MACHAKOS UNIVERSITY

UNIVERSITY EXAMINATIONS 2021/2022

THIRD YEAR SECOND SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMM 300: ENGINEERING ELECTRONICS

DATE: December, 2021 **TIME: 2 Hours**

INSTRUCTIONS

Answer question **ONE** and **ANY OTHER TWO** questions

Question One [30 marks]

(a) Use a K map to simplify

.

$$y = \overline{C}(\overline{A}\,\overline{B}\,\overline{D} + D) + A\overline{B}C + \overline{D}.$$

(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) With the aid if a circuit digram describe the operation of a Hartley oscillator.

(10 marks)

Question Two.

(a) A full wave bridge rectifier is supplied from 230 V, 50 Hz and uses a transformer of turns ratio of 15: 1. It uses load resistance of 50 Ω. Calculate load voltage and ripple voltage. Assume ideal diode and transformer. Assume standard value of ripple factor for full wave rectifier.

(10 marks)

(b) A full wave rectifier circuit is fed from a transformer having a center-tapped secondary winding. The r.m.s. voltage from either end of secondary to center tap is 30 V. If the diode forward resistance is 2 Ω and that of the half secondary is 8 Ω, for a load of 1 kΩ, calculate,

i. Power delivered to load,
ii. % Regulation at full load,
iii. Efficiency of rectification,
iv. T.U.F. of secondary.

(10 marks)

Question Three.

(a) i. The tuned collector oscillator circuit used in the local oscillator of a radio receiver makes use of an LC tuned circuit with L1 = 58.6 μH and C1 = 300 pF. Calculate the frequency of oscillations;

ii. Find the capacitance of the capacitor required to build an LC oscillator that uses an inductance of L_1 = 1 mH to produce a sine wave of frequency 1 GHz;

iii. A Colpitt's oscillator has the following parameters: capacitance C_1 = 0.001 μF, C_2 = 0.01 μF and inductor L = 15 μH. Determine the operating frequency and the feedback fraction for the oscillator.

(8 marks)

(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.

(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) Consider the two circuits in Fig.Q4. The parameters of each transistor are $I_s = 5 \times 10^{-16}$ A and $\beta = 90$. Determine V_{BB} in each circuit such that $V_{CE} = 1.10$ V.

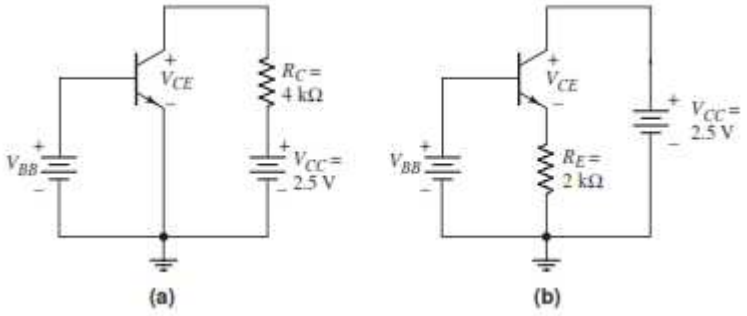

Fig.Q4

(10 marks)

<u>Question Five</u>.

(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]

END