MACHAKOS UNIVERSITY

University Examinations for 2019/2020Academic 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

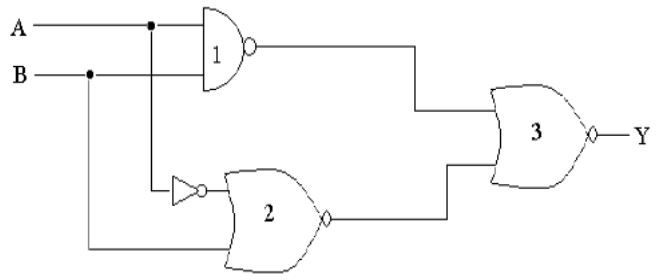
DATE: 26/11/2020 **TIME: 8.30-10.30 AM**

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 Ω is used for half-wave rectification. If the applied voltage $V = 50 \sin wt$ and load resistance is 800Ω, 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 μA and collector current by 1 mA. If collector load R_C = 5 KΩ and R_L = 10 KΩ, 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 Ω, has a load resistance R = 1 KΩ . Given that the input applied voltage V_i = 220sin 314t, find:

i. Peak value of current

ii. Average value of current;

iii. RMS value of current;

iv. Efficiency of the rectifier;

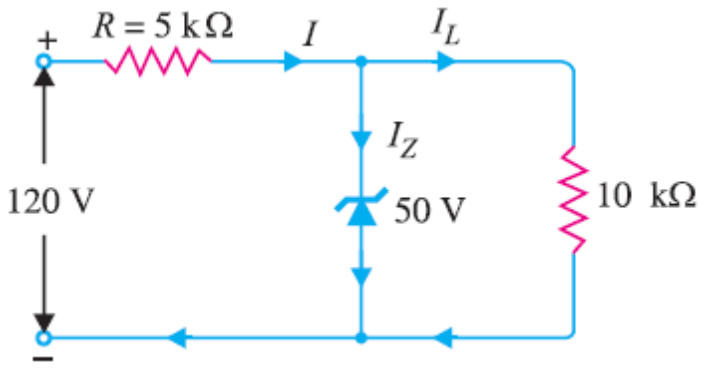
v. Ripple factor. (10 marks)

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)

i. Derive the expression for the frequency of oscillation;

ii. Determine the condition for sustained oscillations. (8 marks)

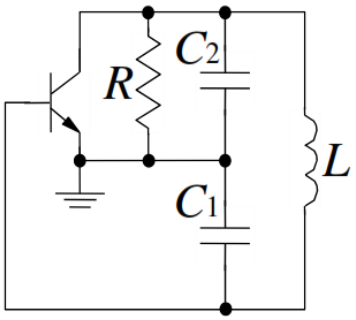


Fig.Q3(a)

b) i A silicon transistor using the voltage divider bias method has the following parameters: R_1 = 33 KΩ, R_2 = 15 KΩ, R_C = 1KΩ, R_E = 680 Ω and V_{CC} = 9 V. Determine the operating point of this transistor.

ii. Given that the load resistor for the transistor in (b) i R_L = 1 KΩ 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 V, R_B = 100 KΩ, R_C = 2 KΩ, β = 50 and V_{CC} = 9 V. Determine the following:

i. Collector current I_C;

ii. Collector-emitter voltage V_{CE} (neglect the small base-emitter voltage);

iii. The new operating point if R_B is changed to 50 KΩ. (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.

ii Design a **MODULO-5** synchronous counter using **JK** flip-flops. (13 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)