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UNIVERSITY REGULAR EXAMINATIONS

2013 /2014 ACADEMIC YEAR

1ST YEAR 2ND SEMESTER EXAMINATIONS

(MAIN EXAMINATION)

BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

COURSE CODE: CSC 122

COURSE TITLE: Discrete Structures II

DATE: 23RD APRIL,2014 **TIME:** 9:00A.M. -12 NOON

INSTRUCTIONS TO CANDIDATES:

- Attempt question **ONE (1)** and **ANY TWO (2)** other questions from section B.
- Question one carries 30 marks and the other questions carry 20 marks each.

1. (a) What is the largest possible number of vertices in a data storage path graph with 70 edges and all vertices of degree at least 3 (4 marks)

(b) Suppose that the probability sample space of a given neuron being fired in a neural network system and recording the number of the neuron is A = {1, 2, 3, 4, 5, 6}. If the elementary for getting each of the numbers have been established as P(1) = 1/12, P(2) = 1/12, P(3) = 1/3, P(4) = 1/6, P(5) = ¼, P(6) = 1/12, compute P(E) if the event E is the number of the neuron being an even number. (6 marks)

(c) (i) Find the first four terms of the sequences defined by the recurrence relations $a_n = 6a_{n-1}$, $a_0=2$ (2 mark)

(ii) What is the solution of the recurrence relation $a_n = 8a_{n-1} – 16a_{n-2}$ with $a_0 = 1$ and $a_1 = 6$? (6 marks)

(d) Given that P(X) is the statement “X spends more than fours revising for discrete structures II every weekend” where the universe of discourse for x consists of all first year computer students. Express each of the qualifications below in English

(i) $\exists X\ P(X)$ (1 mark)

(ii) $\forall\ X\ P(X)$ (1 mark)

(iii) $\exists X\ \neg\ P(X\ )$ (1 mark)

(iv) $\forall X\ \neg\ P(X)$ (1 mark)

(e) Let P(X) be a statement “$X = X^2$”. If the universal discourse consists of the integers, what is the truth value of:

(i) P(-1) (1 mark)

(ii) $\exists X\ P(X)$ (1 mark)

(f) Show that $\begin{vmatrix} 1 & 1 & 1 \\ \alpha & \beta & \gamma \\ \beta\gamma & \gamma\alpha & \alpha\beta \end{vmatrix} = (\alpha - \beta)(\beta - \gamma)(\gamma - \alpha)$ (4 marks)

(iii) Given that

$$A = \begin{pmatrix} 1 & 1 & 0 \\ 1 & 1 & 0 \\ 0 & 0 & 0 \end{pmatrix} \text{ and } B = \begin{pmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{pmatrix}$$

evaluate $A \odot B$ (3 marks)

2. (a) By using modus ponens rule either directly or on the contrapositive of the statements given below make the conclusions

(i) If Chikako programs for hours,
she will get good marks in programming
Chikako programs office for hours (1 mark)

Therefore

(ii) If Kevin misses the lecture, (1 mark)
he will fail the test
Kevin did not fail the test

Therefore

(b) Translate into English the predicate logic used in artificial language $\exists x(P(x) \wedge \neg Q(x))$, where the P(x) says that x is a bird and Q(x) says that x can fly. Take the universe of discourse to be all living creatures. Suggest a witness to the existential quantifier (that is, a creature that makes the sentence true). (2 marks)

(c) (i) Write in math notation the following English sentence: "Every number is divisible by 2 or by 3" (use d|n for "n is divisible by d"). (4 marks)

(ii) For which universe of discourse is it true? (1 mark)

(iii) For which universe of discourse is it false? (1 mark)

(iv) State it is true or false if the universe of discourse complex numbers (1 mark)

(d) Assign symbols to represent the predicates and write the following in symbolic form supplying the domain of discourse. "**Every political party has its years**" (5 marks)

(e) Form a binary search tree for the data 16, 24, 7, 5, 8, 20, 40 and 3 in the given order (4 marks)

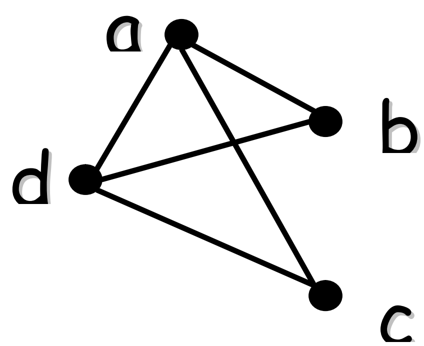
3. (a) Consider an undirected simple graph that has vertices a, b, c, d, and e of degree 4,3,3,2,2.

(i) How many edges does it have? [3 marks]

(ii) Draw this graph. [5 marks]

(iii) What is the adjacency matrix A_G for the following graph G based on the order of vertices a, b, c, d?

[4 marks]



(b) Evaluate the inverse of A given the (8 marks)

$$A=\begin{pmatrix} 2 & 1 & 3 \\ 2 & 2 & 4 \\ 2 & 1 & 2 \end{pmatrix}$$

4. (a) The Kenya Bureau of standards discovered that there were fake microchips being sold in the market and hence decided to be testing all microchips before accepting them. The test machines have not been calibrated for some time hence at times give faulty results. The result is recorded as positive if the test machine gives it as genuine. From the sample to be tested the probability of picking a genuine micro chip is 0.9 and it testing negative is 0.05. The probability of a fake microchip test positive from the sample is 0.2.

(i) Illustrate the probability of the test results by using a tree diagram (3 marks)

(ii) Find the probability that the test results is positive (3 marks)

(iii) Find the probability of the test being correct (3 marks)

(iv) what is the probability that microchip testing positive is genuine (5 marks)

(b) A problem in discrete structures II is given to three students whose chance of solving it are ½, ⅓, and ¼ respectively. What is the probability that at least one of them solves it correctly (6 marks)

5. (a) Study the recurrence relation given below and answer the questions that follow

$$\begin{aligned} a_1 &= 0 \\ a_n &= \left(1 - \frac{1}{n}\right) a_{n-1} + 2n, \text{ for } n \geq 2. \end{aligned}$$

(i) Find the values of and a_2, a_3 (2 marks)

(ii) If $b_n = na_n$, Show that $b_n = b_{n-1} + 2n^2$ for $n \geq 2$. (3 marks)

(iii) Solve the recurrence (9 marks)

$$\begin{aligned} b_1 &= 0 \\ b_n &= b_{n-1} + 2n^2, \text{ for } n \geq 2. \end{aligned}$$

(b) Ngurwe, Wangwe and Bombo went to buy punched cards, magnetic tapes and flash disks in a Nakumatt chain of supermarkets. Ngurwe bought two cards, one tape and three disks for Kshs. 3500.00. Wangwe bought two cards, two tapes and four disks for Kshs 4900.00. Bombo bought two cards, one tape and two disks for Kshs 2500.00. Find the cost price of each of the storage devices. (6 marks)