



KENYATTA UNIVERSITY

EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (ENERGY ENGINEERING)

TET 300: ENGINEERING ELECTRONICS

1ST SEMESTER 2023/2024

TIME: 2 HOURS

INSTRUCTIONS:

- (i) Attempt question ONE and any other TWO questions
- (ii) Use clear diagrams where necessary

QUESTION ONE (30 MARKS)

- a) Define the following
 - i) Oscillators (1 mark)
 - ii) Inequality comparator (1 mark)
 - iii) Truth table (1 mark)
- b) Draw a logic circuit for the logic statement: $X = 1$ if ((A is 1 AND B is 1) OR (A is NOT 1 AND C is 1)) (3 marks)
- c) Explain the difference between relaxation and feedback oscillators. Use diagrams to support your answer. (4 marks)
- d) Calculate the
 - i) operating frequency and (2 marks)
 - ii) feedback fraction for Hartley oscillator (2 marks)

shown in Figure 1. The mutual inductance between the coils, $M = 20 \mu\text{H}$.

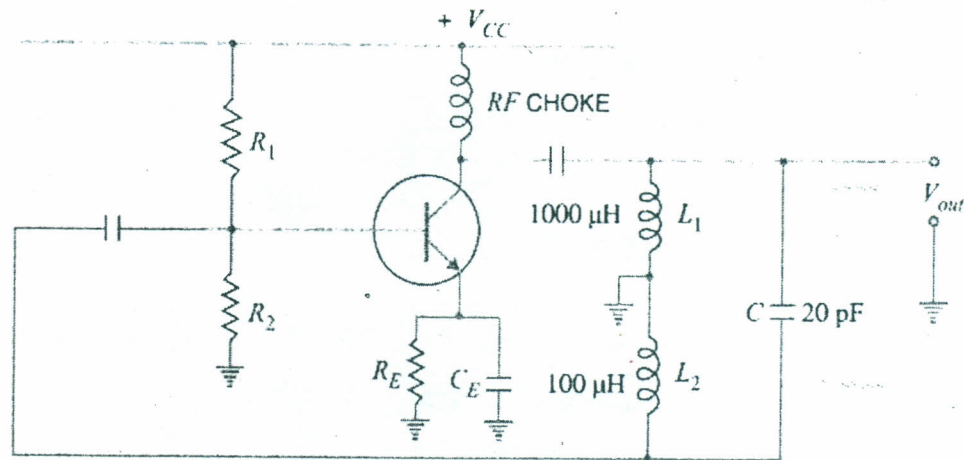


Figure 1

e) Find the expression for y in the logic circuit shown in Figure 2

(3 marks)

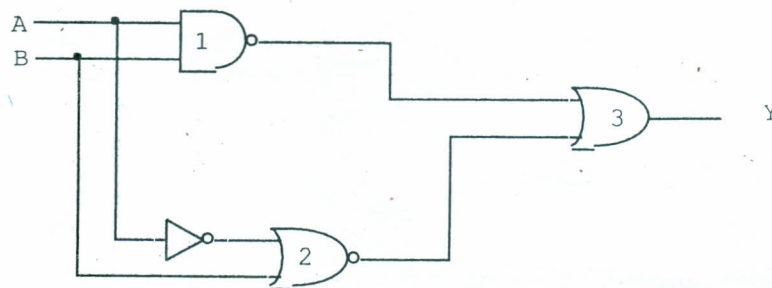


Figure 2

f) A 1 mH inductor is available. Choose the capacitor values in a Colpitts oscillator so that $f = 1$ MHz and $m_v = 0.25$.

(3 marks)

g) Simplify using Boolean algebra $Y = \overline{C \cdot A \cdot B} + (\overline{C} + D) \cdot A \cdot B$

(3 marks)

h) Perform the following

i) hexadecimal subtraction of $(8B6F)_{16}$ from $(E7AC)_{16}$

(2 marks)

ii) Addition $(4712)_8$ and $(1624)_8$.

(2 marks)

iii) In 2's complements add $-10 + -15 = -25$ using 8 bits

(3 marks)

$$11100111 = 10011001$$

QUESTION TWO (20 MARKS)

- a) A car seat belt interlock requires that the car should only start if the driver's seat belt is fastened and either the front passenger seat is occupied and the passenger seat belt is fastened.
- Obtain the truth table of the system and find the SOP Boolean expression for this system. (2 marks)
 - Use Boolean algebra method to simplify the expression in i) above. (5 marks)
 - Implement the system using AND, NOT and OR logic gate. (3 marks)
- b) Explain the difference between the functions of an AND gate and an OR gate. (3 marks)
- c) Discuss the operation of positive edge triggered S-R flip-flop showing the truth table and the logic diagram. (6 marks)

QUESTION THREE (20 MARKS)

- a) Explain the operation of full bridge rectifier. (5 marks)
- b) Give the circuit of a 4-bit Serial-in Parallel shift register using D Flip flops. Briefly discuss the operation. (5 marks)
- c) A transistor is connected in common emitter (CE) configuration in which collector supply is 8 V and the voltage drop across resistance R_C connected in the collector circuit is 0.5 V. The value of $R_C = 800 \Omega$. If $\alpha = 0.96$, determine:
- Collector – emitter voltage. (4 marks)
 - Base current. (6 marks)

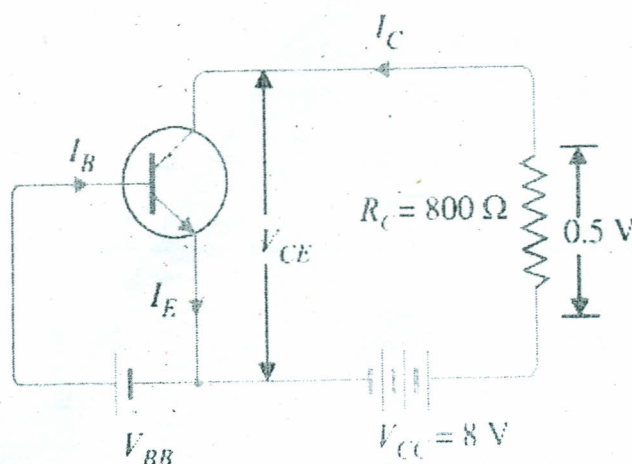


Figure 3

QUESTION FOUR (20 MARKS)

- a) Implement the function $F(A,B,C) = AB + AC'D + BC'$ using only NOR gates

(4 marks)

- b) Convert the following numbers. In each case show how you arrive at your answer.

i) 526.37_8 to hexadecimal. (2 marks)

ii) (731.32) radix 10 to radix 16 equivalent (2 marks)

iii) 59.72_{10} to BCD (2 marks)

- c) A car alarm circuit has three inputs which detect the following conditions:

- Whether the door is CLOSED (0) or OPEN (1);
- Whether the ignition is turned ON or OFF
- Whether the headlights are ON or OFF

Design a simplified logic circuit which uses these three inputs and sounds the alarm if either the headlights are ON while the ignition is OFF; or the door is OPEN when the ignition is ON.

(10 marks)

QUESTION FIVE (20 MARKS)

- a) Give FOUR differences between ripple and synchronous counters

(4 marks)

- b) Minimize the following function and realize using NAND gate.

(6 marks)

$$F = ABC'D + A'BCD + A'B'C'D + ABCD + AB'C'D + (AB)'CD$$

- c) An inductance of 200mH and a capacitor of 10pF are connected together in parallel to create an LC oscillator tank circuit. Calculate the frequency of oscillation. (4 marks)

- d) A bank vault has 3 locks with a key for each lock. Key A is owned by the bank manager. Key B is owned by the senior bank teller. Key C is owned by the trainee bank teller. In order to open the vault door at least two people must insert their keys into the assigned locks at the same time. The trainee bank teller can only open the vault when the bank manager is present in the opening.

- i) Determine the truth table for such a digital locking system (2 marks)

- ii) Find a minimized expression for the output and draw a minimum AND-OR gate network to realize this locking system. (4 marks)