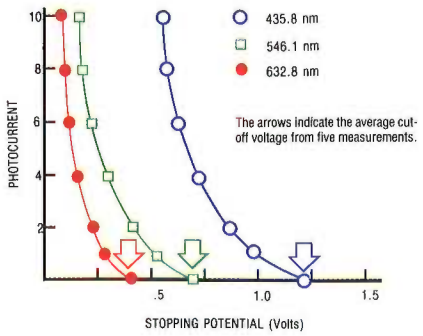
# PHOTOELECTRIC EFFECT/PLANCK'S CONSTANT

## TEL 310 Photoelectric Effect

This apparatus allows the student to repeat the experiment that served to establish the quantum theory of radiation. It effectively demonstrates that the energy of a photoelectron depends on the wavelength of the impinging radiation and not its intensity.




In this experiment, the photocathode is irradiated by a source of monochromatic radiation and a potential applied to the tube so that it opposes the energy of the emitted photoelectrons. The voltage required to just stop the current flow is proportional to the energy of the photoelectron. Plotting the stopping potential as a function of the reciprocal of the wavelength of the radiation gives a straight line plot, the slope of which can be used to calculate Planck's constant. Typical values for this experiment are shown in the graph.

The measurement of very small photocurrent is required for accurate results; therefore, the amplifier is located only a couple of centimeters from the photodiode. This avoids the introduction of extraneous voltages and achieves a minimum detectable photocurrent of the order of 5 x 10-$^{10}$A.

The apparatus includes three filters to provide spectral separation. If monochromatic sources are not available, the filters and a tungsten lamp can be used, although the results are not as good as with a monochromatic source.

### Specifications

**Phototube** Mounted inside the amplifier case.

**Amplifier** Mounted within the case. Consists of an FET input Op Amp followed by a second Op Amp driving the panel meter. Power supplies are internal.

**Amplifier Gain** 3 x $10^7$

**Minimum Current Sensitivity** 5 x $10^{10}$

**Spectral Separation** Provided by red, green and blue filters. Best results are obtained with monochromatic sources such as a mercury arc and a He-Ne laser.

**Dimensions** 9w x 17l x 10h cm (3.5 x 6.7 x 3.9 in).

**TEL 310** **$342.00**

## Planck's Constant Apparatus

- Determine the wavelength of 6 LED's using a diffraction grating
- Plot current/voltage curves characteristic of the LED's (see fig. 2)
- Determine Planck's constant (see fig. 1)

This simple unit enables the student to perform these classical optical experiments. Six LED's emit light at different wavelengths. As power is supplied to each LED, light will be emitted when the energy difference between two electronic states in a diode is great enough for an electron transition to release one quantum of light at the wavelength of the LED.

An oscilloscope (such as our **TEL 5020P**, page 8) can be used to display this characteristic curve. Observing the applied voltage at the "knee" of this curve (see figure 3) for several different LED's Planck's constant can be determined within 10%.

Required Accessories
0-6 VAC Power Supply
Dual Trace Oscilloscope

**TEL 6789** **$242.00**

**NEED TECHNICAL INFORMATION? CALL 1-800-622-2866**

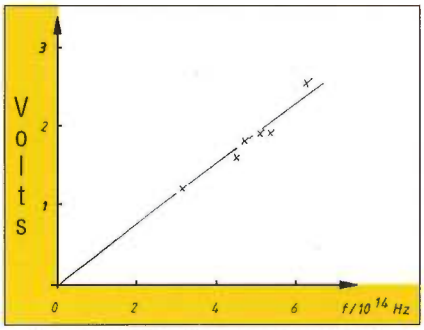



FIGURE 1—DETERMINE PLANCK'S CONSTANT TO WITHIN 10%

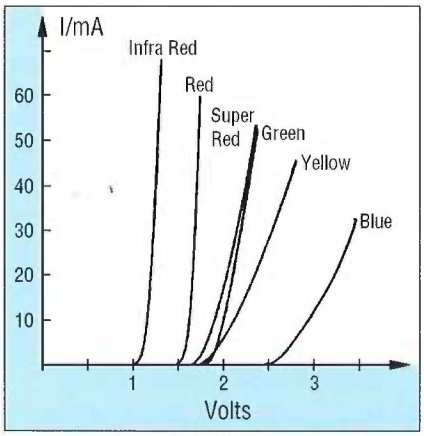
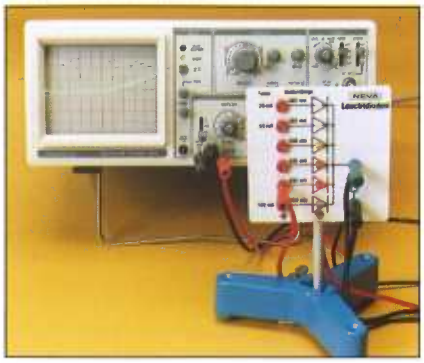


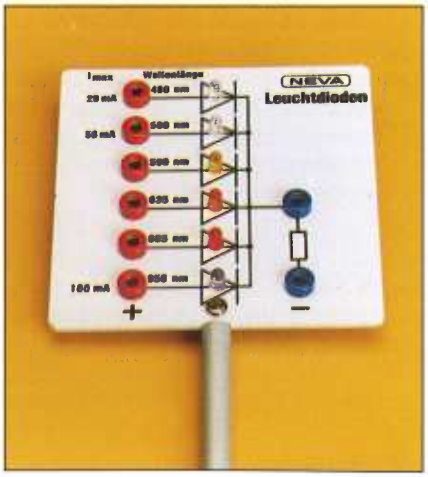

FIGURE 2—CHARACTERISTIC CURRENT/VOLTAGE CURVE OF THE 6 LED'S

TEL 310 PHOTOELECTRIC EFFECT WITH AMPLIFIER

FIGURE 3—PLANCK'S CONSTANT CAN BE DETERMINED FROM THE SLOPE OF THIS CURVE



LED PLANCK'S CONSTANT APPARATUS



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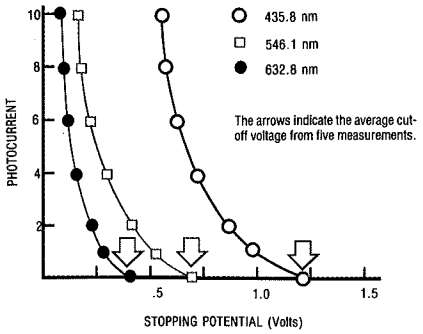


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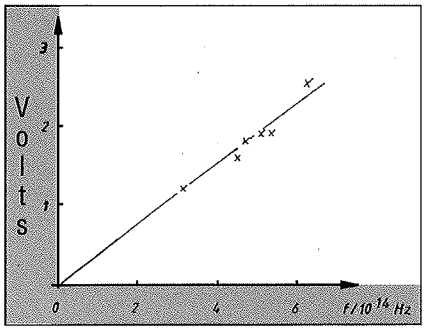


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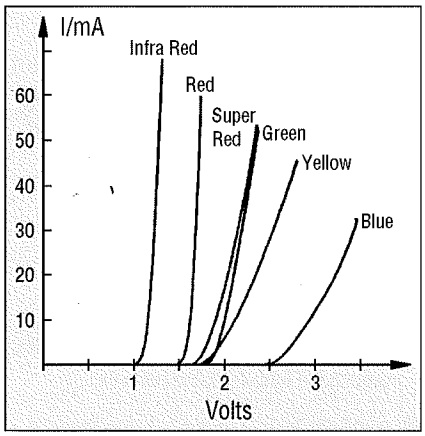


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**TEL 310 PHOTOELECTRIC EFFECT WITH AMPLIFIER**

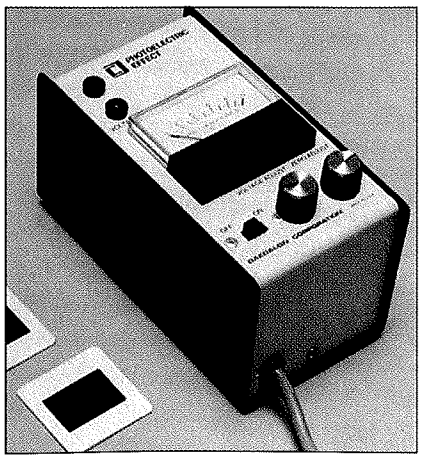
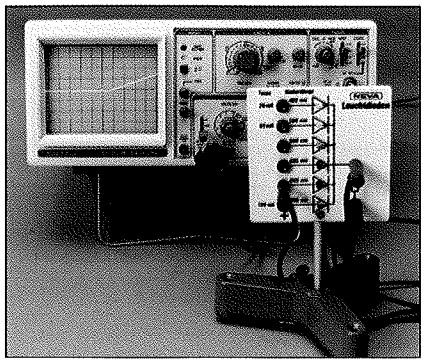


**FIGURE 3—PLANCK'S CONSTANT CAN BE DETERMINED FROM THE SLOPE OF THIS CURVE**



**LED PLANCK'S CONSTANT APPARATUS**