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THE OPEN UNIVERSITY OF SRI LANKA
DEPARTMENT OF COMPUTER SCIENCE
B. SC. DEGREE PROGRAMME 2016/2017
FINAL EXAMINATION
CPU3141: DIGITAL COMPUTER FUNDAMENTALS
DURATION: TWO HOURS (2 HOURS)

Date: 27.12.2017 **Time: 1.30 pm – 3.30 pm**

Answer Four (04) Questions

Q1.

(i) Briefly explain how a particular number can be represented in different Number **Systems** with the use of an **example**.

(ii) Convert the following numbers into **Decimal** (Clearly show the steps).

a) $C52F_{16}$

b) 796_8

c) 100101_2

(iii) Write $\mathbf{-27_{10}}$ using following **binary representations** for **negative numbers.**

a) Sign Magnitude

b) One's Complement

c) Two's Complement

(iv) What is the importance of **Binary Numbers** to the digital systems. ?

(v) **Calculate** the following. (Clearly show the steps)

a) $1011_2 + 10111_2$

b) $1101_2 - 1010_2$

c) $10111_2 * 1011_2$

d) $1111_2 / 101_2$

Q2.

(i) Write short descriptions about the following **Binary Codes**.

a) Error- Detection code

b) Gray Code

c) BCD

(ii) What is the difference between **1 + 1 in Binary** and **1 + 1 in Boolean Logic**?

(iii) Prove the two **De Morgan's Theorems**. (Clearly Show the steps)

(iv) Briefly describe the following **Logic Families**.

a) TTL Logic Family

b) CMOS Logic Family

(v) Convert following **Gray code** value into **binary**. (Show the steps)

100100100

Q3.

(i) Derive the **Truth Table** of a **JK** Flip flop and draw the corresponding **circuit** diagram (Consider a NAND implementation).

(ii) Draw the **logic circuit** of a **4 – to – 1 Multiplexer**.

(iii) List **three (03)** uses of the **Multiplexer**.

(iv) Draw the **timing diagram (pulse waveform diagram)** of the following circuit (Fig.1) with given inputs (Fig 2).

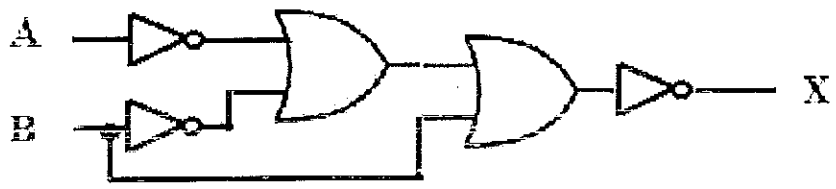

Figure 1: Logic Circuit

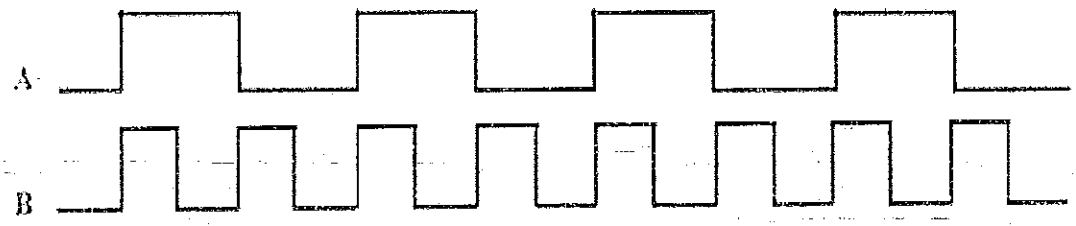

Figure 2: Inputs A and B

(v) Draw a **Full Adder circuit** for **3-bit addition** operation. (Use block diagrams)

Q4.

Consider the following **PoS Boolean Expression;**

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

(i) Draw the **K'Map** for the above expression.

(ii) Simplify the K'Map and derive the simplified **SoP** expression.

(iii) Simplify the K'Map and derive the simplified **PoS** expression.

(iv) Draw the **simplified circuits** for **both expressions** in (ii) and (iii).

(v) Discuss about **Maxterm** and **Minterm** representations.

Q5.

(i) Draw the **logic diagram** of a **4 – bit Ring Counter** with **timing diagram.**

(ii) Compare **Asynchronous** and **Synchronous counters.**

(iii) Draw the **Asynchronous Circuit** described by the following **State Table.**

Present State		**Next State**			
		X = 0		**X = 1**	
0	0	0	0	0	1
0	1	1	1	1	0
1	0	0	0	0	1
1	1	1	1	0	1

(iv) Determine whether there is/are **Race Conditions** in the above (iii) Asynchronous Circuit. (Clearly show the steps)

(v) Explain about a **Circuit Hazard** using an **example**.

Q6.

(i) What are the **components** of the **CPU of a digital system**? Write short descriptions about the components.

(ii) Briefly describe following terms related to **Digital Memory**.

a) Data

b) Address

c) Random Access

d) Sequential Access

(iii) Why do we need **Digital Memory**? Discuss.

(iv) Draw **Block Diagrams** of three **(03) PLD configurations**.

(v) What are the **design considerations** in designing a **RAM with PAL**?