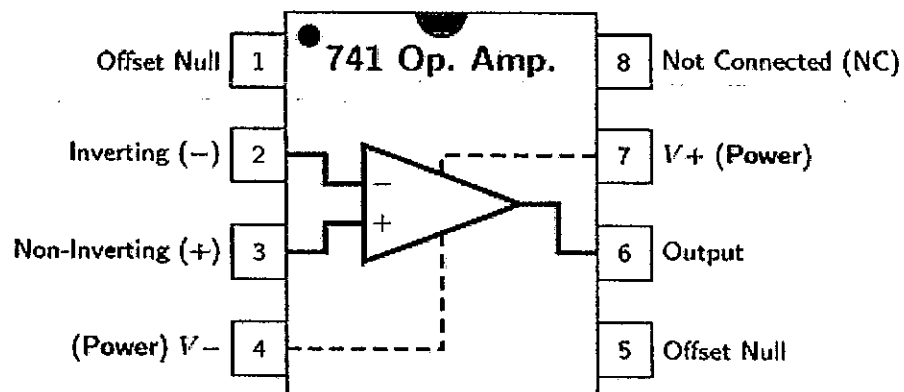
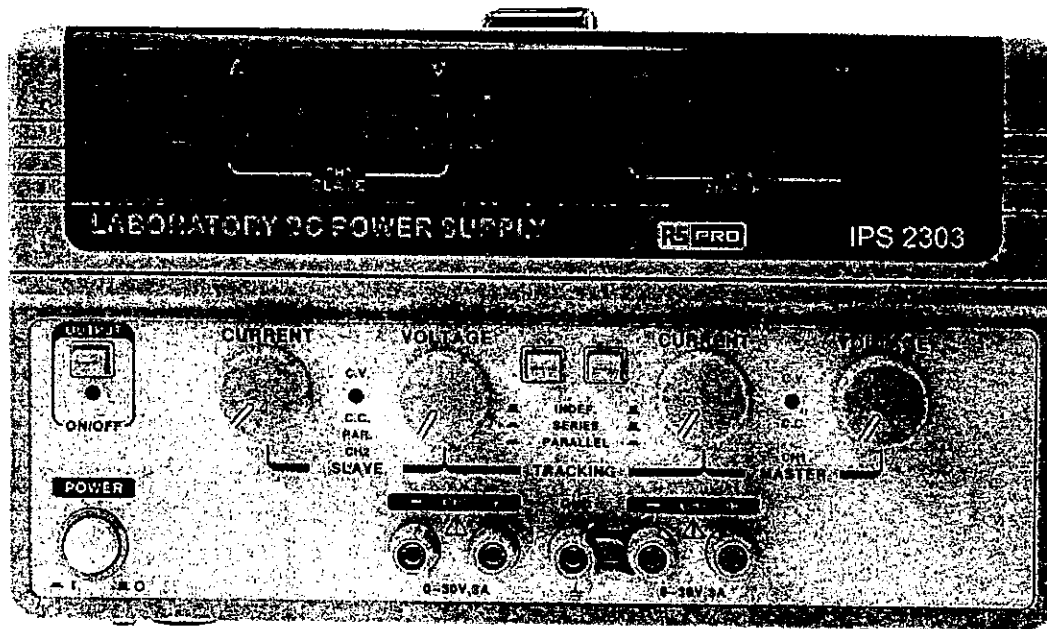
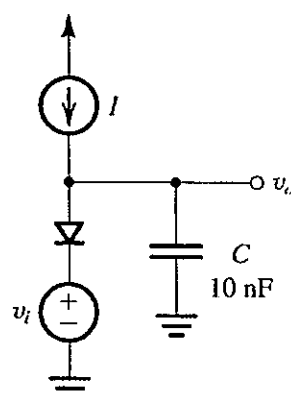


1. (20%) Below are a Laboratory DC power supply and a 741 Op Amp.

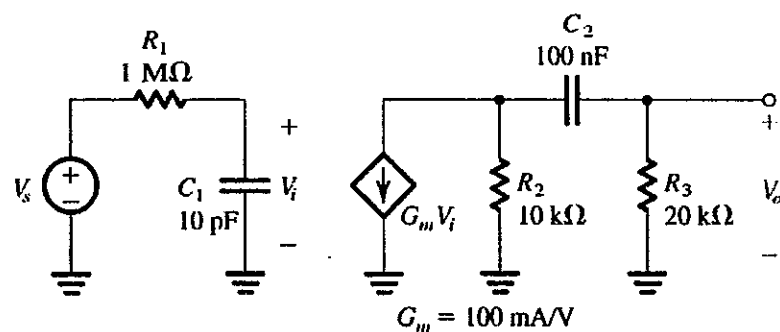


- (a) Provide the wiring diagram and settings on the Laboratory DC power supply to supply proper power for the OP  
 (b) Show the components and wiring diagram to form an inverting amplifier with a gain of 100.
2. (20%) Consider the circuit below: (a) Find the phase shift between  $v_i$  and  $v_o$  when the diode is on. (b) Find the value of  $I$  that will provide a phase shift of  $-45^\circ$ , and find the range of phase shift achieved as  $I$  is varied over the range of 0.1 times to 10 times this value. Assume  $n = 1$  for the diode.

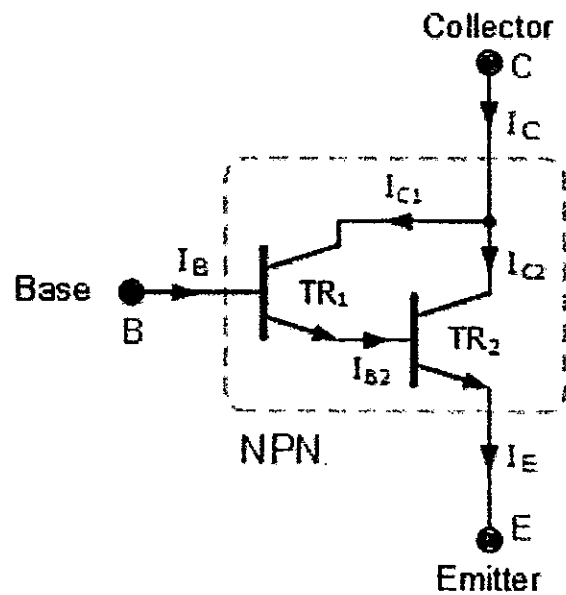


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3. (20%) A source follower is required to connect a high-resistance source to a load whose resistance is nominally  $2\text{ k}\Omega$ . Please design a source follower using MOSFET and explain how the value of the biased current of the MOSFET in the source follower affects the value of the output voltage.
4. (20%) Design a biasing circuit (including resistors, capacitors, and DC power) for a common-source amplifier using an NMOS transistor for which  $K = (W/L) \times (\mu_n C_{ox}) / 2 = 10\text{ mA/V}^2$  and  $V_{th} = 1\text{ V}$ , in order to have the following small-signal equivalent circuit.



5. (20%) Two NPN transistors are connected together in the form of a Darlington Pair to switch a 12V 75W halogen lamp. If the forward current gain of the first transistor is 25, and the forward current gain (Beta) of the second transistor is 80.



- (a) Write down the relation between  $I_C$ ,  $I_B$ , and gains of the first and the second transistors.
- (b) Ignoring any voltage drops across the two transistors, calculate the maximum base current required to switch the lamp fully-ON.

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