

DENEY-1

ÖLÇÜ ALETLERİNİN İNCELENMESİ

Deneyin Amacı: Bu deneyde elektrik devrelerindeki akım, gerilim, direnç gibi fiziksel büyüklüklerin ölçülmesi konusu incelenecektir. Öncelikle bu büyüklüklerin ölçülmesinde kullanılan ölçü aletleri tanıtılacak, ardından basit bir elektrik devresi deney setinde kurularak devredeki akım ve gerilim değerleri ölçülecektir.

Kullanılan Alet ve Malzemeler:

- Avometre (Multimetre)
- Değişik değerlerde direnç ve bağlantı kabloları
- El tipi ve masa tipi multimetre

Teorik Bilgi:

Ölçme, bir büyüklüğün aynı cins başka bir büyüklükle karşılaştırılması demektir. Ölçülecek büyüklükler değiştikçe bunlara ait birimler de değişmektedir. Elektrik enerjisinin üretimi ve tüketimi sırasında bilgi akışını sağlamak ve gerekli bilgileri toplamak için ölçmeye ihtiyacımız vardır. Bir elektrik motorunun çektiği akımı bilirsek, kullanılacak iletkeni, sigortayı, aşırı akım rölesini uygun şekilde seçebiliriz. Bir elektrik tesisatının akım ve gerilim değerini bilirsek, buna uygun kablo seçmemiz daha kolay olur. Ölçme sayesinde çeşitli cihazların onarımı ve arıza yerinin bulunması kolaylaşır.

Tablo 1. Elektriksel Büyüklükler

Fiziksel Nicelik	Birimin Adı	Kısaltması
Elektrik yükü	Coulomb	C
Gerilim	Volt	V
Direnç	Ohm	Ω
İletkenlik	Siemens	S
Endüktans	Henry	H
Kapasitans	Farad	F
Frekans	Hertz	Hz
Güç	Watt	W
Enerji	Joule	J

Tablo 2. Birim Katları

atto (a)	10^{-18}	deci (d)	10^{-1}
femto (f)	10^{-15}	deca (da)	10
pico (p)	10^{-12}	hecto (h)	10^2
nano (n)	10^{-9}	Kilo (k)	10^3
micro (μ)	10^{-6}	Mega (M)	10^6
mili (m)	10^{-3}	Giga (G)	10^9
centi (c)	10^{-2}	Tera (T)	10^{12}

Ölçü Aletleri

Elektriksel büyüklükleri ölçen aletler genel olarak ölçtüğü büyüklüğün biriminden ad alırlar. Örneğin, akım şiddeti birimi amper, akım şiddetini ölçen ölçü aleti ampermetredir. Yapısına göre elektriksel ölçü aletleri, kendi aralarında ikiye ayrılır. Bunlar analog ölçü aletleri ve dijital ölçü aletleridir. Şimdi bunları sırası ile inceleyelim.

1. Analog Ölçü Aletleri

Ölçtüğü değeri skala taksimatı üzerinden ibre ile gösteren ölçü aletleridir. Analog ölçü aletleri çok değişik yapı ve skala taksimatlarına sahip olarak imal edilirler. Bu ölçü aletlerinde değer okumak daha zor gibi görünse de analog ölçü aletleri daha hassas ölçümlere olanak sağlarlar. Şekil 1’de bazı analog ölçü aletleri görülmektedir.



Şekil 1. Analog Ölçü Aletleri

2. Dijital Ölçü Aletleri

Ölçtüğü değeri dijital bir gösterge de sayılarla gösteren ölçü aletleridir. Bu ölçü aletlerinin kullanımı kolay olup özellikleri analog ölçü aletlerine göre daha fazladır.

Günümüzde dijital ölçü aletleri ile ayarlanan değer aşıldığında sinyal alma, ölçülen değerlerin bilgisayar ortamına taşınması ve kullanılması gibi ilave işlemler yapılabilmektedir (Şekil 2).

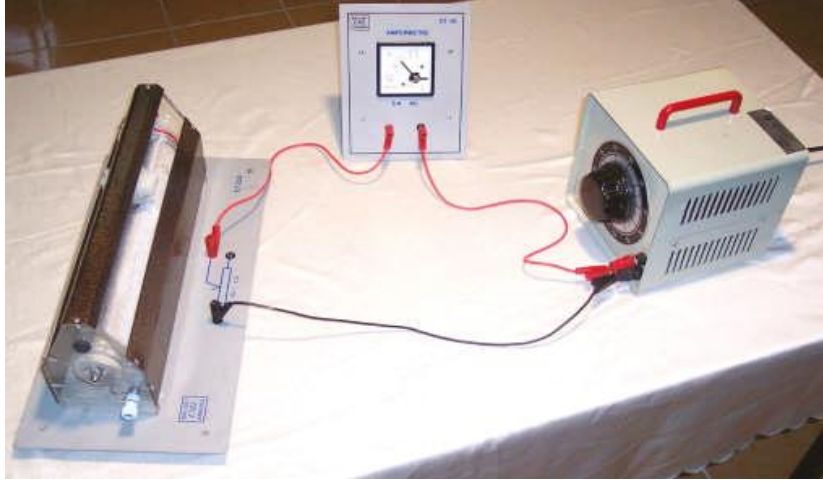


Şekil 2. Dijital Ölçü Aletleri

Ölçü Aletlerinin Kullanılımları

Ampermetre

Elektrik akım şiddetini ölçmeğe yarayan aletlere **Ampermetre** denir. Ampermetreler devreye daima seri olarak bağlanır. Alıcıdan geçen elektrik akımı aynı zamanda ampermetreden de geçebilmesi için alet (yük veya cihaz) ile ampermetre arka arkaya (şekil 3) bağlanır. Bu bağlantı şekline seri bağlama denir.



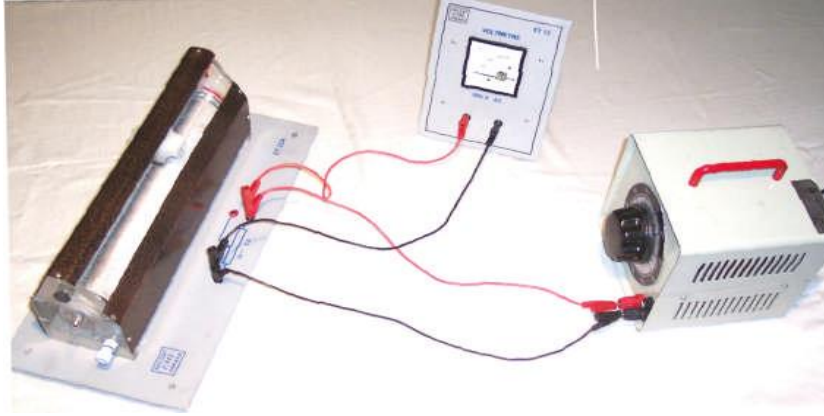
Şekil 3. Ampermetrenin Devreye Bağlanması

Ampermetreler, iç dirençleri küçük olan ölçü aletleridir. Bu aletler devreye paralel bağlanacak olursa, üzerinden büyük bir akım geçeceğinden aletin bobini hasar görecektir.

Voltmetre

Elektrik devrelerinde gerilim ölçmeye yarayan aletlere **Voltmetre** denir. Başka bir deyişle voltmetreler, bir elektrik devresinde iki nokta arasındaki potansiyel farkının

(geriliminin) ölçülmesine yarayan bir ölçü aletidir. Ampermetrelerin aksine, gerilimi ölçülme istenen elektrik devresinin veya gerilim kaynağının iki ucu arasına paralel bağlanır.



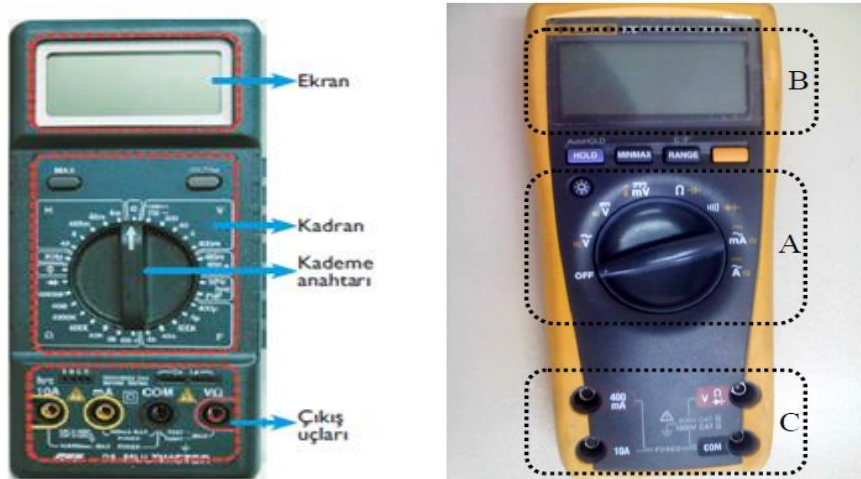
Şekil 4. Voltmetrenin Devreye Bağlanması

Voltmetreler, iç dirençleri büyük olan ölçü aletleridir. Bu ölçü aleti devreye seri bağlanacak olursa, iç direncinin büyüklüğünden dolayı üzerinden büyük bir gerilim düşümü meydana gelir. Voltmetreler seri bağlantıda zarar görmezler.

Multimetre (Avometre A(mper)-V(olt)-O(hm) Metre)

Multimetre (*multi*-çoklu, *metre*-ölçüm) çok çeşitli ölçümler yapabilen bir cihazdır. Multimetre ile akım, direnç, indüktans, sığa ve voltaj (gerilim, potansiyel farkı) gibi çeşitli ölçümler yapılabilir. İki çeşit multimetre vardır: El tipi multimetre ve masa tipi multimetre. El tipi multimetreler taşınabilir olduklarından kullanımı en çok tercih edilen multimetrelerdir. El tipi multimetre, genel olarak üç kısımdan oluşur:














































































































































































































































A. Kademe anahtarı B. Ekran, C. Çıkış uçları.



Şekil 5. El tipi multimetreler

Ekran üzerinde yapılan ölçümün sonucu görülür. Multimetrenin kırmızı ve siyah olmak üzere iki probu vardır. Kırmızı prob (+) kutbu, siyah prob (-) kutbu ifade etmektedir. Bu iki probun bağlantı uçları ölçülecek niceliğe bağlı olarak uygun çıkış uçlarına bağlanır. Multimetre ekranında (-) değer okunuyorsa, problemlerin ters tutulduğu anlaşılmalıdır.

Symbols and Annunciators

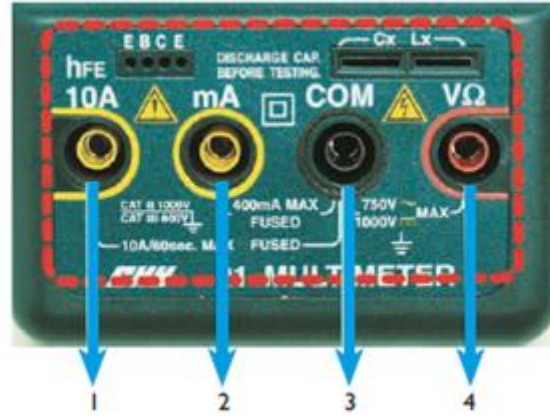
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	Continuity		Diode test		Battery status		DC		AC		REL		HOLD		MIN		MAX		AUTO		REL		HOLD		MIN		MAX		TEMP		°C		°F								
	Battery status		DC		AC		REL		HOLD		MIN		MAX		AUTO		REL		HOLD		MIN		MAX		TEMP		°C		°F												
n	nano (10^{-9}) (capacitance)		µ		m		A		k		F		M		Ω		Hz		%		AC		DC		°F		MAX		V		REL		AUTO		HOLD		°C		MIN		MAX
µ	micro (10^{-6}) (amps, cap)		A		k		F		M		Ω		Hz		%		AC		DC		°F		MAX		V		REL		AUTO		HOLD		°C		MIN		MAX				
m	milli (10^{-3}) (volts, amps)		A		k		F		M		Ω		Hz		%		AC		DC		°F		MAX		V		REL		AUTO		HOLD		°C		MIN		MAX				
A	Amps		k		F		M		Ω		Hz		%		AC		DC		°F		MAX		V		REL		AUTO		HOLD		°C		MIN		MAX						
k	kilo (10^3) (ohms)		F		M		Ω		Hz		%		AC		DC		°F		MAX		V		REL		AUTO		HOLD		°C		MIN		MAX								
F	Farads (capacitance)		M		Ω		Hz		%		AC		DC		°F		MAX		V		REL		AUTO		HOLD		°C		MIN		MAX										
M	mega (10^6) (ohms)		Ω		Hz		%		AC		DC		°F		MAX		V		REL		AUTO		HOLD		°C		MIN		MAX												
Ω	Ohms		Hz		%		AC		DC		°F		MAX		V		REL		AUTO		HOLD		°C		MIN		MAX														
Hz	Hertz (frequency)		%		AC		DC		°F		MAX		V		REL		AUTO		HOLD		°C		MIN		MAX																
%	Percent (duty ratio)		AC		DC		°F		MAX		V		REL		AUTO		HOLD		°C		MIN		MAX																		
AC	Alternating current		DC		°F		MAX		V		REL		AUTO		HOLD		°C		MIN		MAX																				
DC	Direct current		°F		MAX		V		REL		AUTO		HOLD		°C		MIN		MAX																						
°F	Degrees Fahrenheit		MAX		V		REL		AUTO		HOLD		°C		MIN		MAX																								
MAX	Maximum		V		REL		AUTO		HOLD		°C		MIN		MAX																										

Şekil 6. Ekranda yazan sembollerin açıklamaları

Kademe anahtarı dairesel olarak hareket ettirilerek ölçülmek istenen niceliğe göre ayarlanır. Kadran üzerinde akım A, voltaj V, direnç Ω, indüktans H, sığa F veya CAP, frekans Hz, sıcaklık TEMP ile gösterilmiştir. Direnç değerini ölçmek için kademe anahtarı Ω kademesine getirilmelidir. Bazı multimetrelerde Ω kademesinde ohm, kiloohm ve megaohm mertebesindeki direnç değerleri ekranda otomatik olarak görülebilir. Bazı mutimetrelerde ise direnç değeri ölçülürken öncelikle kademe anahtarı en yüksek değere ayarlanır. Bu kademe direnç değeri okunamıyorsa kademe anahtarı daha küçük değere çevrilerek direnç değeri belirlenir. Akım ölçümleri için multimetrenin A kademelerini kullanmak gerekir. Ölçülecek akım değeri amper mertebesinde olması durumunda “A” harfi, miliamper mertebesinde olması durumunda “mA” harfi, mikroamper mertebesinde olması durumunda “µA” harfi kademesinde olmalıdır. Voltaj ölçümleri için multimetrenin V kademelerini kullanmak gerekir. AC gerilim ölçmek için kademe anahtarı AC kademesine (V_{AC}) ayarlanmalıdır. Benzer şekilde DC voltaj ölçmek için kademe anahtarı DC kademesinde (V_{DC}) olmalıdır.

Multimetreyi ölçüm yapılacak devre elemanına bağlamak için “prob” adı verilen kırmızı ve siyah renkli bağlantı kablolarını ölçümü yapılacak niceliğe göre doğru çıkış

uçlarına bağlanmalıdır. Siyah renkli bağlantı kablosu her zaman “COM” isimli çıkış ucuna, kırmızı renkli kablo ise ölçülecek niceliğe göre uygun çıkış ucuna bağlanmalıdır. Akım ölçümü amper mertebesinde yapılacaksa kırmızı bağlantı kablosu 1 numaralı çıkış ucuna, akım miliamper veya mikroamper mertebesinde ise 2 numaralı çıkış ucuna bağlanmalıdır. Siyah bağlantı kablosunun bağlanacağı çıkış ucu 3 numaralı uçtur. Direnç ve voltaj ölçümü için kırmızı bağlantı kablosu 4 numaralı çıkışa bağlanmalıdır (şekil 7).



Şekil 7. Multimetre çıkış uçları

HATIRLATMA: Multimetrelerde her ölçüm öncesi dikkat edilmesi gereken bir “üçlü kontrol kuralı” vardır: Önce kademe tuşu ile uygun nicelik seçilir. Sonra, doğru niceliğin seçilip seçilmediği ekrandan kontrol edilir. En son olarak, problemlerin doğru çıkışa bağlanıp bağlanmadığına bakılır. Örneğin, akım kademesi seçilip problemler yanlışlıkla voltaj çıkışlarına bağlanırsa, bu durumda multimetrenin sigortası atabilir ve o masadaki deneyde ölçüm yapılması mümkün olmayabilir! Özellikle ardı ardına yapılan sürekli ve karışık nicelik ölçümlerinde, problemlerin yerinin düzeltilmesi sıkça unutulmaktadır. Bu nedenle her ölçüm öncesi üçlü kontrol kuralını uygulamak oldukça önemlidir.

Masa tipi multimetreler, genellikle el tipi multimetrelere göre daha hassas olmalarına karşın, taşınabilir olmamaları kullanım alanlarını kısıtlamaktadır. Masa tipi multimetreler ile ölçüm yapmak, el tipi multimetreler ile yapılan ölçüm ile oldukça benzerdir. Siyah prob yine her zaman COM'a bağlanmalıdır. Kırmızı uç; akım ölçerken, 1 amperden küçük ölçümler için “1A” çıkışına, 1A-10A arası ölçümler için ise “10 A” çıkışına bağlanmalıdır, diğer nicelik ölçümleri içinse “V Ω” çıkışına bağlanmalıdır. Masa tipi multimetrede hangi nicelik ölçülecekse onun ile ilgili tuşa basılmalıdır. Tuşların üzerindeki mavi yazılar, ikincil niceliklerdir. Shift butonuna bastıktan sonra bu tuşlara basılırsa, ikincil nicelik ölçümü aktif hale gelecektir.



Şekil 8. Laboratuvarında kullandığımız masa tipi ve el tipi multimetre

Çalışma Soruları

1. Elektriksel büyüklükler ve birim katları nelerdir? Açıklayarak yazınız.
2. Yapısına göre ölçü aletlerini açıklayınız.
3. Ampermetre, voltmetre nedir? Bu aletlerle ölçüm yaparken nelere dikkat etmeliyiz?
4. Multimetre ekranında yer alan sembollerin açılımlarını açıklayınız.
5. Multimetre kademe anahtarı ayarında nelere dikkat etmeliyiz?
6. Multimetrenin çıkış uçlarını bağlarken nelere dikkat etmeliyiz?
7. Üçlü kontrol kuralı nedir?
8. Masa tipi multimetreleri açıklayınız.