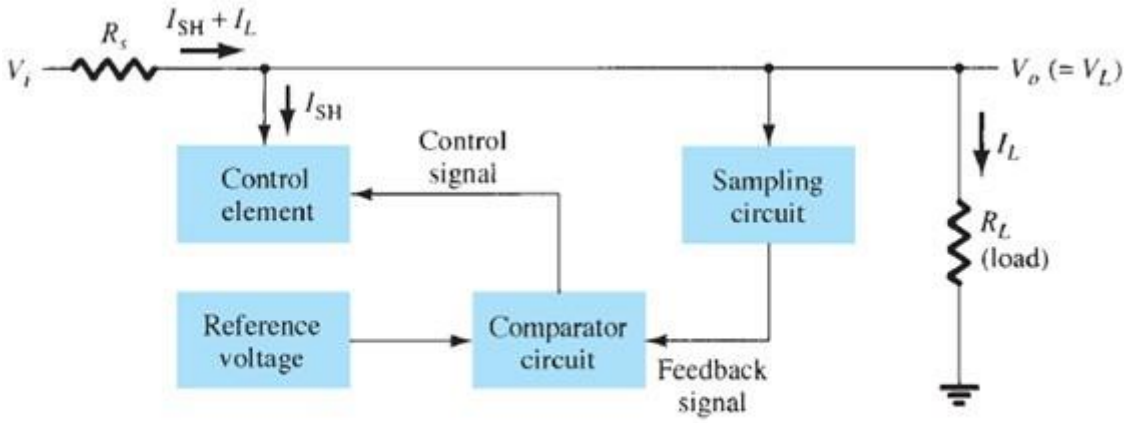
Al-Mustaqbal University College
Department of Medical Instrumentation Techniques Engineering
Class: Three
Subject: Medical electronic system
Lecturer: Dr. zahraa hashim kareem
Lecture-4: Power supply

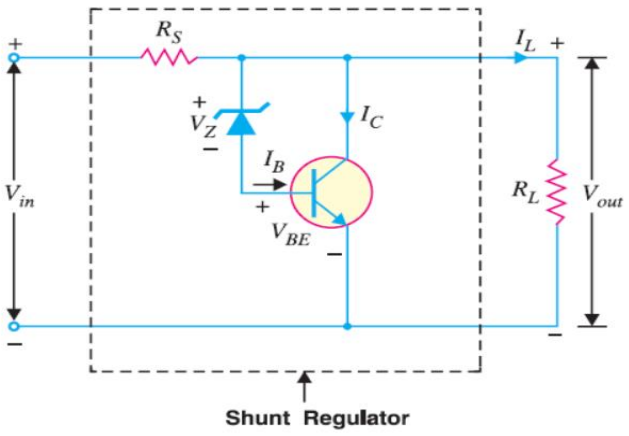
A shunt voltage regulator provides regulation by shunting current away from the load to regulate the output voltage. Figure below shows the block diagram of such a voltage regulator. The input unregulated voltage provides current to the load. Some of the current is pulled away by the control element to maintain the regulated output voltage across the load.



Block diagram of shunt voltage regulator.

Basic Transistor Shunt Regulator A basic shunt regulator circuit is shown in Fig. below .Resistor R_S drops the unregulated voltage by an amount that depends on the current supplied to the load R_L. The voltage across the load is set by the Zener diode and transistor base-emitter voltage. If the load resistance decreases, a reduced drive current to the base of Q_1 results, shunting less collector current. The load current is thus larger, thereby maintaining the regulated voltage across the load. The output voltage to the load is

$$V_o = V_{in} - IR_s$$



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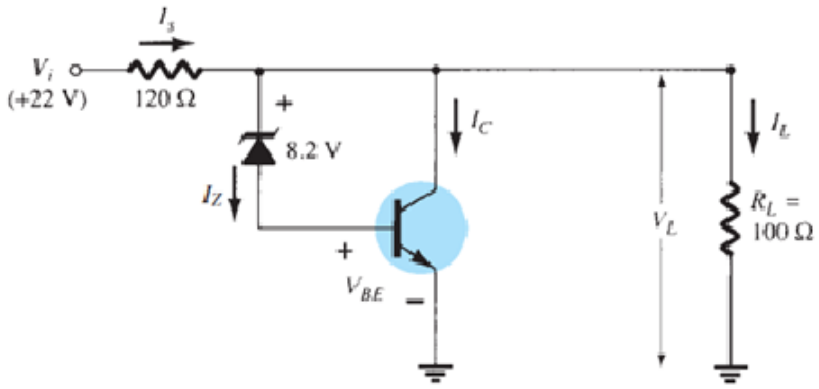
EXAMPLE Determine the regulated voltage and circuit currents for the shunt regulator of Fig.



Solution: The load voltage is

$$V_L = 8.2\text{ V} + 0.7\text{ V} = \mathbf{8.9\text{ V}}$$

For the given load,

$$I_L = \frac{V_L}{R_L} = \frac{8.9\text{ V}}{100\ \Omega} = \mathbf{89\text{ mA}}$$

With the unregulated input voltage at 22 V, the current through R_S is

$$I_S = \frac{V_i - V_L}{R_S} = \frac{22\text{ V} - 8.9\text{ V}}{120} = \mathbf{109\text{ mA}}$$

so that the collector current is

$$I_C = I_S - I_L = 109\text{ mA} - 89\text{ mA} = \mathbf{20\text{ mA}}$$

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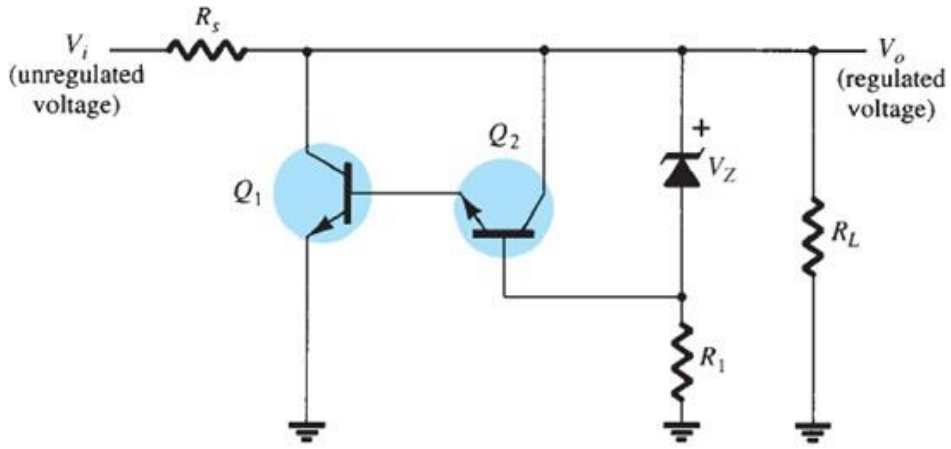
Improved Shunt Regulator The circuit of Fig. below shows an improved shunt voltage regulator circuit. The Zener diode provides a reference voltage so that the voltage across R_1 senses the output voltage. As the output voltage tries to change, the current shunted by transistor Q_1 is varied to maintain the output voltage constant. Transistor Q_2 provides a larger base current to transistor Q_1 than the circuit of Fig above, so that the regulator handles a larger load current. The output voltage is set by the Zener voltage and that across the two transistor base-emitters:

$$V_o = V_L = V_Z + V_{BE_2} + V_{BE_1}$$



Improved shunt voltage regulator circuit.

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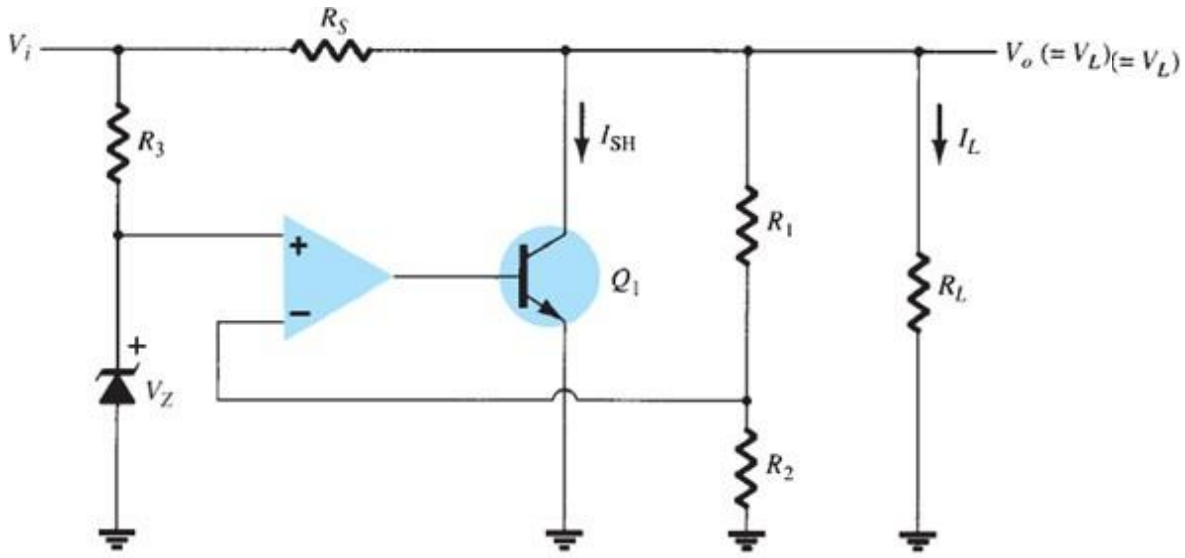
Shunt Voltage Regulator Using Op-Amp Figure shows another version of ashunt voltage regulator using an op-amp as voltage comparator. The Zener voltage is compared to the feedback voltage obtained from voltage divider R_1 and R_2 to provide the control drive current to shunt element Q_1. The current through resistor R_S is thus controlled to drop a voltage across R_S so that theoutput voltage is maintained.



Shunt voltage regulator using an op-amp.

H.W.

What is the out put voltage of the Shunt Voltage Regulator Using Op-Amp (Vo= ?)

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