UNIVERSITY OF SWAZILAND

165

FACULTY OF SCIENCE

DEPARTMENT OF PHYSICS

MAIN EXAMINATION	2011/2012
TITLE OF PAPER:	DIGITAL ELECTRONICS
COURSE NUMBER:	P411
TIME ALLOWED:	3 HOURS

INSTRUCTIONS:

ANSWER ANY FOUR OUT OF FIVE QUESTIONS.

EACH QUESTION CARRIES 25 MARKS.

MARKS FOR DIFFERENT SECTIONS ARE SHOWN ENCLOSED IN SQUARE BRACKETS.

THIS PAPER HAS 6 PAGES INCLUDING THIS PAGE.

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1 (a) (i) Find the decimal equivalent of the number 11100.011_2. [2]

(ii) Convert 34.75_{10} to its binary equivalent. [2]

(b) (i) Find the decimal equivalent of the number $EBA.C_{16}$. [2]

(ii) Convert 204.125_{10} to its corresponding hexadecimal number. [2]

(c) (i) Convert the hexadecimal number $1F.C_{16}$ to its binary equivalent. [3]

(ii) Convert the binary number 10100111.111011 to its hexadecimal equivalent. [3]

(d) (i) If the number 01001001 is in BCD, convert it to straight binary. [3]

(ii) Convert the straight binary number 10011_2 to its Gray code equivalent. [2]

(e) Subtract -23 from -53 using 2s complement binary numbers. Show each step of your working clearly. [6]

2 (a) (i) Write the Boolean expression for the AND-OR logic diagram in **figure 1** of the **Appendix A**. [2]

(ii) Make the truth table for the logic diagram in **figure 1** of the **Appendix A**. [8]

(b) Draw a logic diagram for the Boolean expression $F = \bar{A}\,\bar{B} + AB$ using only 2-input NAND gates. [5]

(c) Convert the following Boolean expressions to their standard SOP or minterm forms:

(i) $F = \overline{(A + \bar{B} + \bar{C})(\bar{A} + B + \bar{C})}$; [4]

(ii) $F = \overline{(A + \bar{B} + \bar{C})(\bar{A} + \bar{B} + \bar{C}) + (CB\bar{A})}$. [6]

3 (a) (i) Write the unsimplified minterm Boolean expression for the truth table in **figure 3** of the **Appendix B**. [2]

(ii) Draw a 4-variable minterm Karnaugh map of the truth table referred to in (i) and use it to write the simplified POS Boolean expression. The expression does not have to be in the canonical form. [6]

(b) (i) Make a 4-input truth table that only gives an output of 1 when the input binary

number has an even decimal digit equivalent less than 10. Consider the input decimal number equivalents from 10 to 15 as don't cares. [3]

(ii) Simplify the minterm Boolean expression for the truth table referred to in (i) using a 4-variable minterm Karnaugh map that includes the don't cares. [5]

(c) Give an example of a magnitude comparator and state its function. [2]

(d) A digital-to-analog converter has a full-scale analog voltage of 5 volts:

(i) What is meant by A/D converter resolution and what is its value in this case? [4]

(ii) If the analog input equals 0.1 V, what is the binary output? [3]

4 (a) The truth table for a full subtractor is given in **figure 4** of **Appendix B**. Draw the logic diagram of a full subtractor using AND, XOR, OR and NOT gates. [5]

(b) **Figure 2** in **Appendix A** illustrates a clocked RS flip-flop pulse-train with the set (S) and reset (R) inputs drawn above and below the pulse-train, respectively. For each of the eight clock pulses (a to h), list the binary output Q of the flip-flop. [4]

(c) Draw a logic diagram for a divide-by-5 ripple counter using JK flip-flops. Use logic symbols for the flip flops without including their logic circuits. [5]

(d) Draw a logic diagram of a 3-bit parallel counter using JK flip-flops. Illustrate its timing diagram. [7]

(e) Draw a logic diagram of a 3-bit ripple down counter and explain how you can change it into a 3-bit ripple up counter. [4]

5 (a) (i) What are the three main uses of shift registers? [3]

(ii) What are the four classes of registers? [2]

(b) (i) Name the three types of semiconductor internal memory of a typical microcomputer system. [3]

(ii) Calculate the number of address lines required for a memory cell with 8 bit hex locations from 0000H to FFFFH. [7]

(c) (i) What are the two methods of digital data transmission between microprocessor-based systems? Give an advantage of each system. **[2]**

(ii) Data bus systems are widely used in microprocessor-based equipment, what method of data transmission do they use? **[1]**

(iii) What is the function of modems (modulator-demodulators)? **[2]**

(iv) Why is a parity bit required in microprocessor-based data transmission? **[2]**

(v) What does the baud rate refer to with regard to data transmission and what is the baud rate when 10 characters are transmitted per second? **[3]**

APPENDIX A – DIAGRAMS

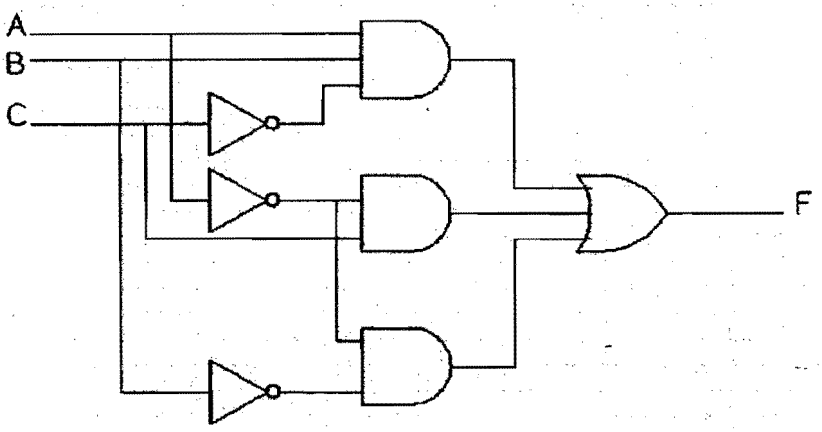

Figure 1

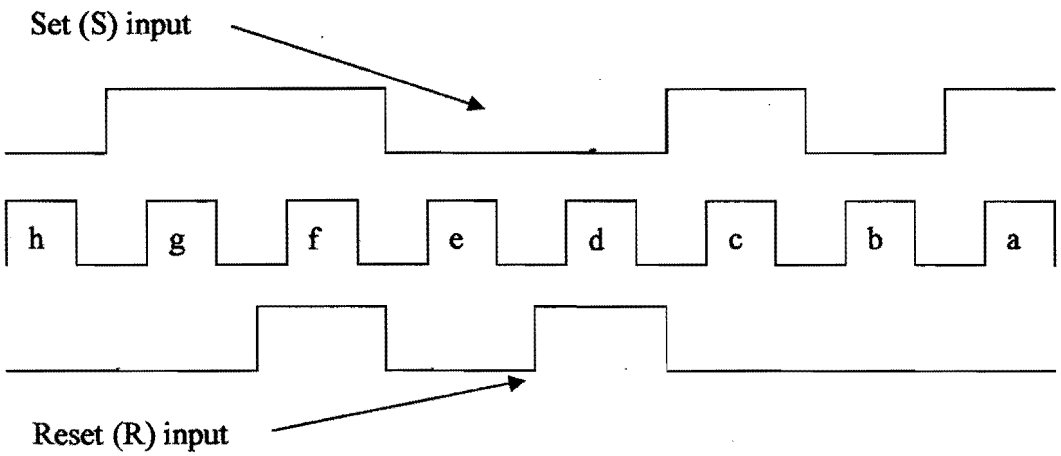

Figure 2

APPENDIX B – TRUTH TABLES

Inputs				Output
A	B	C	D	F
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
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	1
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

Figure 3

Inputs			Outputs	
Minuend (A)	Subtrahend (B)	Borrow in (Bin)	Difference (Di)	Borrow out (Bo)
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

Figure 4

END OF P411 EXAMINATION