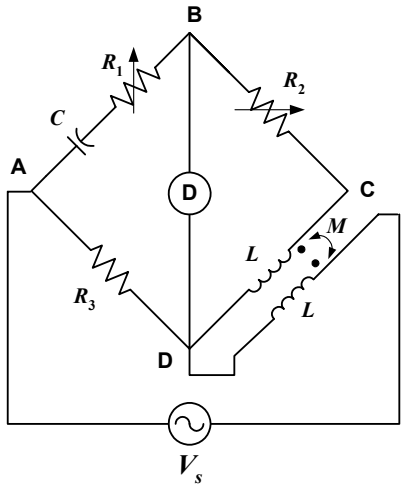

Fig. P-5

6) A certain type of pressure transducer, designed to measure pressure in the range of 0-10 bar, consists of a diaphragm with a strain gauge cemented to it to detect diaphragm deflection. The strain gauge has a nominal resistance of 120 Ω and forms one arm of a Wheatstone bridge, with the other three arms each having a resistance of 120 Ω. The bridge output is measured by

an instrument whose input impedance can be assumed infinite. If, in order to limit heating effects, the maximum permissible gauge current is 30 mA, calculate the maximum permissible bridge excitation voltage. If the sensitivity of the strain gauge is 338 mΩ/bar , and maximum bridge excitation voltage is used. Calculate the bridge output voltage when measuring a pressure of 10 bar. (7.2 V and 50 mV)