



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING

EMM 300: ENGINEERING ELECTRONICS

DATE: 26/11/2020

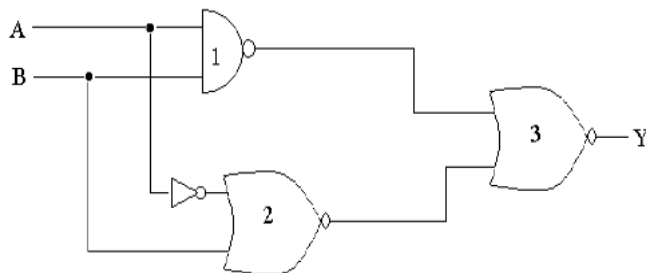
TIME: 8.30-10.30 AM

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (30 MARKS)

- a) Find the Boolean expression for the logic circuit in FigQ3 (a).



FigQ3 (a)

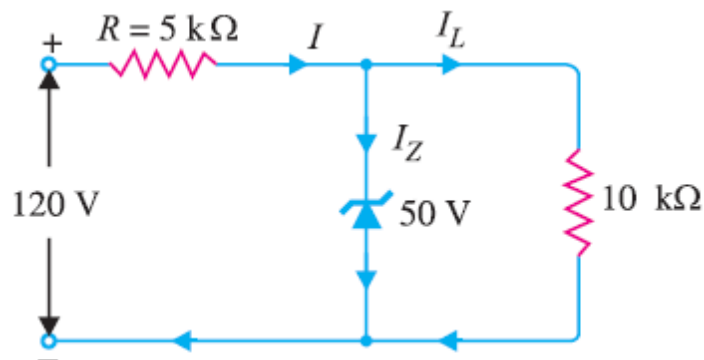
(7 marks)

- b) Prove that the ripple factor of a half-wave rectifier is 1.21 and that of a full-wave rectifier is 0.482. (6 marks)
- c) A diode having internal resistance $20\ \Omega$ is used for half-wave rectification. If the applied voltage $V = 50 \sin \omega t$ and load resistance is $800\ \Omega$, find
- (i) $I_{\max}$, I_{dc} , I_{rms}
 - (ii) ac power input and dc power input

- (iii) dc output voltage
 - (iv) efficiency of rectification (7 marks)
- d) In a transistor amplifier, when the signal changes by 0.02V, the base current changes by 10 μ A and collector current by 1 mA. If collector load $R_C = 5 \text{ K}\Omega$ and $R_L = 10 \text{ K}\Omega$, find:
- i. Current gain;
 - ii. Input impedance;
 - iii. a.c load;
 - iv. Voltage gain;
 - v. Power gain. (10 marks)

QUESTION TWO (20 MARKS)

- a) A circuit consisting of a full-wave rectifier having a forward dynamic resistance $R_f = 500 \Omega$, has a load resistance $R = 1 \text{ K}\Omega$. Given that the input applied voltage $V_i = 220\sin 314t$, find:
- i. Peak value of current
 - ii. Average value of current;
 - iii. RMS value of current;
 - iv. Efficiency of the rectifier;
 - v. Ripple factor. (10 marks)
- b) For the circuit shown in FigQ2, determine:
- i. the output voltage
 - ii. the voltage drop across series resistance
 - iii. the current through zener diode. (10 marks)



FigQ2

QUESTION THREE (20 MARKS)

- a) Consider the ac equivalent circuit of the Colpitt oscillator in Fig.Q3 (a)
- Derive the expression for the frequency of oscillation;
 - Determine the condition for sustained oscillations. (8 marks)

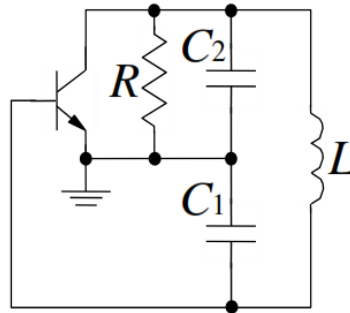


Fig.Q3(a)

- b) i A silicon transistor using the voltage divider bias method has the following parameters: $R_1 = 33 \text{ K}\Omega$, $R_2 = 15 \text{ K}\Omega$, $R_C = 1 \text{ K}\Omega$, $R_E = 680 \Omega$ and $V_{CC} = 9 \text{ V}$. Determine the operating point of this transistor.
- ii. Given that the load resistor for the transistor in (b) i $R_L = 1 \text{ K}\Omega$ and that input and output coupling and emitter bypass capacitors are used draw the ac equivalent circuit. (12 marks)

QUESTION FOUR (20 MARKS)

- a) Add -118 and -32 firstly using eight-bit 2's complement arithmetic and then using 16-bit 2's complement arithmetic. Comment on the results. (10 marks)
- b) A single stage common emitter amplifier using base resistor bias method has the following parameters: $V_{BB} = 2 \text{ V}$, $R_B = 100 \text{ K}\Omega$, $R_C = 2 \text{ K}\Omega$, $\beta = 50$ and $V_{CC} = 9 \text{ V}$. Determine the following:
- Collector current I_C ;
 - Collector-emitter voltage V_{CE} (neglect the small base-emitter voltage);
 - The new operating point if R_B is changed to $50 \text{ K}\Omega$. (5 marks)

- c) Starting with the Boolean expression for a two-input OR gate, apply Boolean laws and theorems to modify it in such a way as to facilitate the implementation of a two-input OR gate by using two-input NAND gates only. (5 marks)

QUESTION FIVE (20 MARKS)

- a) i Define synchronous counters. (13 marks)
- ii Design a **MODULO-5** synchronous counter using **JK** flip-flops. (7 marks)
- b) Explain how a shift register can be used as a ring counter giving the wave forms at the output of the flip-flops. (7 marks)