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 $\beta = 100$, $V_{CC} = 15$ V, $V_{BE} = 0.7$ V, $R_C = 9$ kΩ, $R_B = 50$ kΩ and $V_{BB} = 1.2$ V.

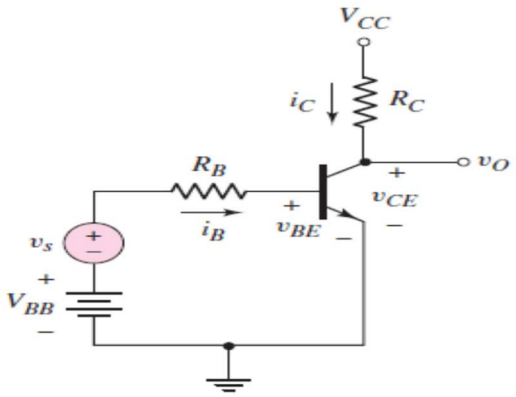

Fig Q1(a).

(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} = 1800 Ω ; h_{re} = 1.5 x 10^{-4} ; h_{fe}= 48 ; h_{oe} = 6 x 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) Explain the following terms with respect to power amplifiers.

i. Collector efficiency;
ii. Distortion;
iii. Power dissipation capability.

(6 marks)

(d) An NPN transistor that is biased using potential divider method, R_C = 10 KΩ, R_L = 30 KΩ, and V_{CC} = 20 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:

i. d.c load line
ii. 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 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 V / μs. If the peak output is 12 V, what is the power bandwidth?

ii. For the given circuit in FigQ3(a) I_{in}(off) = 20 nA. If V_{in}(off) = 0, determine the differential input voltage and the output offset voltage if A = 105.

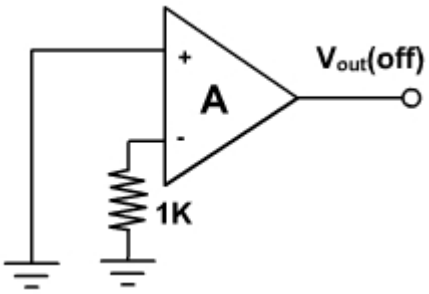

Fig. Q3(a),

(2 marks)

(b) For the inverting amplifier of Fig. Q3(b), find the voltage gain v_o/v_S:

i. Given that the open-loop voltage gains Av is negatively infinite. And

ii. Given that the input impedance R_d between terminals 1 and 2 is infinitely large; thus, the input current is zero.

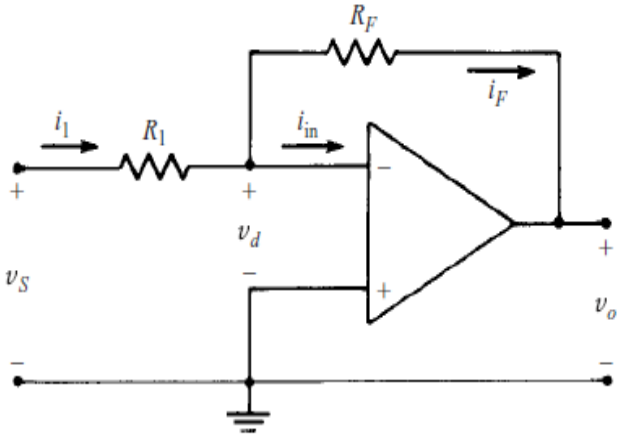

Fig. Q3(b)

(7 marks)

(c) i. An inverting amplifier is implemented with R1 = 1K and Rf = 100 K. Find the percentge change in the closed loop gain A is the open loop gain a changes from 2 x 105 V / V to 5 x 104 V/V.

ii. Repeat, but for a non-inverting amplifier with R1 = 1K at Rf = 99 K.

(11 marks)

QUESTION FOUR (20 MARKS)

(a) A transistor used in CE arrangement has the following set of values: Vcc = + 20 V, R_1 = 80 KΩ, R_2 = 40 K Ω, R_C = 10 KΩ, R_E = 10 KΩ and R_L = 30 KΩ. T he h parameters of the transistor are: h_{ie} = 1500 Ω ; h_{re} = 4 x 10^{-4} ; h_{fe}= 50 ; h_{oe} = 5 x 10^{-5} mho. Determine

i. a.c input impedance of the amplifier;

ii. 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

i gain;
ii. $f_{L;}$
iii. $f_{H.}$

(5 marks)

(d) A transistor supplies 0.85 W to a 4 KΩ 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 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)