



MACHAKOS UNIVERSITY

University Examination 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

EEE 309: ANALOGUE ELECTRONICS II

DATE:

TIME:

INSTRUCTIONS

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 $\beta = 100$, $V_{CC} = 12\text{ V}$, $V_{BE} = 0.7\text{ V}$, $R_C = 6\text{ k}\Omega$, $R_B = 50\text{ k}\Omega$ and $V_{BB} = 1.2\text{ V}$.

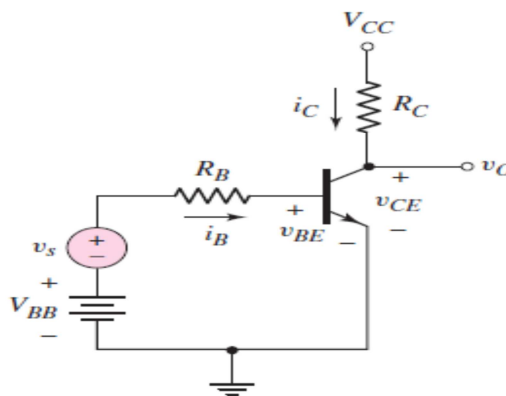


Fig Q1(a).

(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 $I_C = 1\text{ mA}$. $H_{ie} = 1700\ \Omega$; $h_{re} = 1.3 \times 10^{-4}$; $h_{fe} =$

38 ; $h_{oe} = 6 \times 10^{-6}$ siemens and a.c load as seen by the transistor is $r_L = 2 \text{ K}\Omega$.

Determine:

- i. Input impedance;
 - ii. Current gain;
 - iii. Voltage gain (6 marks)
- c) i A power transistor has thermal resistance $\theta = 300 \text{ }^\circ\text{C/W}$. If the maximum junction temperature is $90 \text{ }^\circ\text{C}$ and the ambient temperature is $30 \text{ }^\circ\text{C}$, determine the maximum permissible power dissipation.
- ii. If a heat sink is used with the above transistor, the value of θ is reduced to $60 \text{ }^\circ\text{C/W}$. Calculate the maximum permissible power dissipation. (4 marks)
- d) Derive the expression for the Miller's capacitance $C_M = C_{bc}(1 + A_V)$ where C_{bc} is the internal base-collector junction capacitance and A_V is the voltage gain of a common emitter amplifier. (12 marks)

QUESTION TWO (20 MARKS)

- a) i What is the Barkhausen criterion?
- ii. Describe the two conditions for sustained oscillation. (6 marks)
- b) Consider the ac equivalent circuit of the Hartley oscillator in Fig.Q3 (b)
- i. Derive the expression for the frequency of oscillation;
 - ii. Determine the condition for sustained oscillations.

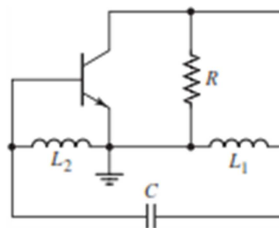


Fig.Q3 (b)

(14 marks)

QUESTION THREE (20 MARKS)

- a) Explain the following terms:

- i. Miller effect;
- ii. Cutoff frequency;
- iii. Cascode configuration. (6 marks)

- b) For the common-emitter circuit in Fig.Q5 (a), assume the emitter bypass capacitor C_E is very large, and the transistor parameters are: $\beta_o = 100$, $V_{BE}(\text{on}) = 0.7\text{V}$, $V_A = 8$, $C_\mu = 2\text{pF}$, and $f_T = 400\text{MHz}$. Determine the lower and upper 3 dB frequencies for the small-signal voltage gain. Use the simplified hybrid model for the transistor.

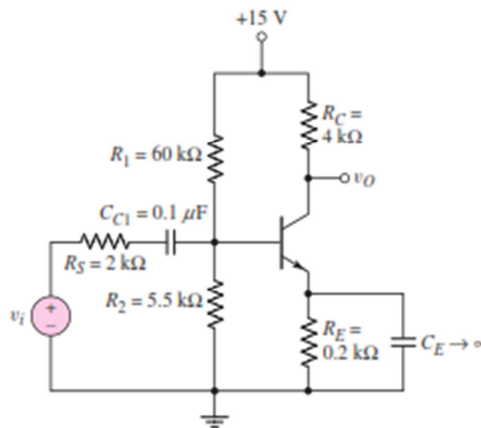
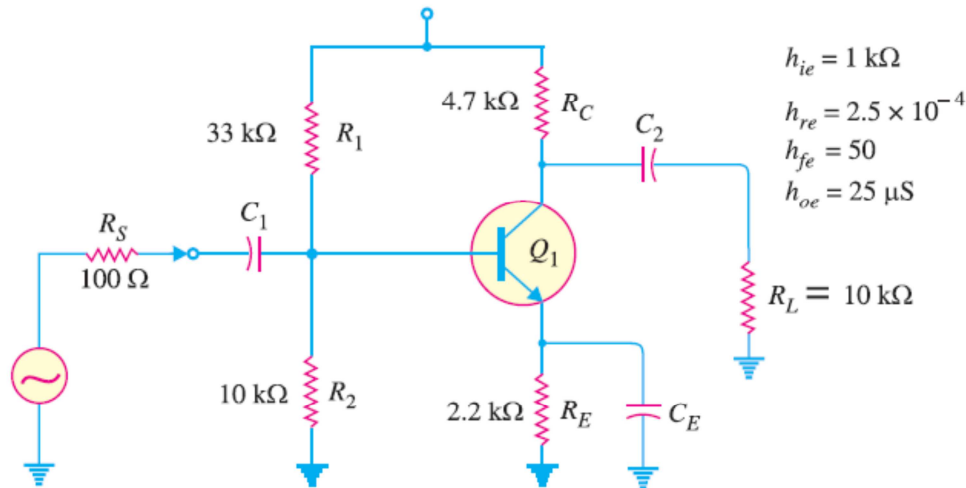


Fig.Q5 (a)

(14 marks)

QUESTION FOUR.

- a) Fig. Q4(a) shows the transistor amplifier in CE arrangement and its h parameters. Calculate the value of the
- i. a.c. input impedance of the amplifier without considering source resistance R_S ;
 - ii. voltage gain and
 - iii. output impedance.



FigQ4(a)

(15 marks)

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

- i gain;
- ii. f_L ;
- iii. f_H

(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 81.6Ω , 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:

- i. the approximate value of zero signal collector current
- ii. The zero signal base current
- iii. P_{dc} and P_{ac}
- iv. Collector efficiency
- v. turn ratio of the transformer.

(11

marks)

- b) For a class B amplifier providing a 20-V peak signal to a $16\text{-}\Omega$ load (speaker) and a power supply of $V_{CC} = 30\text{ V}$, determine the
- i. input power;
 - ii. Output power;
 - iii. Circuit efficiency.
- (9 marks)