UNIVERSITY OF GHANA

BACHELOR OF SCIENCE IN ENGINEERING

SECOND SEMESTER EXAMINATIONS, 2012/2013

CPEN 202 COMPUTER SYSTEMS DESIGN (2 Credits)

INSTRUCTION:

*Answer **ANY five (5)** questions in your answer booklet.*

TIME ALLOWED: *TWO (2) HOURS*

Q1. (i) With the help of a truth table, find the minimum-cost realization of the function $f = x_1x_2 + \bar{x}_2x_3$. Implement the function using two two-input *AND*-Gates, an Inverter and an *OR*-Gate. [8 Marks]

(ii) Explain how Component and Signal are used to code the circuit Q1(i). [4 Marks]

(iii) Write a VHDL code to implement Q1(i). [8 Marks]

Q2. (i) A warning light is to glow when the mains switch is *ON* provided that either switches X_1 and X_2 or $X3$ and X_4 are turned on. Assuming that logics 1 or 0 are produced when a switch is closed and opened respectively, design a minimal logic circuit to produce logic 1 signal when the light is on. [8 marks]

(ii) Redesign Q2 (i) using *NAND*-Gates. [4 Marks]

(iii) Implement Q2 (ii) in VHDL. [8 Marks]

Q3. (i) From first principles, design a full Adder. [5 Marks]

(ii) Illustrate how a 4-bit full Adder may be constructed. [5 Marks]

(iii) Write a VHDL code to implement the 4-bit full Adder. [10 Marks]

Q4. (i) Draw and label clearly the general block diagram of a synchronous sequential machine. [4 Marks]

(ii) Design the circuit for a sequential machine to detect 1110. [15 Marks]

(iii) Name the type of sequential machine you have designed. [1 Mark]

Q5. (i) List any five (5) Programmable Logic Devices (PLDs). [5 Marks]

(ii) Using $f_1 = x_1\bar{x}_2\bar{x}_3 + \bar{x}_1x_2x_3$ and $f_2 = \overline{x_1x_2} + x_1x_2x_3$ design an appropriate Programmable Logic Device (PLD) for these functions. [10 marks]

(iii) Which PLD listed in Q5(i) can handle larger circuits. [2 Marks]

(iv) Name any two (2) limitations of programmable switches. [2 Marks]

(v) Name the custom chips used to reduce design costs. [1 Mark]

Q6. (i) Define *glitch* as it appears in *Timing Hazards*. [2 Marks]

(ii) With an example, explain how a *Static-1 Hazard* can be avoided. [5 Marks]

(iii) Prove that $f = x\bar{z} + yz$ is a *Static-1 Hazard* and suggest how this can be corrected. [10 Marks]

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(iv) With the help of a well-labeled diagram explain what is meant by *Dynamic Hazard*? [3 Marks]