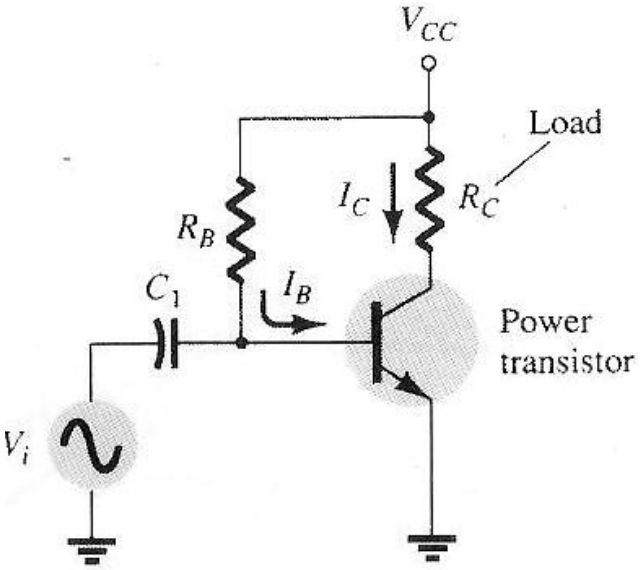
NATIONAL OPEN UNIVERSITY OF NIGERIA
14-16 AHMADU BELLO WAY, VICTORIA ISLAND LAGOS
SCHOOL OF SCIENCE AND TECHNOLOGY
MAY/JUNE 2012 EXAMINATION

PHY 308 ELECTRONICS I
TIME ALLOWED: 3 Hours

INSTRUCTION: Answer any five questions.

1. (a) (i) What is an amplifier? List the main properties of an amplifier and draw a simple circuit diagram of an ideal amplifier to show the relationship among these properties. 5 marks
(ii) Determine the Voltage, Current and Power Gain of an amplifier that has an input signal of $1\,mA$ at $10\,mV$ and a corresponding output signal of $10\,mA$ at $1\,V$. Also, express all three gains in decibels, (dB). 5 marks
(b) (i) Distinguish between the A and B classes of amplifier. With sketch transfer characteristic curves, show the relationship between the input and the output signals of each class. State an advantage of one class over the other. 5 marks
(ii)

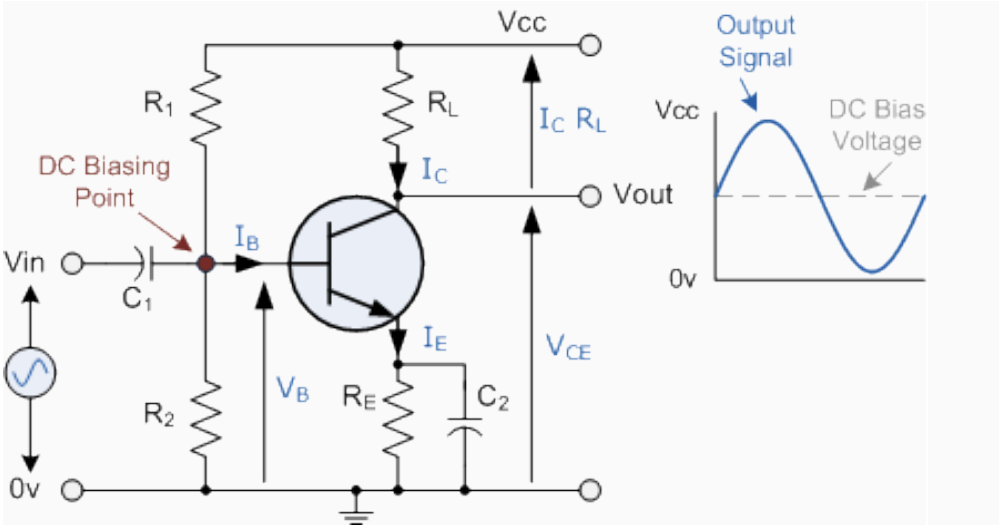


Series-fed class A large signal amplifier

The figure shown is a circuit diagram for a series-fed class A large signal amplifier. Given $R_B=1\,k\Omega$, $R_C=20\,\Omega$ $V_{CC}=20\,V$ and $\beta=25$, calculate V_{CE}.
5 marks

2. (a) (i) A transistor is a three-terminal device. With suitable diagrams, explain briefly the three main transistor configurations (connection in a practical circuit) for an NPN transistor. 6 marks

(ii) Show that the current amplification factors α and β are related by the equation $\beta=\frac{\alpha}{1-\alpha}$ where the symbols have the usual meaning
4 marks
(b)



Circuit diagram for question 2 b

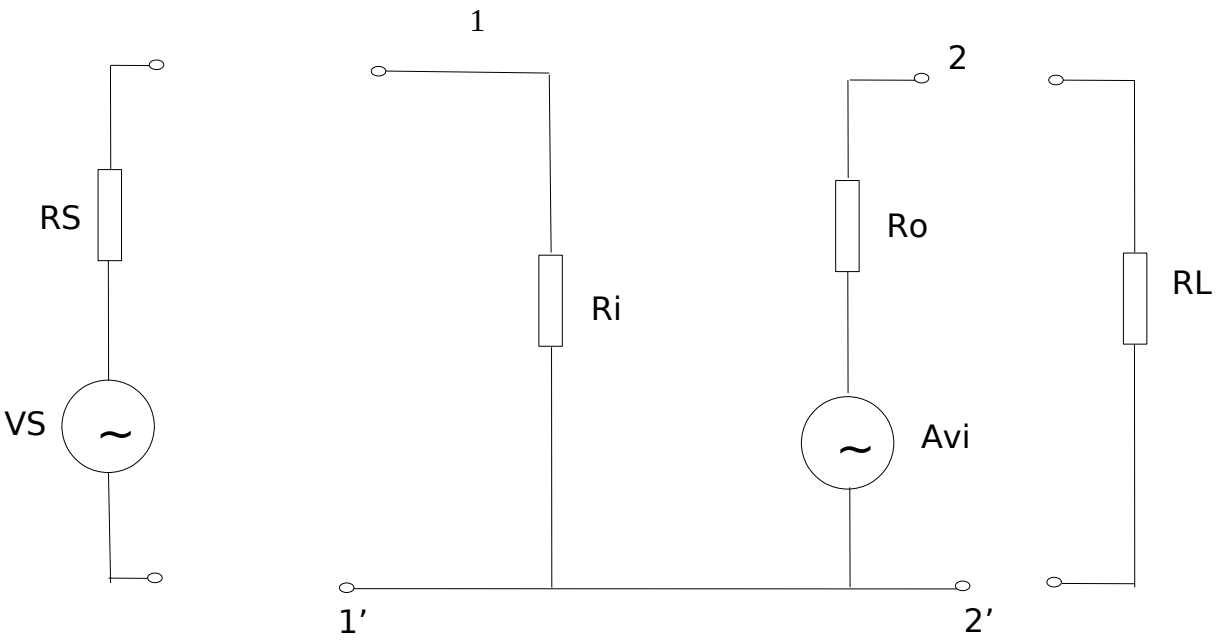
For the emitter bias circuit shown, calculate the values of R_1, R_2 and R_E to provide a quiescent operating point of $I_C=1\,mA$ $V_{CE}=10\,V$. The transistor used in the circuit is silicon with a d.c. current gain at 1 mA of $h_{FE}=50$. Assume the base-emitter voltage $V_{BE}=16\,V$. 10 marks

3. (a) Given I_E= 2.5 mA, h_{fe} = 140, h_{oc} = 20 μS (μmho) and h_{ob} = 0.5 μS, determine:

(i) The common-emitter hybrid equivalent circuit. 5 marks

(ii) The common-base r_e model 5 marks

(b)



Circuit diagram for questions 3b

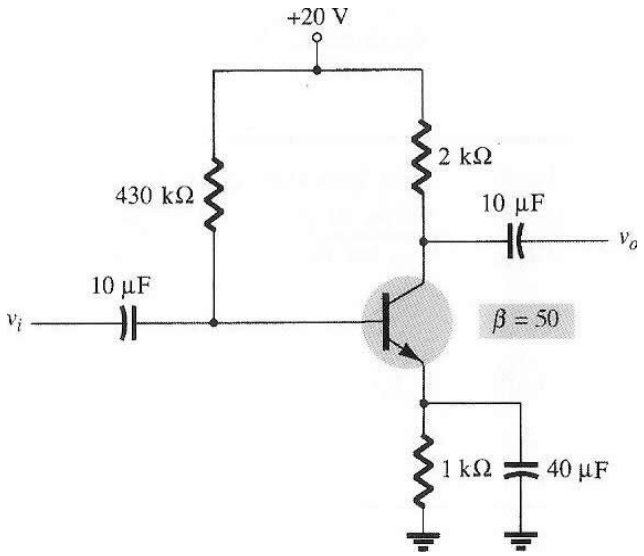
The figure shows an a.c. equivalent circuit of an amplifier. The input and output of the amplifier have values R_i = 5 kΩ, R_o = 50 kΩ . The open-circuit voltage amplification of the amplifier, A = 250. If the signal generator of peak amplitude V_s = 10 mV and internal resistance R_s = 600Ω is connected cross the input terminals 1-1' and a load resistance R_L = 10kΩ is connected across the output terminals 2-2', use the equivalent circuit to determine:
(i) peak value of the signal voltage across 1-1',
4 marks (ii) the peak values of the signal output current and signal voltage 4 marks (iii) voltage and current amplification of the stage 2 marks
4 (a) (i) Complete the following table of h-parameter

Parameter	Meaning	Relation	Condition Unit
h_{11}			Output shorted Ohm
	Reverse voltage gain	$\frac{V_i}{V_o}$	di mensionless
h_{21}	Current gain	$\frac{I_o}{I_i}$	
h_{22}		$\frac{I_o}{V_o}$	Input open

4 marks
(ii) List four factors on which the h-parameter depends
2 marks
(b) Given I_E= 2.5 mA, h_{fe} = 140, h_{oc} = 20 μS (µmho) and h_{ob} = 0.5 μS, determine:
(i) The common-emitter hybrid equivalent circuit
8 marks
(ii) The common-base r_e model
6 marks
5 (a) (i) Briefly explain the term *operating point*
3 marks

(ii) Summarize the operation in the cutoff, saturation, and linear regions of the BJT characteristic.

5 marks
(b)



For the emitter bias network shown determine: I_B, I_c, V_{CE}, V_C, V_E, V_B, V_{BC}.
12 marks

6(a) (i) What is an *oscillator*?
2 marks
(ii) Draw the block diagram of the oscillator
2 marks
(iii) Briefly, distinguish between positive and negative feedback as applied to an oscillator. 4 marks
(b) (i) Draw the circuit diagram for closed-loop non-inverting operational amplifier. 4 marks (ii) For the closed-loop non-inverting operational amplifier, show that $A^{'}=\frac{R_i+R_f}{R_i}$, where the $A^{'}$ is the voltage gain. $R_i \wedge R_f$ are the resistances in the input and feedback paths respectively. 8 marks

7 (a) (i) Explain the usefulness of a rectifier circuit in a dc supply unit
2marks
(ii) Draw the circuit diagram of the half-wave rectifier circuit and indicate the respective input and output waveforms
7 marks (b) (i) A half-wave rectifier using silicon diode has a secondary emf of $14.14\,V\,(rms)$ with a resistance of $0.2\,\Omega$. The diode has a forward resistance of $0.05\,\Omega$ and a threshold voltage of $0.7\,V$. If load resistance is $10\,\Omega$, determine: dc load current, dc load voltage, voltage regulation and efficiency.

6 marks
(ii)Draw the diagram of the full-wave rectifier circuit using the centre-tapped transformer and briefly explain how it works.
5 marks