

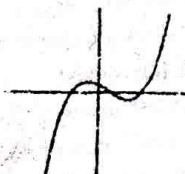
University of Dhaka
Department of Computer Science and Engineering
1st Year 2nd Semester B. Sc. in Computer Science and Engineering
Final Examination, 2012
CSE 1201: Discrete Mathematics

Total Marks: 60

Time: 2.5 Hours

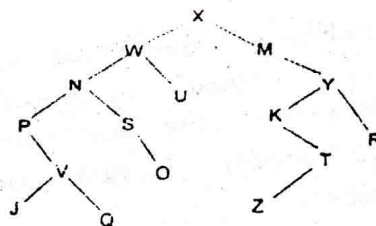
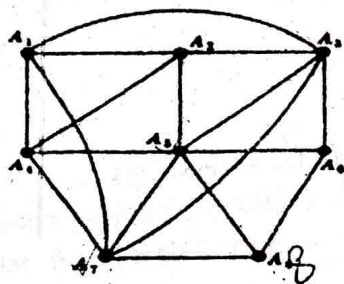
[Answer any four (4) of the following Questions]

1. a) $x + y = 10$ is a relation on the positive integers \mathbb{N} . 4
Is the relation i) reflexive? ii) Symmetric? iii) Antisymmetric? iv) Transitive?
- b) Give a partition of the set $A = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ 1
- c) Prove that all functions are relations but all relations are not functions. 2.5
- d) Find cardinal number of the set: $S = \{5, 7, 9, 11, \dots\}$ 2
- e) Consider a set $S = \{a, b, c\}$ and the relation R on S defined by 2
 $R = \{(a, a), (a, c), (b, c), (c, b)\}$ Find transitive \mathbb{E}
- f) Let $A = \{1, 2, 3, 4, 6, 7\}$ and $B = \{4, 5, 7, 8, 9, 10\}$. Find symmetric difference of A and B . 1.5
- g) Is the following function one-one or onto? Explain. 2



2. a) With example define Argument. 2
- b) Express the following statements using logical connectors and quantifiers. 2.5
 - i) Monkeys-like to eat bananas.
 - ii) No goat knows algebra.
- c) For the following argument explain which rules of inference are used for each step. 4
Everyone in Chittagong lives within 50 miles of the sea. Someone in Chittagong has never seen the sea. Therefore, someone who lives within 50 miles of the sea has never seen the sea.
- d) State contrapositive of the implication: 1
If it is a sunny summer day then I go to the beach.
- e) How can this English sentence be translated into a logical expression? 2
"You cannot ride the roller coaster if you are under 4 feet tall unless you are older than 16".
- f) What does the statement $\forall x T(x)$ mean if $T(x)$ is "x has two parents" and the universe of discourse consists of all people. 1
- g) Find the truth values of the following proposition. 2.5
 $[(p \vee q) \wedge (p \rightarrow r) \wedge (q \rightarrow r)] \rightarrow r$
3. a) Solve each linear congruence equation: 6
 - i) $4x \equiv 3 \pmod{8}$ ii) $3x \equiv 6 \pmod{9}$ iii) $81x \equiv 1 \pmod{256}$
- b) Find the smallest positive integer x such that when x is divided by 2 it yields a remainder 1, when x is divided by 3 it yields a remainder 2, and when x is divided by 5 it yields a remainder 4? 3.5
- c) Using strong induction prove that every amount of postage of 12 taka or more can be formed using just 4 tk and 5 tk stamps. 3
- d) Prove the following proposition using mathematical induction: 2.5
 $3^n < n!$, n is a positive integer greater than 6

4. a) Consider $S = N \times N$, the set of ordered pairs of rational numbers with the operation $*$ defined by $(a,b) * (x,y) = (ay + bx, by)$ 4.5
- Is $(S, *)$ a semigroup? Is it commutative?
 - Find the identity element for $*$.
 - Which elements have inverses and what are they?
- b) Define Normal subgroup. Consider the group $G = \{0, 1, 2, 3, \dots, 19\}$ of addition modulo 20. Let H be the subgroup generated by 5. Is H a normal subgroup? 3.5
- c) Consider the group $G = \{1, 5, 7, 11\}$ under multiplication modulo 12. Is G cyclic? 2
- d) Let σ be the following element of the symmetric group S_6 : 2
- $$\sigma = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 3 & 4 & 1 & 2 \end{pmatrix} \text{ Find } \sigma^{-1} \text{ and } \sigma^2.$$
- e) Consider the ring $R = \{0, 1, 2, \dots, 9\}$ of integer modulo 10. 3
- Find the units of R
 - Find $-3, 3^{-1}, -2, 2^{-1}$?
5. a) A bag contains 12 white, 12 blue, 11 pink and 11 red marbles. How many marbles must be selected to guarantee that at least 3 marbles of the same color are chosen? How many must be selected to guarantee that at least 3 red marbles are selected. 2.5
- b) A student is to answer 8 out of 12 questions in an exam. 4.5
- How many choices has s/he?
 - How many if s/he must answer the 1st or 2nd question but not both?
 - How many if s/he must answer exactly 3 out of the first 5 questions?
 - How many if s/he must answer at least 3 out of the first 5 questions?
- c) Let A, B, C and D are four courses. Find the number of students at a class given the data: 3.5
- 12 take A , 20 take B , 20 take C , 8 take D , 5 take A and B , 7 take A and C , 4 take A and D , 16 take B and C , 4 take B and D , 3 take C and D , 3 take $A+B+C$, 2 take $B+C+D$, 3 take $A+C+D$, 4 take all and 75 take none.
- d) How many different bit strings of length seven start with 11 or ends with 11 holding 0 at the middle place? 2.5
- e) How many ways 4 math books, 2 chemistry books and 3 physics books can be arranged on a shelf that all physics books are remain together? 2
6. a) Mention the main difference between a complete graph and a connected graph? 2
- b) Draw the complementary of the graph C_6 . Is C_6 bipartite? 2
- c) For which values of n , W_n be a regular graph? Store this regular graph using linked list. 3.5
- d) Draw the planar representation of the graph Q_3 . 1.5
- e) Find out the chromatic number of the graph G_1 . 3



- f) Is it possible to derive Euler circuit or Euler path of the graph G_1 ? 2
- g) Traverse the tree T_1 in inorder way. 1

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Department of Computer Science and Engineering
1st Year 2nd Semester B. Sc. in Computer Science and Engineering
Final Examination, 2012
EEE 1221: Digital Systems

Total Marks: 60

Time: 2.5 Hours

[Answer any four (4) of the following Questions]

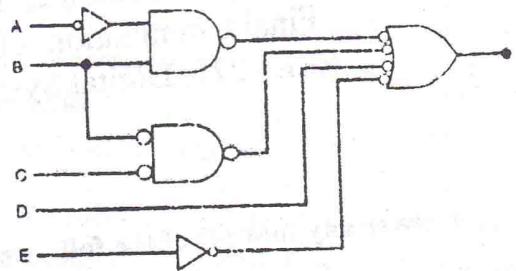
1. a) Add and multiply the following numbers in the given base without converting to decimal 5
 - i). $(135.4)_8$ and $(43.6)_8$
 - ii) $(296)_{12}$ and $(57)_{12}$
- b) What is BCD code? Explain the disadvantages of BCD code. The state of a 12-cell register is 010110010111. What is its content if it represents three decimal digits in BCD. 3
- c) If the digital circuits in a computer only respond to binary numbers, why are octal and hexadecimal numbers used extensively by computer scientists. 4
- d) How many fractional bits 2^{-48} have? 3
2. a) Minimize the following Boolean expressions to the required number of literals 5
 - i. $BC \vee AC \vee AB \vee BCD$ to four literals
 - ii. $ABC \vee \bar{A}\bar{B}C \vee \bar{A}BC \vee \bar{A}\bar{B}\bar{C}$ to five literals
- b) Prove that if $\bar{w}x \vee y\bar{z} = 0$, then $wx \vee \bar{y}(\bar{w} \vee \bar{z}) = wx \vee xz \vee \bar{x}\bar{z} \vee \bar{w}\bar{y}z$ 3
- c) Realize the function $f(A, B, C, D) = A(B \vee CD) \vee B\bar{C}$ using minimum number of NAND gates only. 2
- d) Express the Boolean function $f(x, y, z) = xy \vee \bar{x}z$ as a product of maxterms. 2
- e) Prove or give a counter-example 3
 - i. $AB = \bar{B}C \Rightarrow A = C$
 - ii. $A \vee B = A \vee C \Rightarrow B = C$
3. a) On an n-variable K-map, a certain prime implicant comprises 2^m cells. How many variables will be present in the term indicating the prime implicant? 2
- b) Give an example such that $F(A, B, C, D) = F(\bar{A}, \bar{B}, \bar{C}, \bar{D})$ 2
- c) What is K-map? Mention the disadvantages of K-map. Simplify the following function using a K-map: 4

$$f(A, B, C, D) = \sum m(0, 1, 4, 8, 10, 11, 12) + \sum \phi(2, 3, 6, 7, 9)$$

Define essential prime implicant. Identify the prime implicants and essential prime implicants of $\sum m(1, 6, 8, 14, 15, 16)$ 3
- c) Minimize the following function using the Quine-McClusKey method: 4

$$F(A, B, C, D) = \sum_{m=0} (0, 2, 6, 9, 12, 15, 17)$$
1. a) Find out the decimal equivalent of 1011.101_2 . 2
- b) Represent the decimal value 37 in each of the following ways 3
 - i) Hexadecimal
 - ii) BCD code
 - iii) ASCII
- c) What is the advantage of encoding a decimal number in BCD as compared with straight binary? 3
- d) Construct a full subtracter using two half subtracter. 4

- c) Determine the input conditions needed to cause the output of the following figure to go to its active state. 3



- 5 a) What is meant by triggering of a flip-flop? A J-K flip-flop is invariably used in a master-slave configuration. Why? 2
- b) Realize D-latch using S-R latch. How is it different from D flip-flop? Draw the circuit using NAND gates and explain. 4
- c) What is register? Construct a 4-bit shift register using flip-flops and explain its operation. 4
- d) Compare between combinational and sequential logic circuits. 2
- e) How do you highlight the change of state of a flip-flop from 0 to 1 or 1 to 0? When do we prefer D flip-flop? 3
- 6 a) Construct a MOD-6 counter circuit. How do you convert a MOD-6 counter into MOD-5 counter? Explain it with the help of a circuit. 4
- b) Draw the circuit diagram to combine two 16x4 RAM chips to get a 32x4 memory. 6
- c) Explain the characteristics of MOS over TTL. Briefly discuss the working principle CMOS driving TTL circuit. 3
- d) What is analog multiplexer? Explain its operation. 7

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EEE 1222: Basic Electronics

Total Marks: 60

Time: 2.5 Hours

[Answer any four (4) of the following Questions]

1. a) What do you mean by Input Offset Voltage, Slew Rate, and Gain-Bandwidth Product of an Op-amp? 5
 b) Draw a differentiator circuit using Op-amp. Show that this can be used to generate spike waveform. 1+4
 c) Draw and Explain how a Summing Amplifier can be obtained using op-amp with inverting mode? 5
2. a) What are the practical benefits of using negative feedback? 2
 b) Distinguish between Zener diode and Rectifier diode. 3
 c) Explain the working principle of a Series Voltage Regulator with an appropriate circuit diagram. 5
 d) Give the circuit diagram of a Tuned Collector oscillator and briefly explain its operation. 5
3. a) Using illustrations, explain the depletion region at a pn-junction is produced. List the characteristics of the depletion region. 5
 b) Write down the expression that describes the I-V relation of a diode. Draw the I-V characteristics of a rectifier diode using this expression. 1+4
 c) Explain the operation of a full wave bridge rectifier circuit. 5
4. a) Sketch and explain the shape of the common emitter input and output characteristics. 5
 b) Explain how a transistor may be used for voltage amplification. 5
 c) Discuss the thermal stability of transistor circuits with regard to I_{CBO} and V_{BE} . Define the stability factor S for a transistor.
5. a) Using illustrations, explain the operation of an n-channel JFET. Show the internal depletion regions and explain their shape. 5
 b) Explain the operation of an n-channel enhancement MOSFET using suitable illustrations. 5
 c) Form a typical FET maximum transfer characteristics, determine g_m at $V_{GS} = -1\text{ V}$ and $V_{DS} = -4\text{ V}$.
6. a) Explain the process of turning ON of an SCR using two transistor analogy. 5
 b) Draw a circuit diagram of UJT relaxation oscillator circuit. Explain how spike waveform can be generated from it. 2+4
 c) Explain the operation of a simple 180° phase control circuit using SCR. 4

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MATH 1223: Linear Algebra

Total Marks: 60

Time: 2.5 Hours

[Answer any four (4) of the following Questions]

1. a) Define the terms Euclidean inner product, norm and distance in \mathbb{R}^n and \mathbb{C}^n . Find the Euclidean norms of \underline{u} and \underline{v} , inner product $\underline{u} \cdot \underline{v}$ and distance between \underline{u} and \underline{v} if $\underline{u} = (2 - 3i, 1 + i, 3 + 7i)$, $\underline{v} = (4 + 5i, 3i, 5 - 4i)$. 7

- b) State Cauchy-Schwarz and Minkowski's inequalities in \mathbb{R}^n and verify by taking any two vectors in \mathbb{R}^3 . For which values of k are the vectors $\underline{u} = (2, 1, 3)$ and $\underline{v} = (1, 7, k)$ in \mathbb{R}^3 orthogonal? 8

2. a) Determine the value of k such that the following system of equations x, y and z has: 8

- i) a unique solution $x - 3z = -3$
ii) no solution $2x + ky - z = -2$
iii) more than one solution $x + 2y + kz = 1$

- b) Find the inverse matrix if possible by using elementary row operations of the matrix 7

$$A = \begin{bmatrix} 5 & 3 & 2 \\ 3 & 3 & 2 \\ 0 & 1 & 1 \end{bmatrix}$$

3. a) Define linear dependence and independence of a set of vectors in a vector space. Determine whether the vectors $(2, -1, 0, 3)$, $(1, 2, 5, -1)$ and $(7, -1, 5, 8)$ in \mathbb{R}^4 are linearly dependent or independent. 8

- b) Define linear combination of vectors. Write the matrix $E = \begin{pmatrix} 3 & -1 \\ 1 & -2 \end{pmatrix}$ as a linear combination of the matrices $A = \begin{pmatrix} 1 & 1 \\ 0 & -1 \end{pmatrix}$, $B = \begin{pmatrix} 1 & 1 \\ -1 & 0 \end{pmatrix}$ and $C = \begin{pmatrix} 1 & -1 \\ 0 & 0 \end{pmatrix}$ 7

4. a) Solve the following system of equations using Gauss-Jordan Elimination. 7

$$\begin{aligned} 2x - 4y - z &= -8 \\ 4x - 8y + 3z &= 4 \\ -2x + 4y + z &= 11 \end{aligned}$$

- b) Express the following system in matrix form and then solve it by inverse matrix technique: 8

$$\begin{aligned} 3x_1 - x_2 + x_3 &= -5 \\ -x_1 - x_2 &= 1 \\ x_1 + x_3 &= -4 \end{aligned}$$

5. a) Define basis and dimension of a vector space. Let S and T be the following subspaces of \mathbb{R}^4 : 8

$$\begin{aligned} S &= \{(x, y, z, t) : y + z + t = 0\} \\ T &= \{(x, y, z, t) : x + y = 0, z - 2t = 0\} \end{aligned}$$

Find basis and dimension of (i) S (ii) T and (iii) $S \cap T$

- b) Define the kernel and image of a linear transformation. Let $T : \mathbb{R}^3 \rightarrow \mathbb{R}^3$ be linear operator defined by

$$T(x, y, z) = (3x - y, y - z, 3x - 2y + z)$$

Find a basis and dimension of the (i) image of T and (ii) kernel of T .

6. a) State Cayley-Hamilton theorem. Verify this theorem for the matrix

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

And using the theorem find A^{-1} .

- b) Define eigenvalues and eigenvectors. Find all eigenvalues and corresponding eigenvectors of the matrix

$$\begin{bmatrix} 1 & 1 & 2 \\ 0 & 2 & 2 \\ -1 & 1 & 3 \end{bmatrix}$$

Also find the matrix P that diagonalizes A and determine $P^{-1}AP$.

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STAT 1224: Introduction of Statistics

Total Marks: 60

Time: 2.5 Hours

[Answer any four (4) of the following Questions]

1. a) Distinguish between (i) population and sample (ii) parameter and statistic (iii) discrete variable and continuous variable (iv) Bar diagram and histogram. 8
b) The following figures show the marks obtained by some students of CSE department. 7

37	42	41	46	35	43	34	19	48	26
25	33	30	34	13	22	14	39	23	38
11	18	29	25	26	25	44	38	17	18
23	27	20	21	49	15	24	27	11	45

- (i) Construct a frequency distribution of the data.
(ii) Construction a stem and leaf diagram of the data.
(iii) Draw a histogram and frequency polygon.
2. a) What are the properties of a good average? Examine these properties with reference to the arithmetic mean and median and give an example of situations in which each of them can be appropriate measure for the average. 5
b) Calls made by a telephone saleswoman were monitored. The lengths (in minutes) of 30 calls are summarized in the following table. 6

Length of call	0 - 2	2 - 5	5 - 8	8 - 11	11 - 15
Number of calls	17	6	4	2	1

- Compute arithmetic mean and median length of call.
- c) Show that for two nonzero positive numbers $AM \geq GM \geq HM$ (under usual notations). 4
3. a) What do you mean by dispersion? State its different measures. Why we need relative measures of dispersion? 2+2
b) Describe different levels of measurement with examples. +1
c) In a medical Survey, a group of diabetic patients was observed. The glucose levels (in usual unit) of the patients are given below: 3
7

Glucose level	9 - 10	11 - 12	13 - 14	15 - 16	17 - 18
No. of Patients	4	5	6	3	2

Calculate mean deviation, standard deviation and coefficient of variation.

4. a) Define skewness and kurtosis. Also discuss their different measures. Show that β_1 and β_2 are invariant to the changes in origin and scale of measurement. 5
b) The first four moments of a distribution about 2 are 1, 5, 10 and 112. Find mean, variance, skewness and kurtosis and comment of the shape of the distribution. 6
c) Define scatter diagram. Discuss the usefulness of scatter diagram to predict the relationship between two variables. 4
5. a) Define Pearson's product moment correlation coefficient. State its important properties and uses. 4
b) When do you need rank correlation? Derive the formula for Spearman's rank correlation coefficient. 4

- c) The following data relate to the percentage of unemployment (x) and percentage of change in wages (y) over several years.

x	16	22	23	17	18	24	27	20
y	50	32	27	21	41	28	23	35

- (i) Without mathematical calculation can you predict the relationship between x and y.
(ii) Calculate product moment correlation coefficient (r) and interpret the result.

6. a) Define a simple regression model. State the variables and parameters involved in a simple regression model. Discuss a technique for estimating the parameters of a simple regression model.
b) What do you mean by coefficient of determination? Show that the geometric mean of two regression coefficients is same as the correlation coefficient.
c) What is contingency table? How does it differ from correlation table? Find the value χ^2 from the following contingency table.

	No Cold	Mild Cold	Severe Cold
Vitamin C	53	35	12
Placebo	37	65	98