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

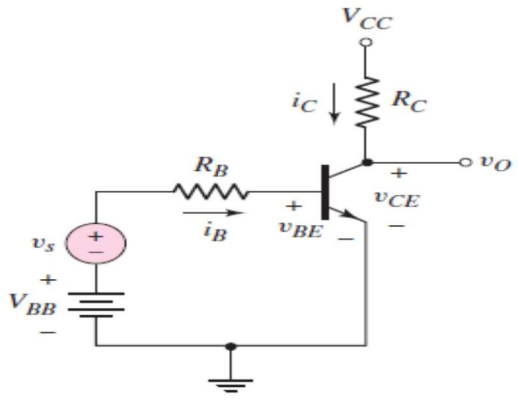


Fig Q1(a). (8 marks)

b) A transistor used in common emitter configuration has the following set of h parameters when d.c. operating point is $V_{CE} = 5$ V and $I_C = 1$ mA. $H_{ie} = 1700$ Ω ; $h_{re} = 1.3 \times 10^{-4}$; $h_{fe} = 38$; $h_{oe} = 6 \times 10^{-6}$ siemens and a.c load as seen by the transistor is $= r_L = 2$ KΩ. Determine:

i. Input impedance;

ii. Current gain;

iii. Voltage gain (6 marks)

c) i A power transistor has thermal resistance $\theta = 300\ ^oC/W$. If the maximum junction temperature is 90 ^oC and the ambient temperature is 30 ^oC, 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 $^oC/W$. 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 Av 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.

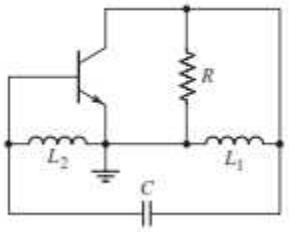


Fig.Q3 (b) (14 marks)

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: $ß_o = 100$ V_{BE} (on) = 0.7V, V_A=8, Cμ= 2pF, and f_τ = 400MHz. Determine the lower and upper 3 dB frequencies for the small-signal voltage gain. Use the simplified hybrid model for the transistor.

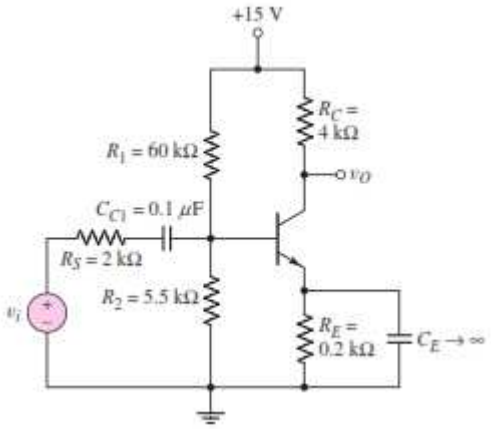


Fig.Q5 (a) (14 marks)

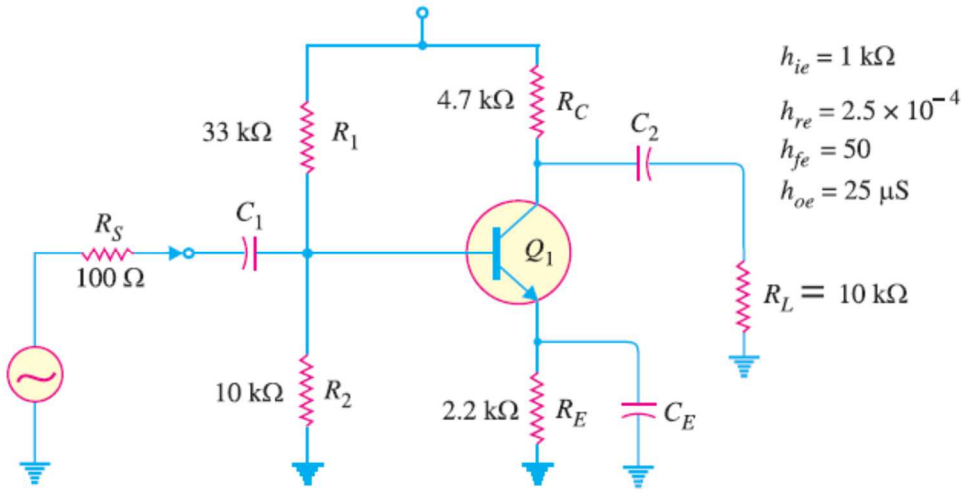
QUESTION FOUR.

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 Rs;

ii. voltage gain and

iii. output impedance.



FigQ4(a) (15 marks)

b) 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

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 β = 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:

i. the approximate value of zero signal collector current

ii. The zero signal base current

iii. Pdc and Pac

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-Ω load (speaker) and a power supply of V_{CC} = 30 V, determine the

i. input power;

ii. Output power;

iii. Circuit efficiency. (9 marks)