THE OPEN UNIVERSITY OF SRI LANKA
DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE
B. SC. DEGREE PROGRAMME2012/2013
FINAL EXAMINATION
CPU3141: DIGITAL COMPUTER FUNDAMENTALS
DURATION: TWO HOURS (2 HOURS)

Date: 25.11.2013 **Time: 1.30 pm to 3.30 pm**

Answer **FOUR** Questions **ONLY.**

Q1.

(i) What is a Number **System**? Write the names of two (2) commonly used number systems.

(ii) Convert following **decimal numbers** into **binary.**

a) 21_{10}
b) 37.625_{10}
c) -371_{10}
d) -26.25_{10}

(iii) Represent following decimal number in **BCD** and **Gray Code.**

135_{10}

(iv)

a) Briefly describe ASCII character code.
b) Convert following words into ASCII code (Use the appended ASCII Table at the end of the paper)

HOME
Student

Q2.

(i) Any Boolean function can be expressed in Canonicalform; either in Mintermsor Maxterms. Briefly describe **Minterm** and**Maxterm** with suitable examples.

(ii)

a) Use the following truth table to derive **POS** term for the output X
b) Simplify the above POS term using **K-Map** (Karnaugh Map) method.

Input				Output
A	**B**	**C**	**D**	**X**
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0

0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	1
1	1	1	1	0

(iii) Consider the following **Boolean expressions**.Simplify the expressions using **Boolean Algebraic Rules**. Draw the simplified circuit diagrams using appropriate logic gates.

a) (A + C + D)(A + C + D')(A + C' + D)(A + B')

b) ABC + A'B'C + A'BC + ABC' + A'B'C'

(iv) Discuss the **similarities** and **differences** between **Boolean algebra** and **binary number system.**

Q3.

(i)

a) Draw the truth table for a Full Adder.

b) Draw the logic circuit for Full Adder using XOR gates.

(ii) What is the function of **Parity Circuits**(Parity Generators and Parity Checkers)?

(iii) Decoder is a circuit that changes a code into a set of signals.

a) Draw the truth table for **2-to-4 Decoder.**

b) Draw the logic circuit or the **2-to-4 Decoder.**

c) Draw block diagram design of a **2-to-4 Decoder** using only the **1-to-2 Decoders**.

(iv) Explain the operation of a Multiplexer using a block diagram. List two (**02**)uses of **Multiplexers**.

Q4.

(i) The most general model of sequential circuits has inputs, outputs and internal states. There are two models of sequential circuits. Briefly describe **the two models of sequential circuits** using **block diagrams**.

(ii) Describe the function of **Master-Slave JK flip-flop**. (Use block **diagrams.**)

(iii) What is a Shift**Register**?

a. What are the **four types** of Shift Registers?

b. Draw a block diagram of **one** of them.

(iv) Draw the **timing diagram** for the **four bit synchronous counter**.

Q5.

(i) List five (05) properties of **Asynchronous Sequential Circuits.**

(ii) Design an **asynchronous circuit** for the specification given in the **primitive flow table below**. (Clearly indicate the steps.)

State	Inputs		Output	Comments
	A	B	X	
p	0	1	0	A = X because B = 1
q	1	1	1	A = X because B = 1
r	0	0	0	After state p or s
s	1	0	0	After state r
t	1	0	1	After state q or u
u	0	0	1	After state t

(iii) Draw the **block diagram** and **truth table** for **asynchronous decade counter**.

(iv) Discuss **four(04) advantages** of **asynchronous counters**.

Q6.

(i) What are **four (04)** ways of programming **paths** in a **ROM**, and describe them briefly.

(ii) Modern computers are designed with a memory hierarchy depending onthe speed and capacity requirements. Describe memory **hierarchy brieflybased** on the above mentioned characteristics.

(iii) ***Reads*** dominate processor cache accesses. All instruction accesses are *Reads*. What are the ***Read*policies**, and briefly describe them.

(iv) Describe how the **CPU (Central Processing Unit)**, in association with **memory** executes a computer program.

ASCII Table

Dec	Hex	Name	Char	Ctrl-char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	0	Null	NUL	CTRL-@	32	20	Space	64	40	@	96	60	`
1	1	Start of heading	SOH	CTRL-A	33	21	!	65	41	A	97	61	a
2	2	Start of text	STX	CTRL-B	34	22	"	66	42	B	98	62	b
3	3	End of text	ETX	CTRL-C	35	23	#	67	43	C	99	63	c
4	4	End of xmit	EOT	CTRL-D	36	24	$	68	44	D	100	64	d
5	5	Enquiry	ENQ	CTRL-E	37	25	%	69	45	E	101	65	e
6	6	Acknowledge	ACK	CTRL-F	38	26	&	70	46	F	102	66	f
7	7	Bell	BEL	CTRL-G	39	27	'	71	47	G	103	67	g
8	8	Backspace	BS	CTRL-H	40	28	(	72	48	H	104	68	h
9	9	Horizontal tab	HT	CTRL-I	41	29	)	73	49	I	105	69	i
10	0A	Line feed	LF	CTRL-J	42	2A	*	74	4A	J	106	6A	j
11	0B	Vertical tab	VT	CTRL-K	43	2B	+	75	4B	K	107	6B	k
12	0C	Form feed	FF	CTRL-L	44	2C	,	76	4C	L	108	6C	l
13	0D	Carriage feed	CR	CTRL-M	45	2D	-	77	4D	M	109	6D	m
14	0E	Shift out	SO	CTRL-N	46	2E	.	78	4E	N	110	6E	n
15	0F	Shift in	SI	CTRL-O	47	2F	/	79	4F	O	111	6F	o
16	10	Data line escape	DLE	CTRL-P	48	30	0	80	50	P	112	70	p
17	11	Device control 1	DC1	CTRL-Q	49	31	1	81	51	Q	113	71	q
18	12	Device control 2	DC2	CTRL-R	50	32	2	82	52	R	114	72	r
19	13	Device control 3	DC3	CTRL-S	51	33	3	83	53	S	115	73	s
20	14	Device control 4	DC4	CTRL-T	52	34	4	84	54	T	116	74	t
21	15	Neg acknowledge	NAK	CTRL-U	53	35	5	85	55	U	117	75	u
22	16	Synchronous idle	SYN	CTRL-V	54	36	6	86	56	V	118	76	v
23	17	End of xmit block	ETB	CTRL-W	55	37	7	87	57	W	119	77	w
24	18	Cancel	CAN	CTRL-X	56	38	8	88	58	X	120	78	x
25	19	End of medium	EM	CTRL-Y	57	39	9	89	59	Y	121	79	y
26	1A	Substitute	SUB	CTRL-Z	58	3A	:	90	5A	Z	122	7A	z
27	1B	Escape	ESC	CTRL-[	59	3B	;	91	5B	[	123	7B	{
28	1C	File separator	FS	CTRL-\	60	3C	<	92	5C	\	124	7C	|
29	1D	Group separator	GS	CTRL-]	61	3D	=	93	5D	]	125	7D	}
30	1E	Record separator	RS	CTRL-^	62	3E	>	94	5E	^	126	7E	~
31	1F	Unit separator	US	CTRL-	63	3F	?	95	5F	_	127	7F	DEL