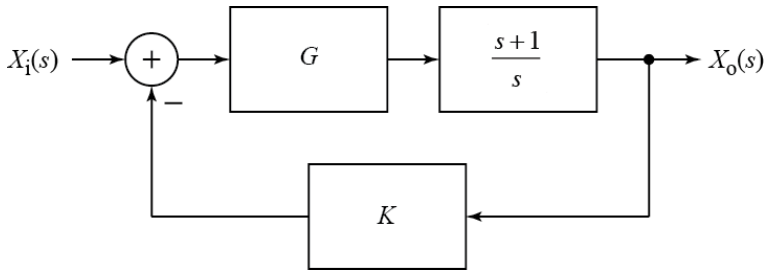
Practice Exam #3

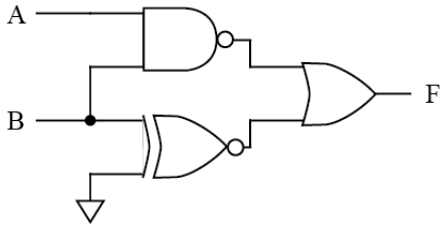
1.



a) Find the transfer function, $H(s) = \dfrac{X_o(s)}{X_i(s)}$, for the above system.

b) If $G = 10$, for what values of K is the system stable? (Consider positive and negative values of K.)

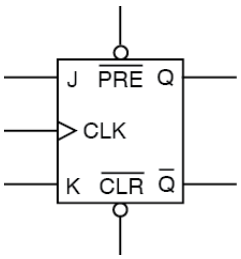
2. a) For the circuit shown below, find the simplest possible Boolean expression for F in terms of A and B. The simplest answer has the minimum total number of ANDS, ORS, and NOTS (inverters).



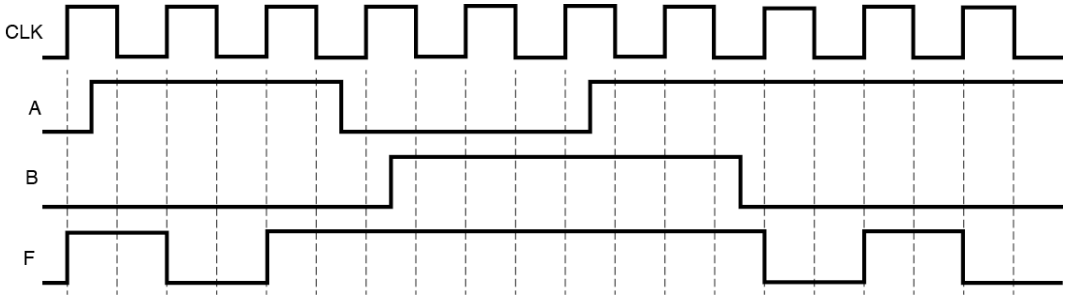
b) Find the simplest Sum-Of-Products (SOP) form for the following Boolean expression:

$$(A+B)(\overline{A}+\overline{B})C$$

c) Show the minimum logic circuit (using logic gates and a Flip-Flop) that has the following timing diagram. CLK, A, and B are inputs, and F is the output. You may use AND, OR, EX-OR, and NOT (inverter) gates. The optimal design has the minimum total number of gate inputs.



$\overline{PRE}$	$\overline{CLR}$	CLK	J	K	Q	$\overline{Q}$	MODE
0	1	X	X	X	1	0	Preset
1	0	X	X	X	0	1	Clear
0	0	X	X	X	-	-	not used
1	1	↑	0	0	Q	$\overline{Q}$	Hold
1	1	↑	0	1	0	1	Reset
1	1	↑	1	0	1	0	Set
1	1	↑	1	1	$\overline{Q}$	Q	Toggle
1	1	not ↑	X	X	Q	$\overline{Q}$	Hold



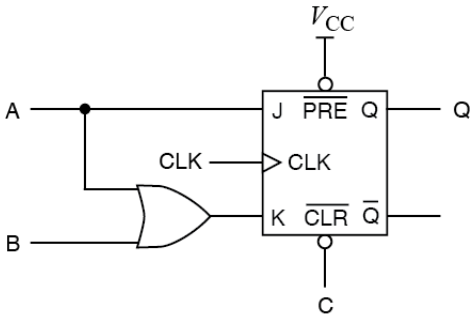
3. a) Find the sum of the following hexadecimal numbers and express the answer in binary and Binary Coded Decimal (BCD).

A3 + 7F

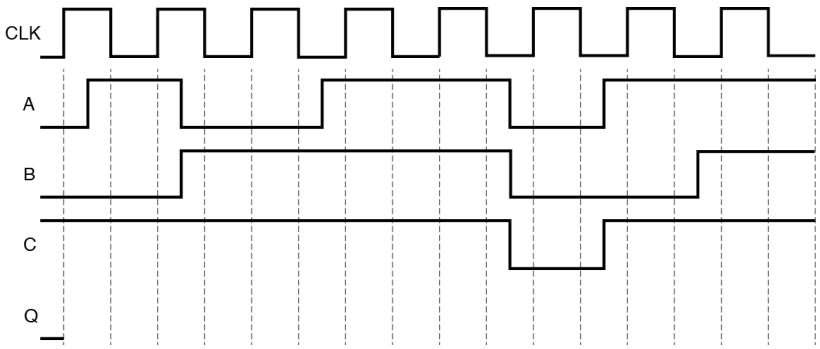
b) Find the product of the following binary numbers and express the answer in octal.

101011 · 011001

c) A Flip-Flop circuit, truth table, and timing diagram are shown below. Fill in the missing waveform for Q in the timing diagram.



$\overline{PRE}$	$\overline{CLR}$	CLK	J	K	Q	$\overline{Q}$	MODE
0	1	X	X	X	1	0	Preset
1	0	X	X	X	0	1	Clear
0	0	X	X	X	-	-	not used
1	1	↑	0	0	Q	$\overline{Q}$	Hold
1	1	↑	0	1	0	1	Reset
1	1	↑	1	0	1	0	Set
1	1	↑	1	1	$\overline{Q}$	Q	Toggle
1	1	not ↑	X	X	Q	$\overline{Q}$	Hold



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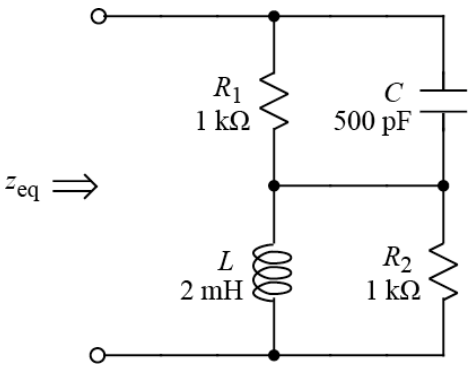

Find the numerical value of the equivalent impedance, z_{eq}, for the circuit. Frequency ω = 1 Mr/s. Express your answer in both rectangular and polar form.