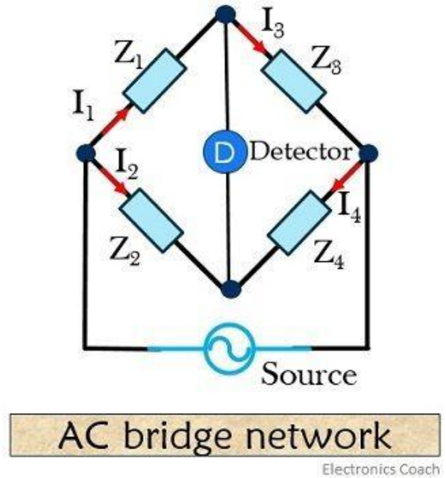
Experimental No. (6)
AC bridge meter

Phys Lab 2

Dr. Ishaq Musa

AC Bridges

Definition: AC bridges are the circuits that are used for the measurement of **electrical quantities** such as inductance, capacitance, resistance.

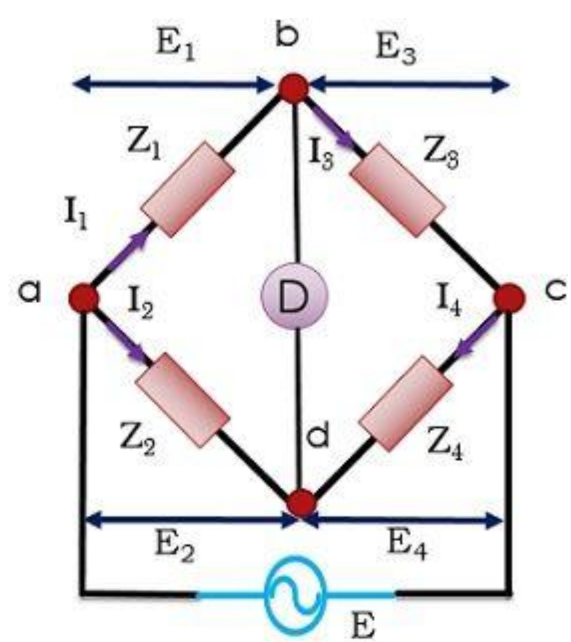


there are 2 conditions in order to balance the bridge-

1- The detector current I_d should be zero.

2- The potential difference between the detector node should be zero

AC Bridges general balance equation



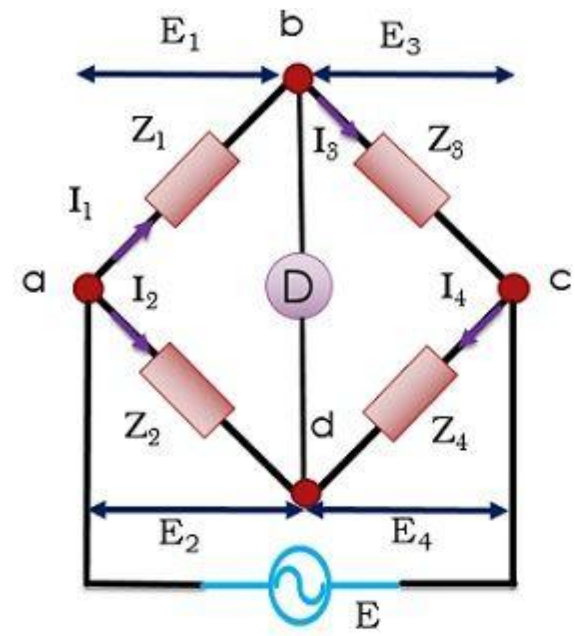
The current through detector must be 0 that requires the potential difference V_{bd} to be 0.

In such a condition voltage drop from a to b will get equal to voltage drop from a to d, both in magnitude and phase.

$E_1 = E_2$

Applying ohms' law

$I_1 Z_1 = I_2 Z_2$



At balance

$$I_1 = I_3 = \frac{E}{Z_1 + Z_3}$$

$$I_2 = I_4 = \frac{E}{Z_2 + Z_4}$$

Substituting the value of I_1 and I_2

$$Z_1 Z_4 = Z_2 Z_3$$

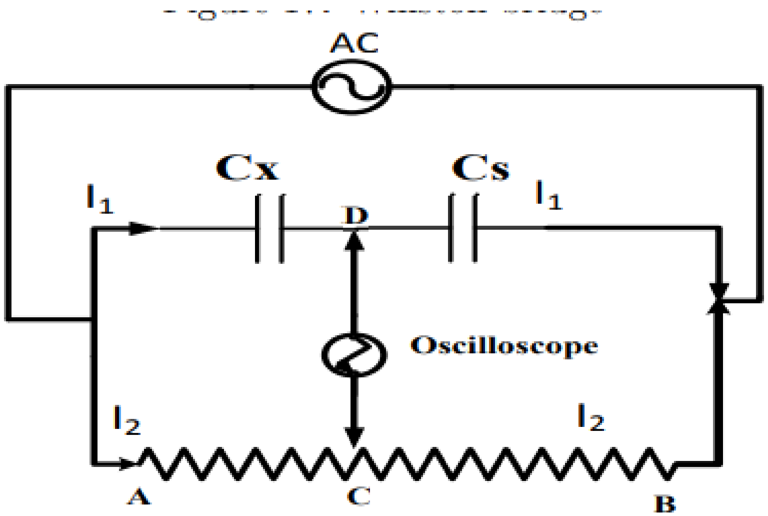
Experiment

$$V_{DC} = V_D - V_C = 0, \quad So \quad V_{AD} = V_{AC}$$

$$I_1 Z_{c_x} = I_2 R_{AC}$$

$$\frac{I_1}{\omega C_x} = I_2 \frac{\rho L_{AC}}{Area\ of\ the\ wire}$$

→ Eq.1



$$V_{BD} = V_{BC}, \quad So \quad I_1 Z_{c_s} = I_2 R_{BC}$$

$$\frac{I_1}{\omega C_s} = I_2 \frac{\rho L_{BC}}{Area\ of\ the\ wire}$$

→ Eq.2

Divided Eq. 1 by Eq.2

$$C_x = C_s \frac{L_{BC}}{L_{AC}}$$

Note: Impedance of capacitor

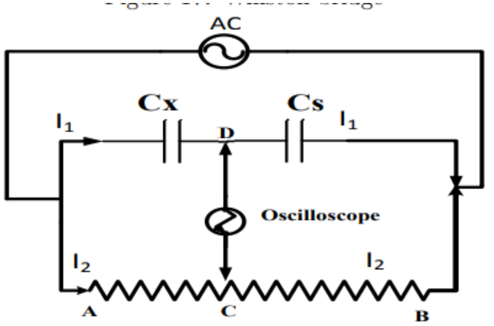
$$Z_C = \frac{1}{\omega C}$$

Experimental Procedure

Part 1

Cx1= 470 micro Farad

$C_s(\mu F)$	$L_{BC}(cm)$	$L_{AC}(cm)$	$\frac{L_{AC}}{L_{BC}}$
68			
100			
470			
1000			
$Draw C_s Vs. \frac{L_{AC}}{L_{BC}}, Slope = C_{x1} = ...$			



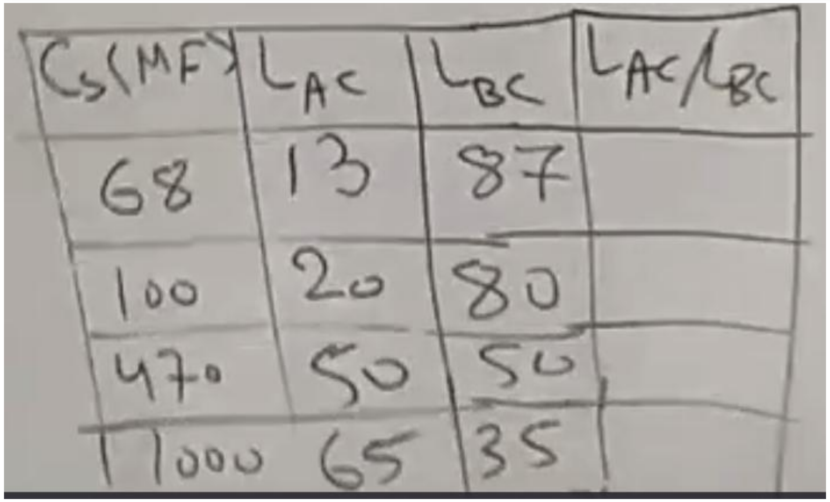
Sample calculation:

$$C_x = C_s \frac{L_{BC}}{L_{AC}}$$

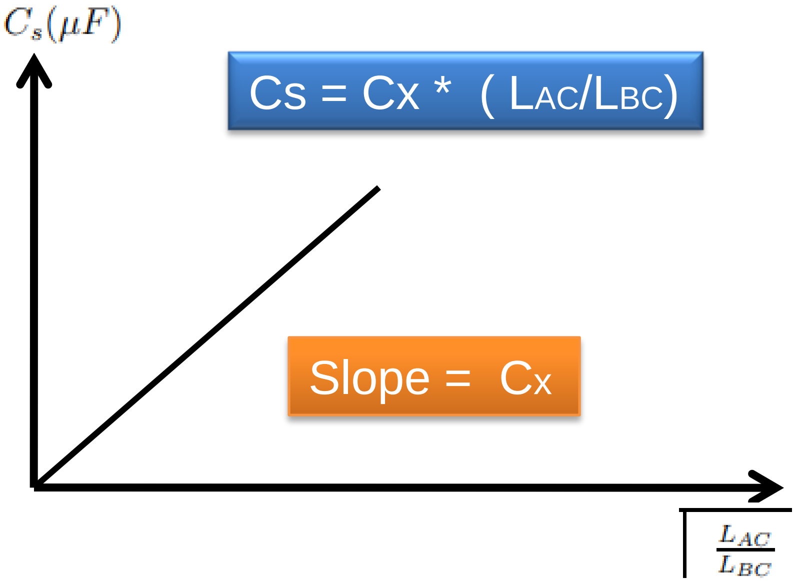
Cx = 68 Micro.Farad (87 cm/13 cm)

Cx = 455 Micro Farad

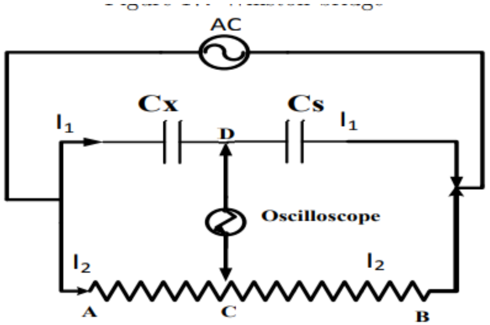
Data of Experiment from record Video



Cs(MF)	LAC	LBC	LAC/LBC
68	13	87	
100	20	80	
470	50	50	
1000	65	35	



Experimental Procedure



Part 2

Cx2= 220 micro Farad

$C_s(\mu F)$	$L_{BC}(cm)$	$L_{AC}(cm)$	$\frac{L_{AC}}{L_{BC}}$
68			
100			
470			
1000			

$Draw C_s Vs. \frac{L_{AC}}{L_{BC}}, Slope = C_{x1} = ...$

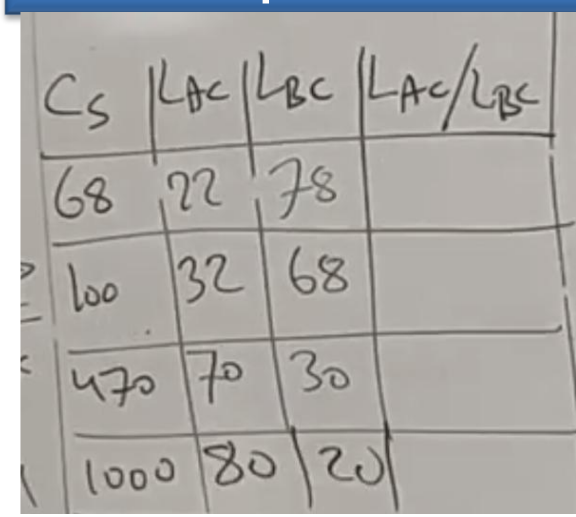
Sample calculation:

$$C_x = C_s \frac{L_{BC}}{L_{AC}}$$

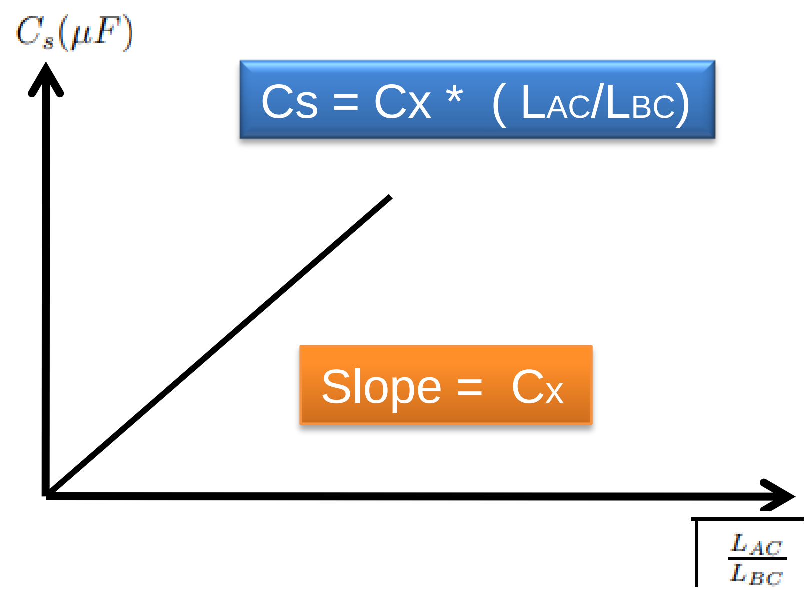
Cx = 68 Micro.Farad (78 cm/22 cm)

Cx = 241 Micro Farad

Data of Experiment from record Video



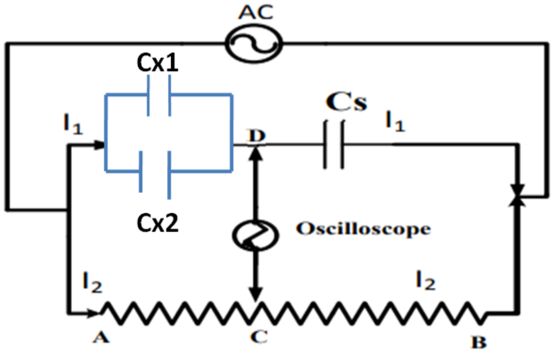
Cs	LAc	LBc	LAc/LBc
68	22	78	
100	32	68	
470	70	30	
1000	80	20	



Experimental Procedure

Part 3 (connect Cx1 and Cx2 in parallel)

Cxeq= 590 micro Farad



$C_s(\mu F)$	$L_{BC}(cm)$	$L_{AC}(cm)$	$\frac{L_{AC}}{L_{BC}}$
68			
100			
470			
1000			
$Draw C_s Vs.\frac{L_{AC}}{L_{BC}}, Slope = C_{x1} = ...$			

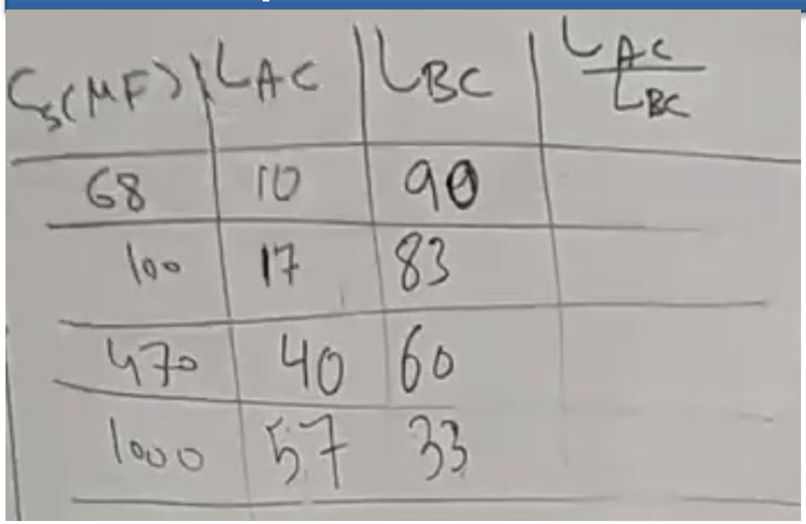
Sample calculation:

$$C_x = C_s \frac{L_{BC}}{L_{AC}}$$

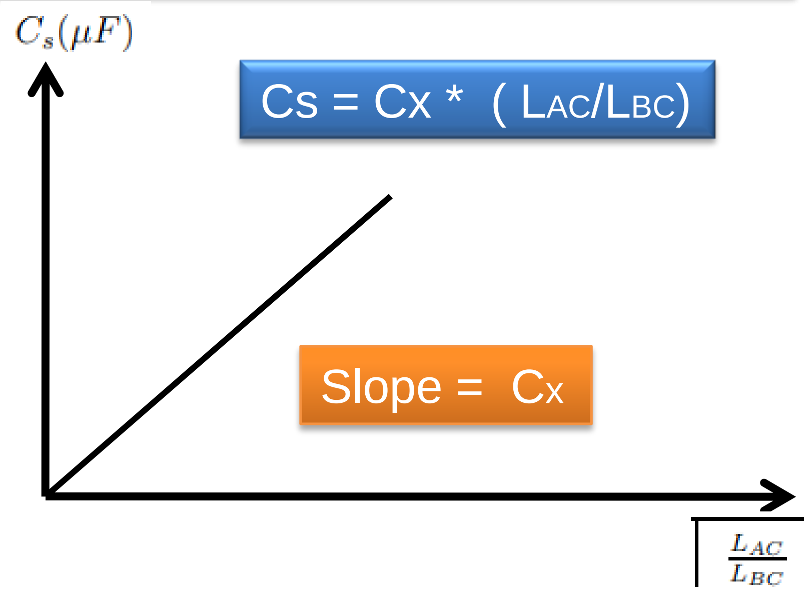
Cx = 68 Micro.Farad (90 cm/10 cm)

Cx = 612 Micro Farad

Data of Experiment from record Video

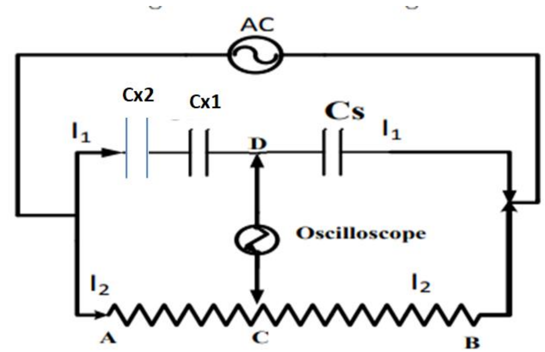


$C_s(\mu F)$	L_{AC}	L_{BC}	$\frac{L_{AC}}{L_{BC}}$
68	10	90	
100	17	83	
470	40	60	
1000	57	33	



Experimental Procedure

Part 4 (connect Cx1 and Cx2 in series)



Cxeq= 150 micro Farad

$C_s(\mu F)$	$L_{BC}(cm)$	$L_{AC}(cm)$	$\frac{L_{AC}}{L_{BC}}$
68			
100			
470			
1000			
$Draw C_s Vs. \frac{L_{AC}}{L_{BC}}, Slope = C_{x1} = ...$			

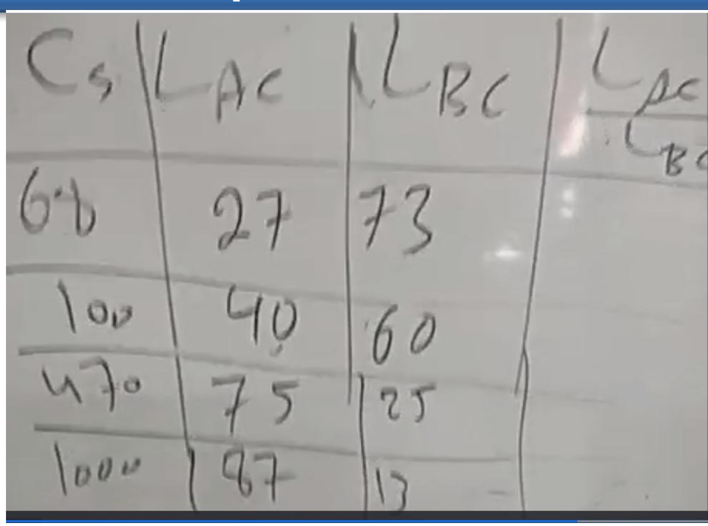
Sample calculation:

$$C_x = C_s \frac{L_{BC}}{L_{AC}}$$

Cx = 68 Micro.Farad (73 cm/27 cm)

Cx = 183 Micro Farad

Data of Experiment from record Video



Cs	LAC	LBC	LAC/LBC
68	27	73	
100	40	60	
470	75	25	
1000	87	13