

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

**EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN PHYSICS
AND BACHELOR OF EDUCATION (SCIENCE)**

PHYS 476: ANALOG ELECTRONICS

STREAMS:

TIME: 2 HOURS

DAY/DATE: THURSDAY 13/04/2023

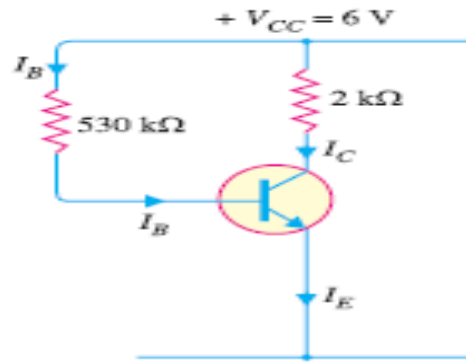
11.30 A.M. – 1.30 P.M.

INSTRUCTIONS

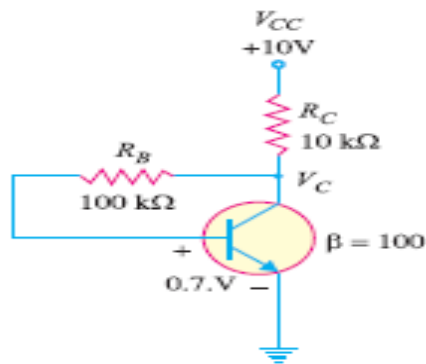
Answer question one and any other two questions

QUESTION ONE (30 MARKS)

- a) What do you understand by transistor biasing? [3 marks]
- b) An npn silicon transistor has $V_{cc}=5V$ and the collector load $R_c=2\text{ k}\Omega$ find,
 - i) the maximum collector current that can be allowed during the application of signal for faithful application [3 marks]
 - ii) the minimum zero signal collector current required [2 marks]
- c) What do understand by multistage transistor amplifier? [2 marks]
- d) The figure below shows a silicon resistor with $\beta=50$ biased by base resistor method
 - i) Draw the dc load line
 - ii) Determine the operating point
 - iii) What is the stability factor? [8 marks]



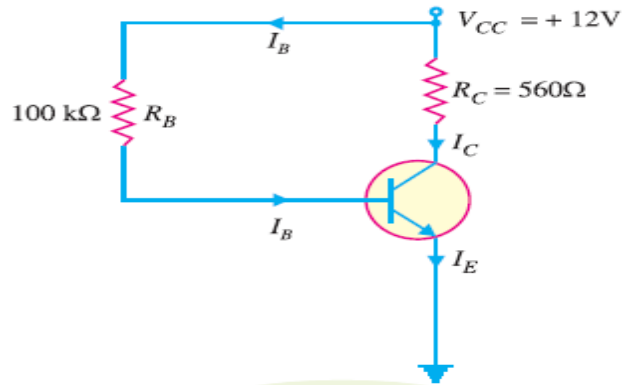
- e) i) Determine the type of biasing in the figure below [1 mark]
 ii) Find its operating point [5 marks]



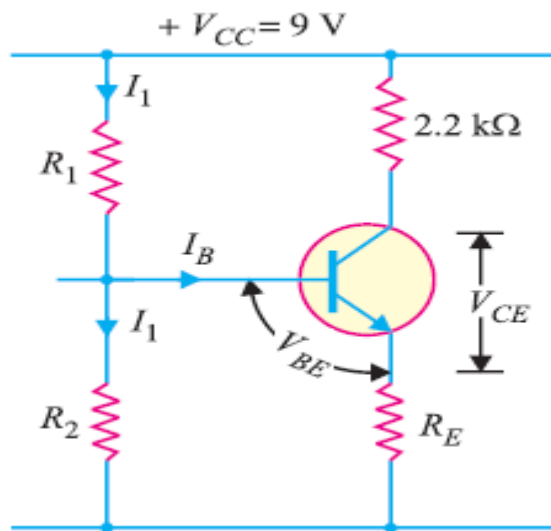
- f) Describe characteristics of OPAMP [3 marks]
 g) Explain the advantages of using silicon and not germanium in semiconductor devices [4 marks]

QUESTION TWO (20 MARKS)

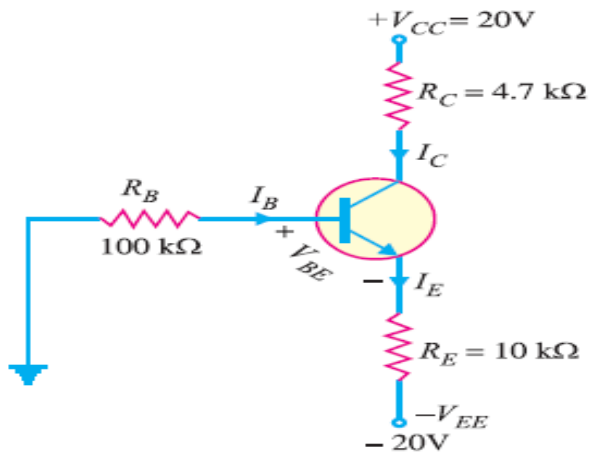
- a) A base bias circuit in the figure below is subjected to an increase in temperature from 25°C to 75°C. If $\beta = 100$ at 25°C and 150 at 75°C, determine the percentage change in Q-point values (V_{CE} and I_C) over this temperature range. Neglect any change in V_{BE} and the effects of any leakage current [8 marks]



b) In the circuit shown below, the operating point is chosen such that $I_C = 2\text{mA}$, $V_{CE} = 3\text{V}$. If $R_C = 2.2\text{ k}\Omega$, $V_{CC} = 9\text{V}$ and $\beta = 50$, determine the values of R_1 , R_2 and R_E . Take $V_{BE} = 0.3\text{V}$ and $I_1 = 10I_B$. [7 marks]

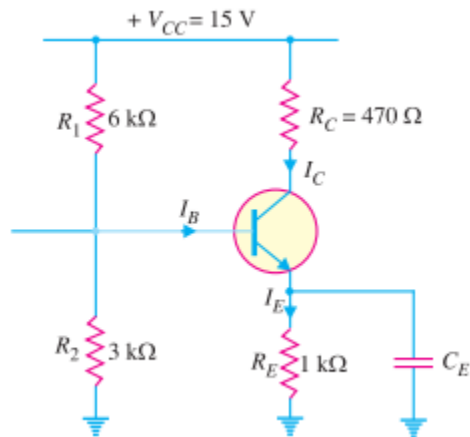


c) For the emitter bias circuit shown below, find I_E , I_C , V_C and V_{CE} for $\beta = 85$ and $V_{BE} = 0.7\text{V}$. [5 marks]

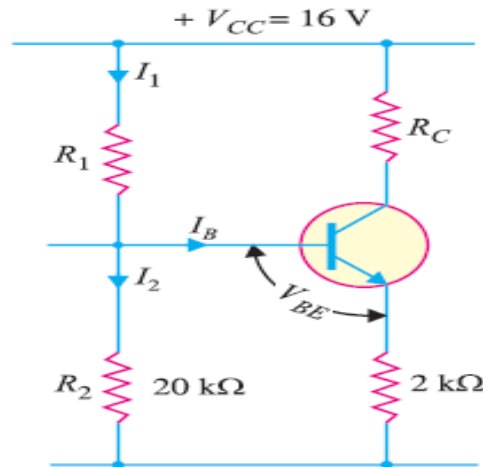


QUESTION THREE (20 MARKS)

a) The circuit shown below uses silicon transistor having $\beta = 100$. Find the operating point and stability factor [9 marks]



b) An npn transistor circuit below has $\alpha = 0.985$ and $V_{BE} = 0.3V$. If $V_{CC} = 16V$, calculate R_1 and R_C to place Q point at $I_C = 2mA$, $V_{CE} = 6$ volts. [7 marks]

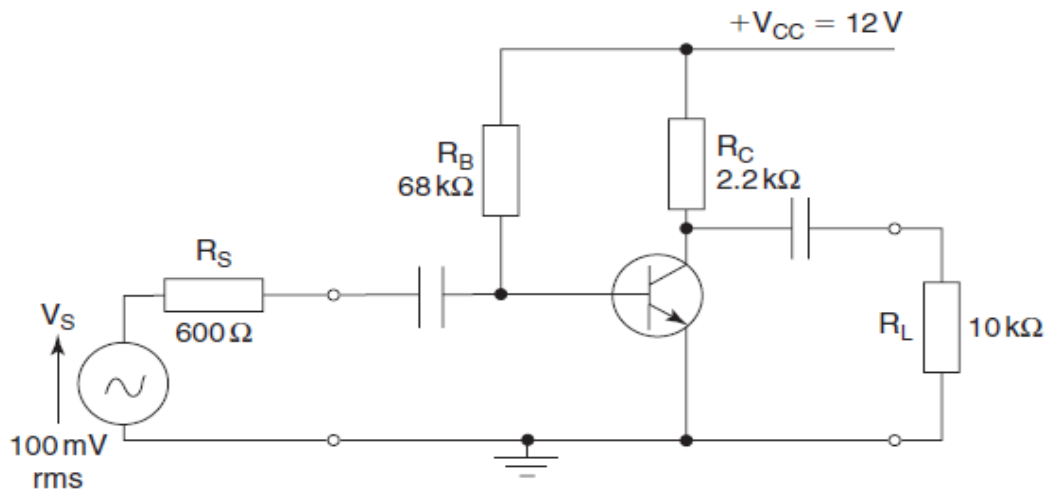


c) Find the value of I_C for potential divider method if $V_{CC} = 9V$, $R_E = 1k\Omega$, $R_1 = 39 k\Omega$, $R_2 = 10 k\Omega$, $R_C = 2.7 k\Omega$, $V_{BE} = 0.15 V$ and $\beta = 90$. [4 marks]

QUESTION FOUR (20 MARKS)

- (a) sketch the h-parameter equivalent circuit
- (b) determine the amplifier current and voltage gains using
 - (i) network analysis, and
 - (ii) h-parameter equations.

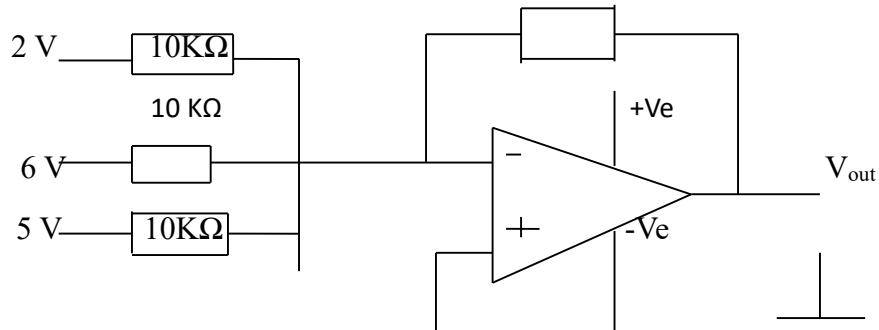
The h-parameters are $h_{ie} = 2.5 k\Omega$; $h_{fe} = 90$; $h_{oe} = 45 S$ [15 marks]



c) A transistor employs a $4 K\Omega$ load and $V_{CC} = 13V$. What is the maximum input signal if $\beta = 100$? Given $V_{knee} = 1V$ and a change of $1V$ in V_{BE} causes a change of $5mA$ in collector current [5 marks]

QUESTION FIVE (20 MARKS)

a) The figure below shows a circuit of a summing amplifier. Determine the value of output voltage for this circuit [10 marks]



b) A differentiator has a feedback resistor $R_1 = 14 \text{ K}\Omega$ and input capacitance $C_1 = 0.02 \mu\text{F}$. Calculate cut-off frequency and its maximum linear operating frequency [4 marks]

c) The figure below shows an OPAMP configuration. Determine the value of R_2 required to produce a gain of 150 [6 marks]

