JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF INFORMATICS AND INNOVATION SYSTEMS

UNIVERSITY EXAMINATION FOR BACHELORS DEGREE

1ST YEAR 1ST SEMESTER 2013/2014 ACADEMIC YEAR

REGULAR

COURSE CODE: SMA 3113

COURSE TITLE: LOGICAL FUNCTIONS

EXAM VENUE: LR 2 **STREAM: (BSc. Comp Security, ICT, BIS)**

DATE: 17/04/14 **EXAM SESSION: 2.00 – 4.00 PM**

TIME: 2.00 HOURS

Instructions:

1. **Answer question 1 (Compulsory) and ANY other 2 questions**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

QUESTION ONE (30 MARKS) COMPULSORY

a) Simplify the Boolean function F(x, y, z) = S(2, 3, 4, 5) 6 Marks

b) Convert the following twos complement binary numbers to their equivalent decimal number
i) (01.011)2's-compl; ii) (11.011)2's-compl 6 Marks

c) Convert the following binary numbers to their equivalent decimal numbers
i) 1011.101_2 ii) 0.0110_2 iii) 1010.1101_2 iv) 1110110_2 6 Marks

d) For the given functions, rearrange the formulae to make x the subject of the formulae. Show your working. i) $y(2x + 1) = x + 1$ ii) $m = k\sqrt{a(1-x)}$ 6 Marks

e) Solve the following using one's complements i) 1000-1010 ii) 1101-111 6 Marks

QUESTION TWO (20 MARKS)

a) In a survey of 10 households, the number of children was found to be
4, 1, 5, 4, 3, 7, 2, 3, 4, 1
(i) State the mode. {1 Mark}
(ii) Calculate
(a) the mean number of children per household {2 Marks}
(b) the median number of children per household. {2 Marks}
(c) A researcher says: "The mode seems to be the best average to represent the data in this survey." Give ONE reason to support this statement. {1 Mark}

b) Three resistors R_1, R_2, and R_3 are connected in parallel in an electric circuit. Solve for the effective resistance R_{eff} given that $\frac{1}{R_{eff}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ {4 Marks}

c) In the design of orifice plate flowmeters, the volumetric flowrate, Q ($m^3 s^{-1}$), is given by

$$Q = C_d A_0 \sqrt{\frac{2g\Delta h}{1 - {A_0^2}/{A_p^2}}}$$

where Cd is a dimensionless discharge coefficient, Δh (m) is the head difference across the orifice plate and Ao (m^2) is the area of the orifice and Ap (m^2) is the area of the pipe.

(i) Rearrange the equation to solve for the area of the orifice, Ao, in terms of the other variables. 4 Marks

(ii) A volumetric flowrate of 100 $cm^3 s^{-1}$ passes through a 10 cm inside diameter pipe. Assuming a discharge coefficient of 0.6, calculate the required orifice diameter, so that the head difference across the orifice plate is 200 mm. 3 Marks
Be very careful with the units!

d) Obtain the conjunctive normal form of the form (p Λ q) v (~p Λ q Λ r) 3 Marks

QUESTION THREE (20 MARKS)

a) Given the sets A = {a, b, c, d, e, f} B = {a, c, e, g, i, k} C = {g, h, i, j, k} Find
   i) AUB ii) A∩B iii) A∩C 6 Marks

b) Prove the following: i). A + Ā.B =A + B
   ii) A.(Ā +B) = A.B
   iii) (A + B).(Ā + C) = A.C + Ā.B
   iv) (A + C).(Ā + B) = A.B + Ā.C
   12 Marks

c) State De Morgans' Theorem 02 Marks

QUESTION FOUR (20 MARKS)

a) Construct the table for (a v b) ↔ [(~a) Λ c) → (b Λ c)] 8 Marks

b) Show the equivalence of the following:
   i) [d → (~a) Λ b) Λ c] and~[(a v (~(b Λ c))) Λ d] 5 Marks
   ii) P v (q v r) and (p v q) Λ (p v) 7 Marks

QUESTION FIVE (20 MARKS)

a) Prove the following identity: (A U B) ∩ (AU B^c) = A 4 Marks

b) Draw Venn diagrams showing:
   i) (A U B) = (A U C) but B ≠ C 4 Marks
   ii) (A ∩ B) = (A ∩ C) but B ≠ C 4 Marks

c) Draw the logic circuit L with inputs A, B, C and output Y which corresponds to each Boolean expression:
   i) Y = ABC + A'C' + B'C' 4 Marks
   ii) Y =AB'C + ABC'+ AB'C' 4 Marks