



MACHAKOS UNIVERSITY

University Examinations for 2023/2024 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FIFTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS
ENGINEERING)

EEE 533: ELECTRONIC CIRCUITS AND SYSTEMS

DATE:

TIME:

INSTRUCTIONS:

- (i) There are **Five** questions.
- (ii) Question No.1 is **Compulsory** and carries **30 Marks**.
- (iii) Select any **other Two** questions, each of which carries 20 Marks.
- (iv) Define all symbols used.
- (v) Marks will be awarded for procedure, methodologies used and not necessarily on the final answer.

QUESTION ONE (COMPULSORY) (30 MARKS)

- a)
 - (i) What is a Voltage Controlled Oscillator (VCO) and what is it used for? (4 marks)
 - (ii) Using relevant schematic diagrams, show how a Colpitt Oscillator Tank can be converted into a (VCO). (6 marks)
- b)
 - (i) Draw the circuit for a diode voltage regulator and describe its operation. (7 marks)
 - (ii) The h_{fe} for each transistor in a Darlington Pair is 100. Calculate the gain for the pair. (3 marks)
- c)
 - (i) Show how linear integrated circuits are fabricated for active components. Use relevant sketches. (4 marks)

- (ii) Demonstrate thorough understanding of what a Power Supply is. (6 marks)

QUESTION TWO (20 MARKS)

- (a) (i) Name two types of current-limiting circuits. (3 marks)
(ii) Draw the circuit diagram of the Wien Bridge Oscillator and describe its operation. (7 marks)
- (b) The equivalent circuit of a voltage regulator is depicted at Fig. Q2. Derive the expression for R_s , the source resistance, in terms of V_S , V_D , I_D , R_L , & r_d . (10 marks)

QUESTION THREE (20 MARKS)

- (a) (i) Draw the schematic diagram of a tuned amplifier based on a simple common-emitter configuration. (4 marks)
(ii) Describe the technical operation of the amplifier in (i). (6 marks)
- (b) (i) Fig Q3 is a common-emitter configuration of a BJT. Derive the h – parameters for the configuration. (8 marks)
(ii) Name the applications of a VCO. (2 marks)

QUESTION FOUR (20 MARKS)

- (a) Fig. Q4 (a) is a differential amplifier, while Fig. Q4(b) is a current source. Show how the two diagrams can be combined to produce a new differential amplifier with improved bandwidth. (6 marks)
- (b) Explain the following terms with respect to Frequency Synthesis:
i. Reference frequency.
ii. Phase detector.
iii. Frequency divider. (6 marks)
- (c) Using a relevant block diagram describe the operation of a logic analyzer. (8 marks)

QUESTION FIVE (20 MARKS)

- (a) Consider the Digital-to-Analog Converter Circuit depicted in Fig.Q5.
- Describe how the circuit functions. (5 marks)
 - Given a data input 1 0 1 0, and that $V_{High} = 5 \text{ volts}$ and $V_{Low} = 0$, calculate: -
 - Total current. (5 marks)
 - Output voltage. (5 marks)

Take R_F , R_3 , R_2 , R_1 , and R_0 as $10k\Omega$, $20k\Omega$, $40k\Omega$, $80k\Omega$, and $160k\Omega$ respectively.

- (b) Discuss the Widlar Current Source and its application. (5 marks)

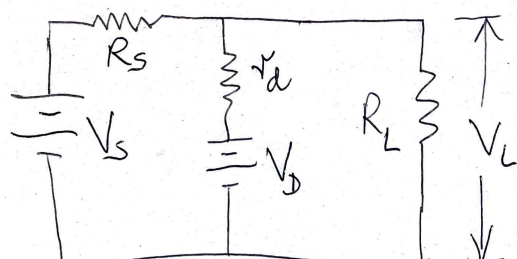


Fig Q2

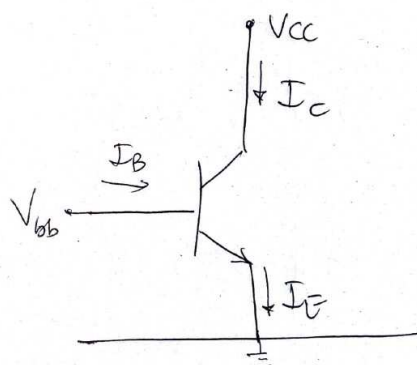


Fig Q3.

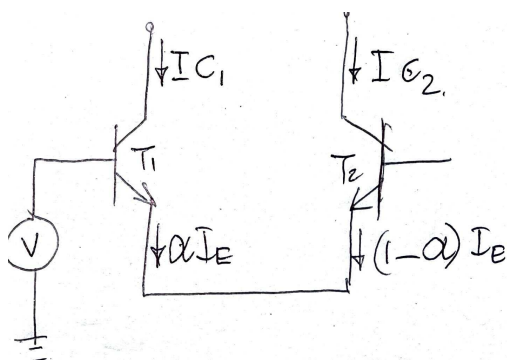


Fig Q4 a. Diff. Am

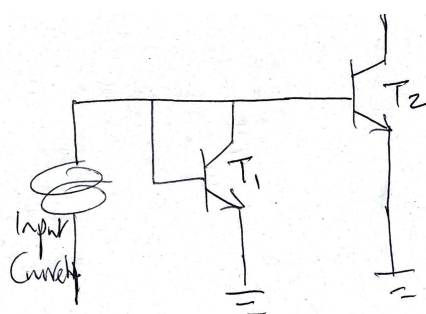


Fig Q4 b. Current Source

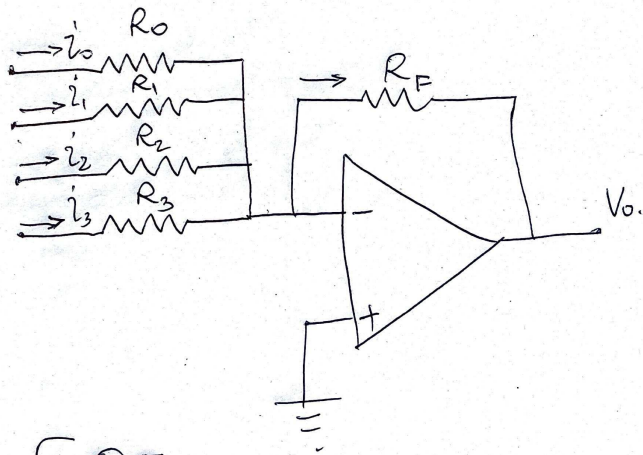


Fig Q5