POSSESION OF MOBILES IN EXAM IS UFM PRACTICE.

Name _____ **Enrollment No.**_____

Jaypee Institute of Information Technology, NOIDA
End Term Examination, EVEN Semester 2022
B.Tech IV Sem

Course name: Digital Systems/ Introduction to Digital Systems **Maximum Time: 2 Hr**
Course Code: 18B11EC213/15B11EC314 **Maximum Marks: 35**

After the completion of the course, students will be able to:

CO1: Familiarize with the fundamentals of number systems, Boolean algebra and Boolean function minimization techniques.
CO2: Analyze and design combinational circuits using logic gates.
CO3: Analyze state diagram and design sequential logic circuits using flip flops.
CO4: Understand the classification of signals and systems and learn basic signal operations and Fourier analysis.
CO5: Understand various steps involved in digitization and transmissions of a signal.

Note: Attempt All Questions

Q.1. [CO1] Find the simplest SOP expression using K-map for the following function:

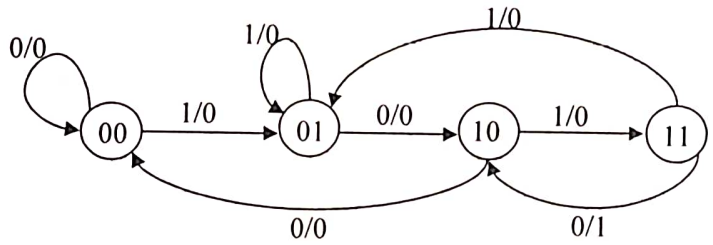
$$F(w, x, y, z) = \Sigma m(0, 1, 4, 6, 8, 9, 10, 12) + d(5, 7, 14)$$

Also find Essential Prime Implicants (EPI) for the above given function. **[4]**

Q.2. [CO2] Design a BCD to Excess-3 (XS-3) code converter. **[4]**

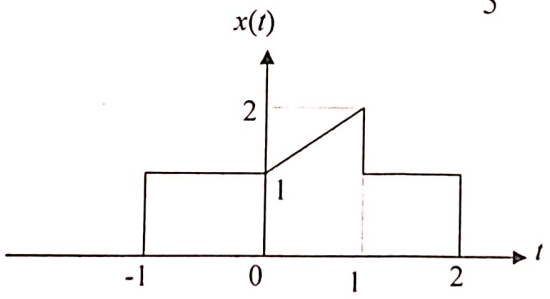
Q.3. [CO3] Explain the working of 4 bit ring counter using D flip flop and draw its timing diagram. **[3]**

Q.4. [CO3] Implement the synchronous sequential circuit using D flip flop for the given state diagram. **[4]**



Q.5. [CO4] For the signal $x(t)$ as shown in below Figure, draw the graph of following signals:

(a) $x(-t+2)$ (b) $x(\frac{3}{5}t)$ **[3]**



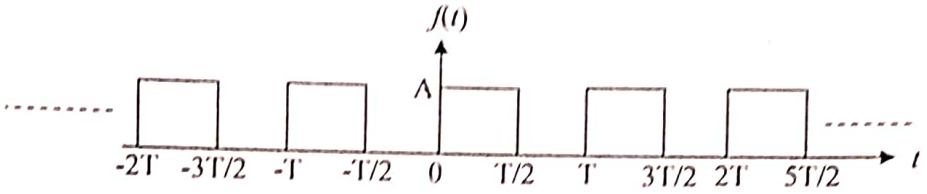
Q.6. [CO4] Determine whether the following signals are periodic or not? If periodic, determine the fundamental period.

(a) $\sin\left(\frac{2\pi}{3}n\right)+\cos\left(\frac{2\pi}{5}n\right)$ (b) $\sin(2t)+\cos\left(\sqrt{3}t\right)$ [3]

Q.7. [CO4] Check the causality and linearity properties of following system:

$$y(t)=x^2(t)+x(t-4)$$ [2]

Q.8. [CO4] Find the complex Fourier series coefficient for $k = 0$ (DC component) for the given periodic waveform. [2]



Q.9. [CO4] Find the Fourier transform of the signal defined as:

$$x(t)=e^{-t}\sin(5t)u(t)$$ [3]

Q.10. [CO5] State Sampling theorem and hence determine the Nyquist rate and Nyquist interval corresponding to each of the following signals:

(a) $m(t)=1+\cos(200\pi t)+\sin(400\pi t)$

(b) $m(t)=10\cos(40\pi t)\cos(300\pi t)$ [3]

Q.11. [CO5] For the binary sequence given as 10110, draw the output waveforms for the following modulation schemes and signalling formats:

(a) BASK

(b) BPSK

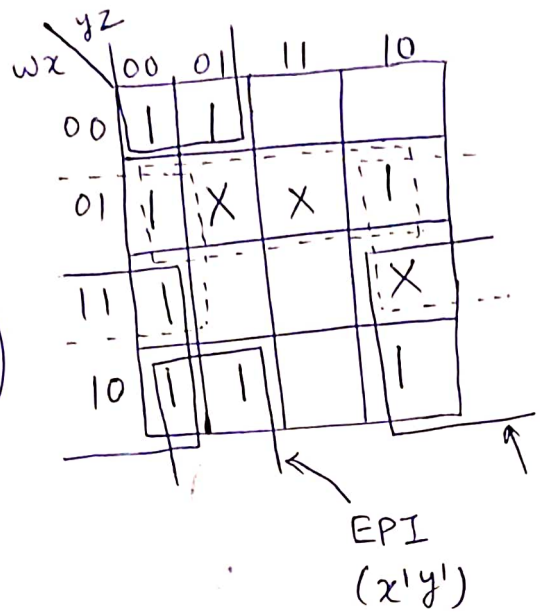
(c) Bipolar NRZ (AMI NRZ)

(d) Manchester (Split phase) [4]

T3 Solution.

Sol.: $F(w,x,y,z) = \Sigma m(0,1,4,6,8,9,10,12) + d(5,7,14)$

Q1



2

[Two EPIs
x'y' , wz']

1

Simplest form

$$F(w,x,y,z) = x'y' + wz' + xz'$$ — 1

or

$$F(w,x,y,z) = x'y' + wz' + w'x$$

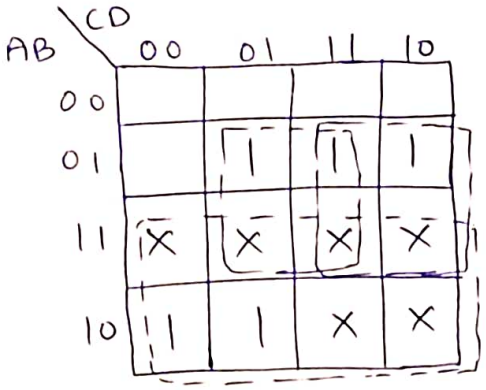
BCD to XS-3 Code Converter

Set 2

Q2

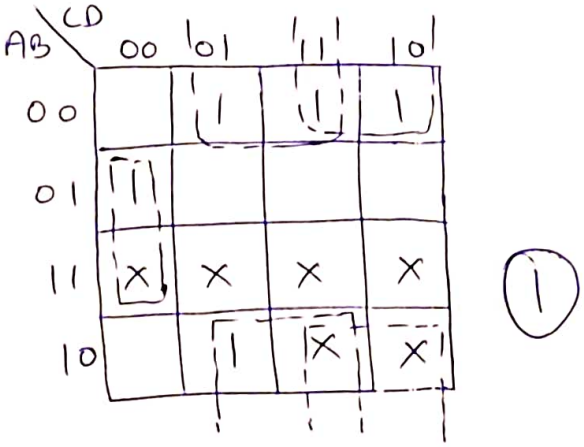
BCD Code				XS-3 Code			
A	B	C	D	W	X	Y	Z
0	0	0	0	0	0	1	1
0	0	0	1	0	1	0	0
0	0	1	0	0	1	0	1
0	0	1	1	0	1	1	0
0	1	0	0	0	1	1	1
0	1	0	1	1	0	0	0
0	1	1	0	1	0	0	1
0	1	1	1	1	0	1	0
1	0	0	0	1	0	1	1
1	0	0	1	1	1	0	0

1



1

$W = A + BC + BD$



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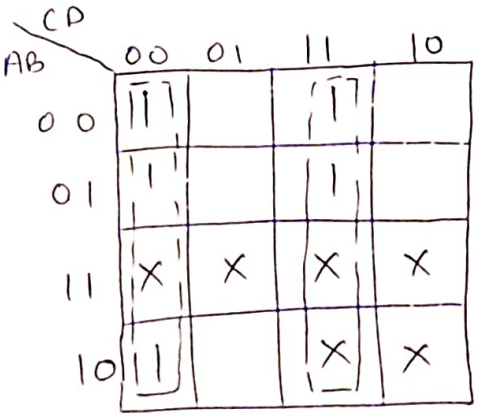
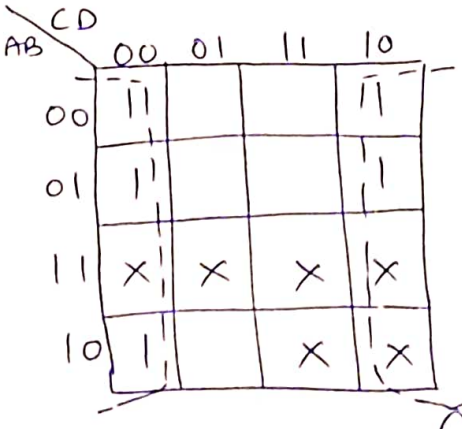
$X = B'C + B'D + BC'D'$



1

$Y = CD + C'D'$



1

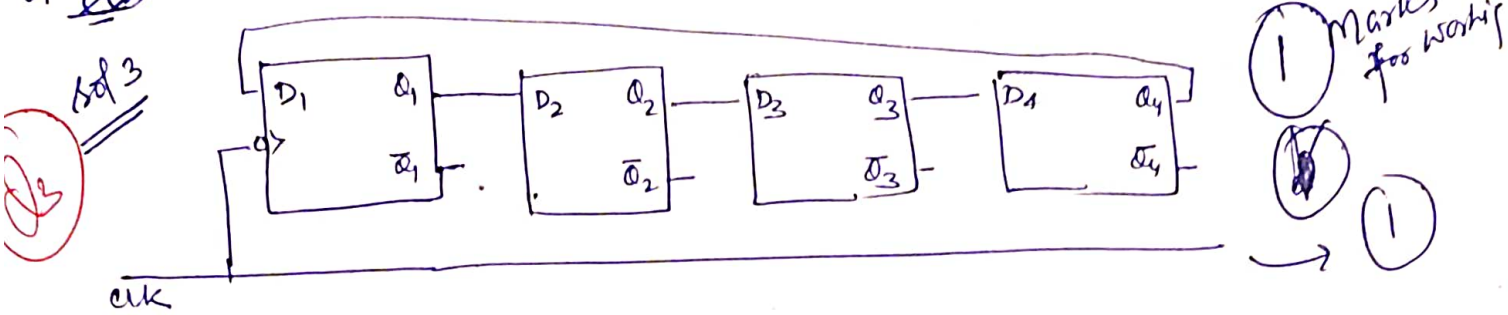
$Z = D'$

Q_1	Q_0	$D_1 (Q_0)$	$D_0 (\bar{Q}_1)$
0	0	0	1
0	1	1	1
1	1	1	0
1	0	0	0

$D_0 \rightarrow \bar{Q}_1$ $\quad$ $D_1 \rightarrow Q_0$

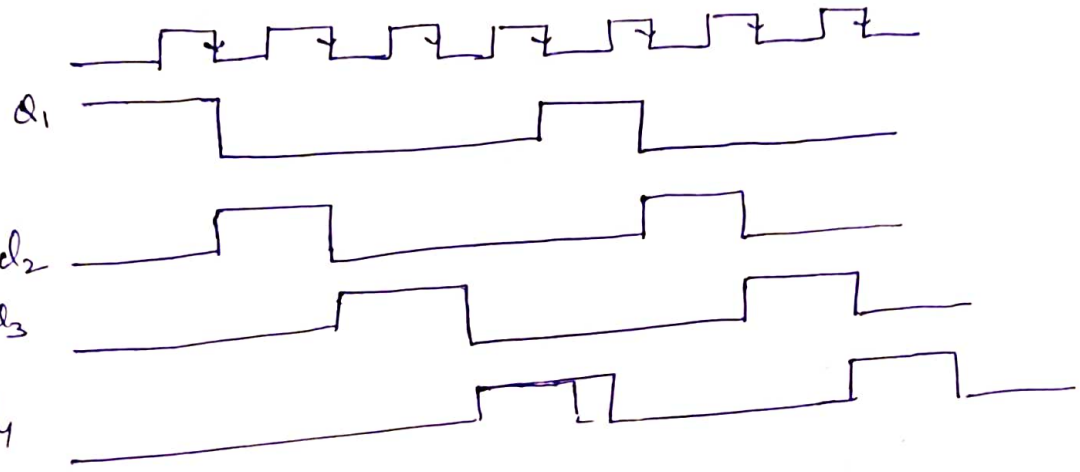
Q

Sol 3



1 Marks for working

1



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Sol Q4

Transition and output table

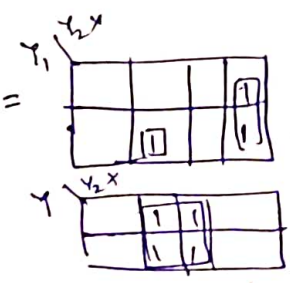
PS $(Y_1 Y_2)$	NS $(Y_1 Y_2)$ $X=0$	NS $(Y_1 Y_2)$ $X=1$	O/P (Z) $x=0$	O/P (Z) $x=1$
A → 0 0	0 0	0 1	0	0
B → 0 1	1 0	0 1	0	0
C → 1 0	0 0	1 1	0	0
D → 1 1	1 0	0 1	1	0

1

PS Y_1	PS Y_2	I/P x	NS Y_1	NS Y_2	I/P of FF D_1	I/P of FF D_2	O/P Z
0	0	0	0	0	0	0	0
0	0	1	0	1	0	1	0
0	1	0	1	0	1	0	0
0	1	1	0	1	0	1	0
1	0	0	0	0	0	0	0
1	0	1	1	1	1	1	0
1	1	0	1	0	1	0	0
1	1	1	0	1	0	1	0

1

$D_1 =$



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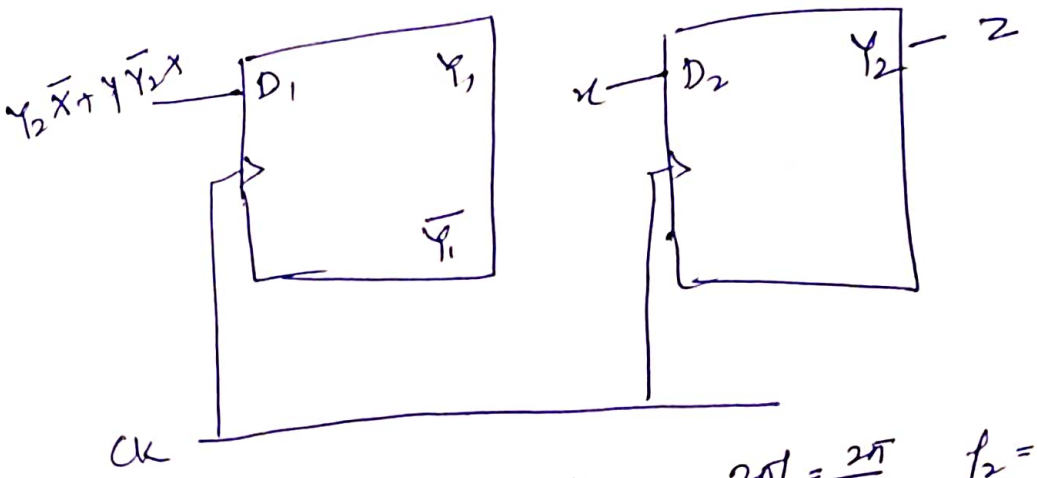
$D_1 = Y_2\bar{x} + Y_1\bar{Y}_2 x$

$D_2 = \bar{x}$



(1)

$2\pi/_2 = \frac{2\pi}{5}$ $f_2 = \frac{1}{5} = \frac{k_2}{N_2}$

Soln (a) $2\pi f_1 = \frac{2\pi}{3}$ $f_1 = \frac{1}{3} = \frac{k_1}{N_1}$

$N_1 = 3$ $N_2 = 5$ $\frac{N_1}{N_2} = 3/5$ (1.5)

Periodic

LCM (3,5) = 15

Q6

(b) Aperiodic $\omega_1 = 2$ $f_1 = \frac{1}{\pi}$ $T_1 = \pi$ (1.5)

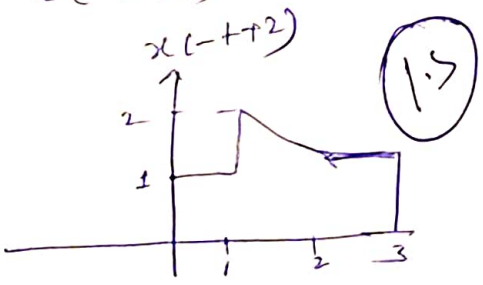
$\omega_2 = \sqrt{3}$ $f_2 = \frac{\sqrt{3}}{2\pi}$ $T_2 = \frac{2\pi}{\sqrt{3}}$

$\frac{T_1}{T_2} = \frac{\sqrt{3}}{2}$ irrational — Aperiodic

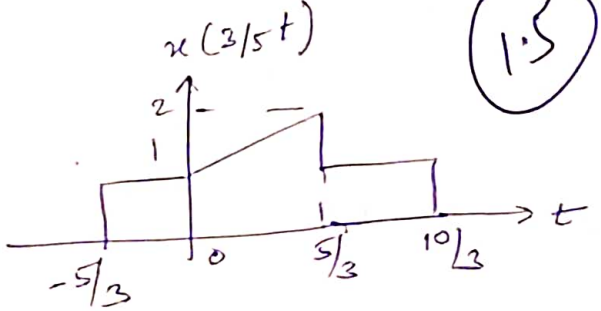
Q5

Q5

$x(-t+2)$



(1.5)



(1.5)

$y(t) = x^2(t) + x(t-4)$

$t=-2$ $\quad y(-2) = x^2(-2) + x(-6)$

$t=0$ $\quad y(0) = x^2(0) + x(-4)$

$t=2$ $\quad y(2) = x^2(2) + x(-2)$

Causal system (1)

Present & Past

Non linear system (1)

$$C_0 = \frac{1}{T}\int_0^T x(t)\,dt = \frac{1}{T}\int_0^{T/2} A\,dt = \frac{A}{T}\,T\Big|_0^{T/2} = \frac{A}{T}\times\frac{T}{2} = A/2$$ (2)

$$C_n = \frac{1}{T}\int_0^T x(t)\,e^{-jn\omega_0 t}\,dt = \frac{1}{T}\int_0^{T/2} A\,e^{-jn(2\pi/T)t}\,dt$$

$$= \frac{A}{T}\,\frac{e^{-jn(2\pi/T)t}}{-jn(2\pi/T)}\Big|_0^{T/2} = -\frac{A}{jn2\pi}\left[e^{-jn\pi} - 1\right]$$

$$= \frac{A}{jn2\pi}\left[1 - e^{-jn\pi}\right] = \frac{A}{jn2\pi}\left[1 - (-1)^n\right]$$

$$C_n = \begin{cases} 0 & \text{for even } n \\ A/jn\pi & \text{for odd } n \end{cases}$$

$x(t) = e^{-t}\sin 5t\,u(t)$

$$e^{-t}\left(\frac{e^{j5t} - e^{-j5t}}{2j}\right)u(t)$$ (1)

$$= \frac{1}{2j}\int_{-\infty}^{\infty}\left[\left(e^{-t}\left(e^{j5t} - e^{-j5t}\right)u(t)\right]e^{-j\omega t}\,dt\right.$$

$$= \frac{1}{2j}\left[\frac{1}{1+j(\omega-5)} - \frac{1}{1+j(\omega+5)}\right]$$ (1)

$$= \frac{5}{(1+j\omega)^2 + 5^2}$$ (1)

Q10:- (a) $f_1 = 100\,Hz$ $f_2 = 200\,Hz$

$f_n = 2 \times 200\,Hz = 400\,Hz$ (1.5)

Interval $= \frac{1}{400\,Hz} = 2.5\,ms$

(b) $\omega_{m_1} = 40\pi$ $\omega_{m_2} = 300\pi$

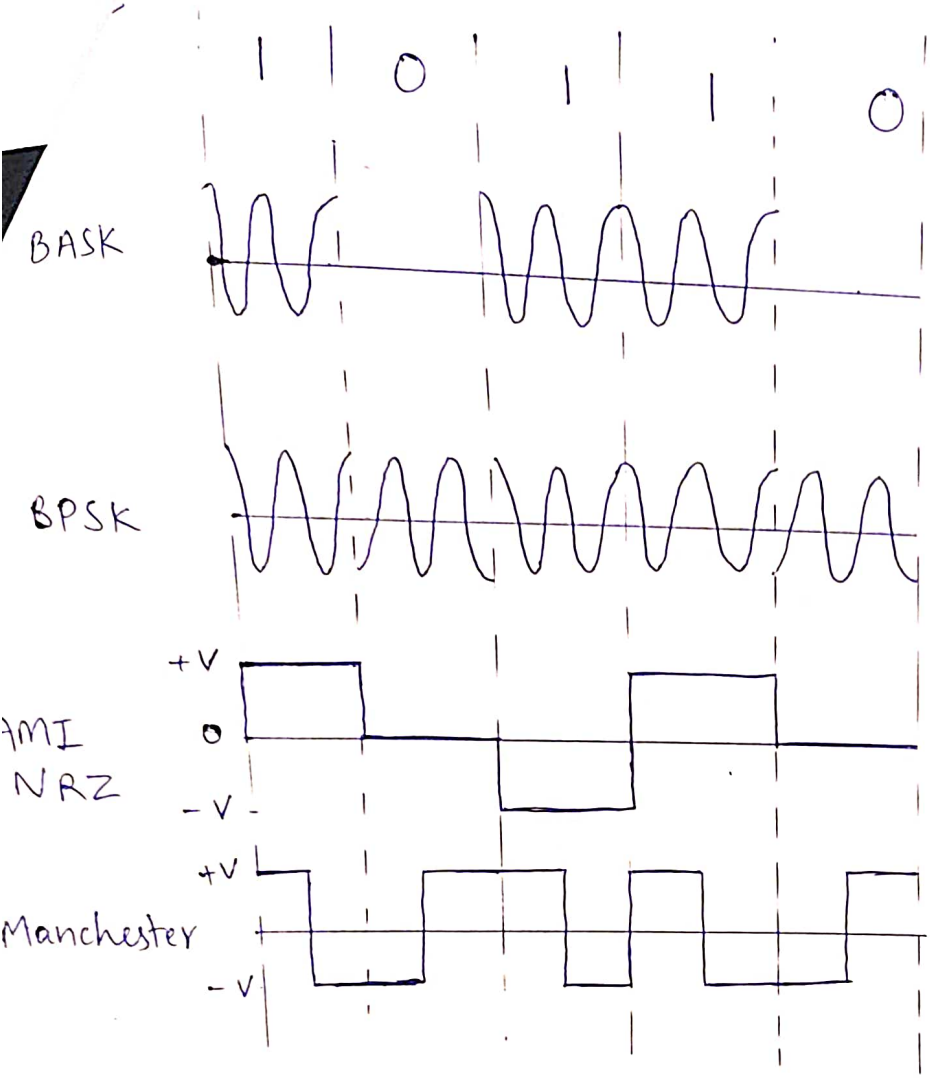
$f_{m_0} = \frac{340}{2} = 170\,Hz$

$2f_m = 340\,Hz$ (1.5)

$f_n = \frac{1}{340}\,second =$

21 Q11

t.



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