



MACHAKOS UNIVERSITY

University Examinations for 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
THIRD YEAR SUPPLEMENTARY EXAMINATIONS FOR
BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC
ENGINEERING

EEE 309: ANALOGUE ELECTRONICS II

DATE: _____

TIME: _____

INSTRUCTIONS TO STUDENTS

Answer question **ONE** and **ANY OTHER TWO** questions

QUESTION ONE [30 MARKS].

- (a) Calculate the small-signal voltage gain of the bipolar transistor circuit shown in Fig Q1(a). Assume the transistor circuit parameters are $\beta = 100$, $V_{CC} = 15 \text{ V}$, $V_{BE} = 0.7 \text{ V}$, $R_C = 9 \text{ k}\Omega$, $R_B = 50 \text{ k}\Omega$ and $V_{BB} = 1.2 \text{ V}$.

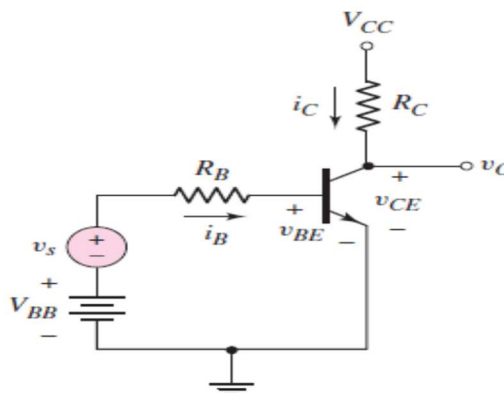


Fig Q1(a).

(8 marks)

- (b) A transistor used in common emitter configuration has the following set of h parameters when d.c. operating point is $V_{CE} = 5 \text{ V}$ and $I_C = 1 \text{ mA}$. $H_{ie} = 1800 \Omega$; $h_{re} = 1.5 \times 10^{-4}$; $h_{fe} = 48$; $h_{oe} = 6 \times 10^{-6} \text{ siemens}$ and a.c load as seen by the transistor is $r_L = 2 \text{ K}\Omega$. Determine:
- Input impedance;
 - Current gain;
 - Voltage gain.
- (6 marks)
- (c) Explain the following terms with respect to power amplifiers.
- Collector efficiency;
 - Distortion;
 - Power dissipation capability.
- (6 marks)
- (d) An NPN transistor that is biased using potential divider method, $R_C = 10 \text{ K}\Omega$, $R_L = 30 \text{ K}\Omega$, and $V_{CC} = 20 \text{ V}$. The values R_1 and R_2 are set so as to fix the operating point at 10 V , 1 mA . Assuming R_E is negligible sketch on the same axis:
- d.c load line
 - a.c load line.
- (10 marks)

QUESTION TWO (20 MARKS)

- (a) With the aid of a circuit diagram describe the operation of a Hartley oscillator.
- (11 marks)
- (b) i. A 1 mH inductor is available. Choose the capacitor values in a Colpitts oscillator so that $f = 1 \text{ MHz}$ and the feedback fraction $m_v = 0.25$.
- (6 marks)
- ii. State the Barkhausen criterion and explain its significance.
- (3 marks)

QUESTION THREE (20 MARKS)

- (a) i. An operational amplifier has a slew rate of $2 \text{ V} / \mu\text{s}$. If the peak output is 12 V , what is the power bandwidth?
- ii. For the given circuit in FigQ3(a) $I_{in(off)} = 20 \text{ nA}$. If $V_{in(off)} = 0$, determine the differential input voltage and the output offset voltage if $A = 105$.

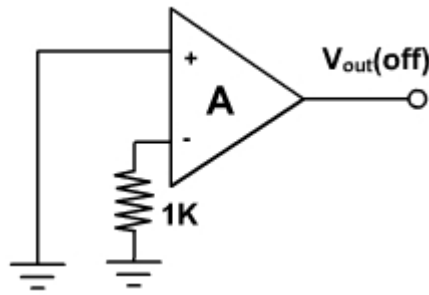


Fig. Q3(a),

(2 marks)

- (b) For the inverting amplifier of Fig. Q3(b), find the voltage gain v_o/v_s :
- Given that the open-loop voltage gains A_v is negatively infinite. And
 - Given that the input impedance R_d between terminals 1 and 2 is infinitely large; thus, the input current is zero.

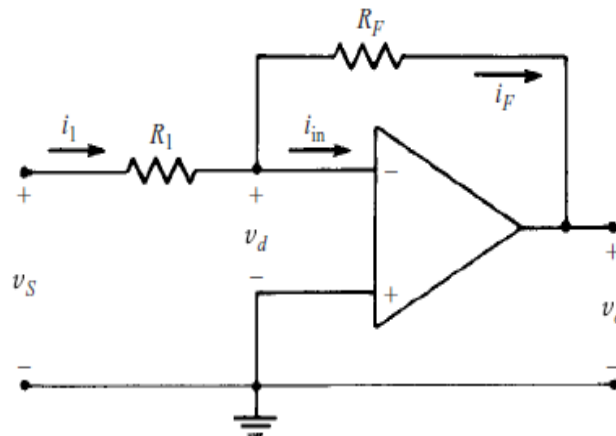


Fig. Q3(b)

(7 marks)

- (c) i. An inverting amplifier is implemented with $R_1 = 1\text{K}$ and $R_f = 100\text{K}$. Find the percent change in the closed loop gain A as the open loop gain A changes from $2 \times 10^5 \text{ V/V}$ to $5 \times 10^4 \text{ V/V}$.
- ii. Repeat, but for a non-inverting amplifier with $R_1 = 1\text{K}$ at $R_f = 99\text{K}$.

(11 marks)

QUESTION FOUR (20 MARKS)

- (a) A transistor used in CE arrangement has the following set of values: $V_{cc} = +20\text{V}$, $R_1 = 80\text{K}\Omega$, $R_2 = 40\text{K}\Omega$, $R_C = 10\text{K}\Omega$, $R_E = 10\text{K}\Omega$ and $R_L = 30\text{K}\Omega$. The h parameters of the transistor are: $h_{ie} = 1500\Omega$; $h_{re} = 4 \times 10^{-4}$; $h_{fe} = 50$; $h_{oe} = 5 \times 10^{-5} \text{ mho}$. Determine
- a.c input impedance of the amplifier;
 - voltage gain.

(7 marks)

- (b) State any three limitations h-parameters.

(3 marks)

- (c) An amplifier has mid-band voltage gain A_{vmid} of 1000 with $f_L = 50$ Hz and $f_H = 50$ KHz, if 5% feedback is applied calculate the following with feedback
- gain;
 - f_L ;
 - f_H .

(5 marks)

- (d) A transistor supplies 0.85 W to a 4 K Ω load. The zero signal D.C collector current is 31 mA and the D.C collector current with signal is 34 mA. Determine the second harmonic distortion.

(5 marks)

QUESTION FIVE (20 MARKS)

- (a) A common emitter class A transistor power amplifier uses a transistor with $\beta = 100$. The load has a resistance of 81.6 Ω , which is transformer coupled to the collector circuit. If the peak values of collector voltage and current are 30 V and 35 mA respectively and the corresponding minimum values are 5 V and 1 mA respectively, determine :

- the approximate value of zero signal collector current
- the zero signal base current
- P_{dc} and P_{ac}
- collector efficiency
- turn ratio of the transformer.

(11 marks)

- (b) For a class B amplifier providing a 20-V peak signal to a 16- Ω load (speaker) and a power supply of $V_{CC} = 30$ V, determine the

- input power;
- output power;
- circuit efficiency.

(9 marks)