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University Examinations 2012/2013

SECOND YEAR, FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER TECHNOLOGY AND FIRST YEAR, FIRST SEMESTER FOR BACHELOR OF SCIENCE IN COMPUTER SCIENCE

SMA 2100: DISCRETE MATHEMATICS

DATE: AUGUST 2013 **TIME: 2HOURS**

INSTRUCTIONS: *Answer questions **one** and any other **two** questions*

QUESTION ONE - (30 MARKS)

a) State what is meant by the following terminologies:
   i. Disjoint sets (1 Mark)
   ii. Function from A to B. (1 Mark)
   iii. Universal set (1 Mark)
   iv. Power set. (1 Mark)

b) Let $F: Z \longrightarrow Z, f(x) = 4x + 3$
   i. Check whether f is injective (2 Marks)
   ii. Check whether f is subjective (2 Marks)

c) Negate the following statements
   i. $\forall x \varepsilon \mathbb{R}, x^2 > 0$ (2 Marks)
   ii. There exists a (living) person who is 200 years old. (2 Marks)

d) A study conducted by prime consultants of the characteristics of 200. Jua kali enterprises which had failed in business revealed that 190 of them were either undercapitalized or had inexperienced management or had poor location. The number with all three of the characteristics above was 8. It was found that 20 enterprises had inexperienced management and poor location. Enterprise that were undercapitalized but had experienced management and good location were 80 in number, 30 enterprises has inexperienced management but had sufficient capitalization and good location. Further

14 enterprises were undercapitalized and had inexperienced management. Finally 18 enterprises were found to be undercapitalized and had poor location.

i. Illustrate the above information in a Venn diagram. (8 Marks)

ii. How many Jua Cali enterprise had:

(i) At least one of the problems studied. (1 Mark)

(ii) Two out of the three problems studied. (1 Mark)

e) i) Test the validity of the following argument. If Ghana wins the world cup, then either Brazil lost in quarter final or Kenya did not participate. Brazil did not lose in quarter finals and Kenya did not participate. Therefore Ghana did not win the world cup. (4 Marks)

ii) Test if the following are rautologies.

(i) $p \wedge [q \rightarrow p]$ (2 Marks)

(ii) $[p \wedge (\sim p \vee \sim q)] \rightarrow q$ (2 Marks)

QUESTION TWO (20 MARKS)

a) Let:

$f(x) = \frac{3-3x}{1-7x}$ $g(x) = \frac{10-4x}{-3x-4}$

i. Find fog. State the domain. (3 Marks)

ii. $g(f(x))$ (3 Marks)

b) Test whether the following functions are 1,-1 onto or bijective. Find f^{-1} if the function is invertible

i. $f: \mathbb{Z} \longrightarrow \mathbb{R}$ $where\ f(x) = x^2$ (1 Mark)

ii. $f: \mathbb{R} \longrightarrow \mathbb{R}$ $where\ f(x) = x^3 + 1$ (1 Mark)

iii. $f: \mathbb{Z} \longrightarrow \mathbb{N}$ $where\ f(x) = |x|$ (1 Mark)

c) Given the sets $U = \left\{3, -4, \sqrt{78}, 3^{\frac{1}{2}}, 0, -\frac{4}{7}, \sqrt[3]{3}, \pi, e\right\}$. List the members of the following sells;

i. Natural numbers (1 Mark)

ii. Integers (1 Mark)

iii. Rational numbers (1 Mark)

iv. Whole numbers (1 Mark)

d) Solve for x in $-2 < 2x + 1 \leq 3$ (2 Marks)

e) Show that $(A \cup B)^C = A^C \cap B^C$ (4 Marks)

QUESTION THREE (20 MARKS)

a) Use a direct proof to show that the product of any two rational numbers x and y is a rational number. (4 Marks)

b) Show that

i. The sum of any two irrational numbers need not be irrational. (2 Marks)

ii. The product of any two irrational numbers need not be irrational. (2 Marks)

c) i) Prove that for any two propositions p and q, the compound proposition $p \rightarrow q$ is logically equivalent to $\sim q \rightarrow \sim p$ i.e the contrapositive. (2 Marks)

ii) Use indirect proof or proof by contraposition to show that a natural number x is even if x^2 is even. (5 Marks)

d) Use proof by induction to show that the sum of the first n odd numbers is n^2. (5 Marks)

QUESTION FOUR (20 MARKS)

a) define the following

i. A proposition (2 Marks)

ii. A tautology (2 Marks)

b) i) Write the converse, inverse and contrapositive of the following statement "if he is not frustrated, then he will make it". (2 Marks)

ii) Rewrite the statement without using implication. (2 Marks)

iii) Rewrite the statement above using the phrase.

(i) "….necessary condition…." 1 ½ Marks)

(ii) "…..sufficient condition…." 1 ½ Marks)

c) Write the following in symbolic notations and using quantifiers.

i. The sum of any 2 consecutive integers is odd. (2 Marks)

ii. There is no real solution to the equation $3x^2 + 1 = -4$. (2 Marks)

d) Let p and q be two propositions. Show that $(p \wedge q) \vee (p \wedge \neg q) \vee (\neg p \wedge q) = p \vee q$. (5 Marks)