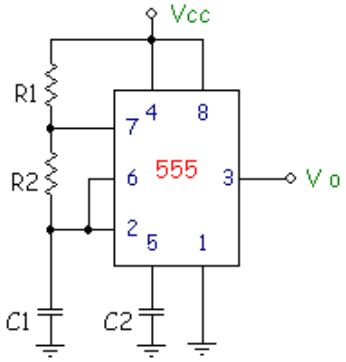
Fundamentals of Engineering Design (FED) 101- LC9

Test 3

Student name:

Student ID number:

Please provide complete and clear answers.



1. Given the following 555 timer in Astable mode, where R1=50KΩ, R2=10KΩ, C1=0.001μF and C2=1nF
   a) Calculate the on-time, T_{ON}. (2 points)
   b) Calculate the frequency, f. (2 points)
   c) Calculate the duty cycle, d. (2 points)
   d) How could you change components in the circuit to double the frequency of the output pulses without affecting the duty cycle? Demonstrate mathematically that your component changes have had the desired effect. (4 points)

Solution:

a) $T_{ON} = 0.693(R1 + R2)C1 = 0.693(50 \times 10^3 + 10 \times 10^3)(1 \times 10^{-9}) = 41.58 \times 10^{-6} =$

$T_{ON} = 41.6\ \mu s$

b) $f = 1.44/((R1 + 2R2)(C1)) = 1.44/((50 \times 10^3 + 20 \times 10^3)(1 \times 10^{-9})) = 0.020571 \times 10^{-6}$

$f = 20571Hz$

c) $D = \left(\frac{T_{ON}}{T}\right) \times 100$

$T = \frac{1}{f} = 4.86 \times 10^{-5}$

$D = (41.6 \times 10^{-6}/4.86 \times 10^{-5}) \times 100 = 0.856 \times 100$

$D = 86\%$

d) $f = 20571Hz$ Double that is 41,143 Hz

Half the size of C1 to 0.5 nF

$f = 1.44/((R1 + 2R2)(C1)) = 1.44/((50 \times 10^3 + 20 \times 10^3)(5 \times 10^{-10})) = 41{,}143\ Hz$