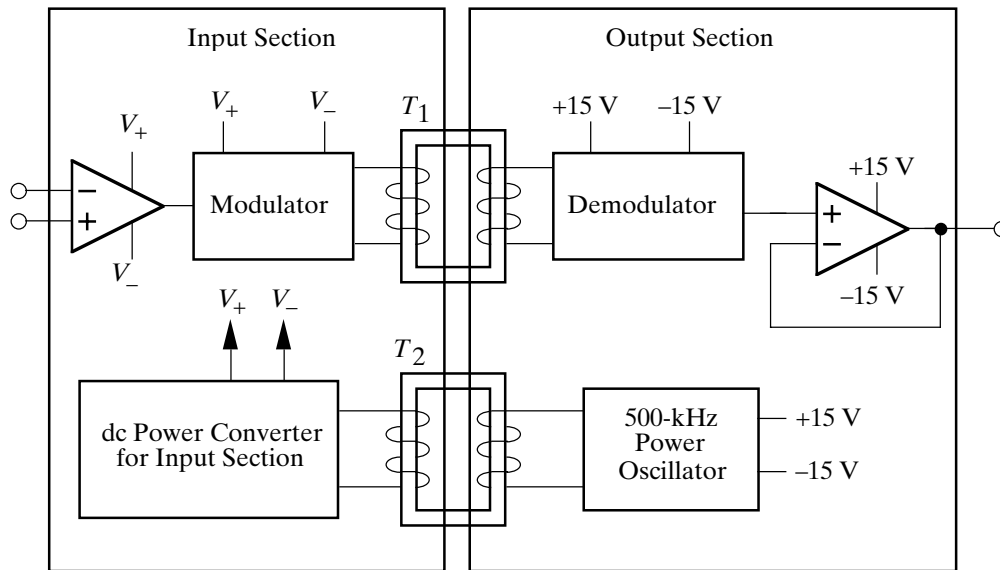


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- 1a** Stress is the force per unit area (F/A) while strain is the fractional change in length (DL/L).
- 1b** The Thompson emf is caused by a difference in temperature (the diffusion of electrons from a hotter region to a cooler region) while the Peltier emf is caused by a difference in electron mobility (the diffusion of electrons from a region of higher mobility to a region of lower mobility).
- 1c** The platinum resistance thermometer is a conductor whose resistance increases with increasing temperature and the thermistor is a semiconductor whose resistance decreases with increasing temperature.
- 2a** Handout slide #66:



Essential points (handout slide #67):

- The transformer can only transmit high frequencies and blocks d.c. to 60 Hz
- To transmit 1 Hz to 10 kHz signals from the input to the output, the input stage must use the signal to modulate the amplitude of a high frequency carrier, and the output stage must demodulate to recover the signal
- Need isolated power for the input electronics (power oscillator as above or battery)

[full credit required (i) an amplifier; (ii) the modulator, transformer, and demodulator; and (iii) isolated power for the input stage]

[15 points off for showing a regular amplifier and no provision for input power]

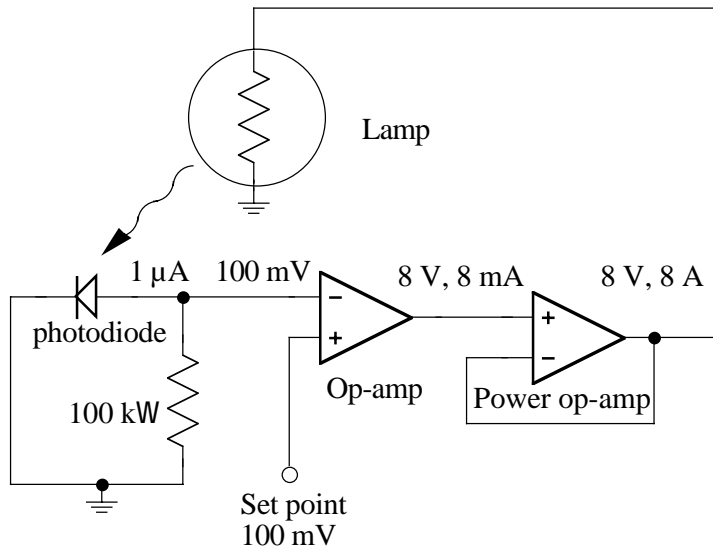
[10 points off for using a transformer with no modulation/demodulation and no provision for input power]

2b

60 Hz from the output cannot pass through the transformer to the input because the transformer can only pass high frequencies. Signals can only be sent from the input to the output stage as a modulation of the amplitude of a high frequency carrier.

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3a (similar to handout slide #291)



The op-amp provides whatever voltage is necessary to make the negative and positive inputs equal (virtual short rule for very high gain). It was also OK to use a high-gain differential amplifier in place of the op-amp. If the gain is 10^4 , the difference between the negative and positive amplifier inputs would only be $8 \text{ V} \times 10^{-4} = 0.8 \text{ mV}$.

3b

- the increasing thickness of metal film causes a decrease in lamp output
- photodiode output decreases below the set point
- the op-amp output voltage increases (negative feedback)
- the power amplifier output voltage increases and the lamp becomes brighter
- the increase in lamp voltage stops when the photodiode signal is once again equal to the set point

145L midterm #2 grade distribution:

Problem		31-40	1	D
1	28.4 (36 max)	41-50	2	C
2	11.6 (32 max)	51-60	4	B-
3	23.4 (32 max)	61-70	4	B
total	63.4 (100 max)	71-80	2	A-
		81-85	1	A
		86-90	1	A+
		91-100	0	