

University of Dhaka
Department of Computer Science and Engineering
First Year Second Semester B.Sc. Final Examination-2018
CSE-1201: Fundamentals of Programming
Total Marks: 70, Credits: 3, Time: 3 hours

Answer any Five(5) of the following questions ($5 \times 14 = 70$)

1. (a) Define function. List the properties of a function. [2]
- (b) Briefly describe the functionality of the following variable modifiers: (i) static (ii) extern (iii) volatile [3]
- (c) The numbers which consist of only the digits 1, 2 and 3 are called Pretty Number. Write a code segment to implement the function $isPN(x)$: that takes a number x as input and returns 1 if x is a Pretty Number, otherwise returns 0. [4]
- (d) Write a code segment to read two time (HH:MM:SS) values from a date and print the maximum difference between them. Output must follow the format of HH:MM:SS. [5]
(24 HR Format)

2. (a) Consider the following program to calculate the n th Fibonacci number.

```
#include <stdio.h>

#define mod 1000000007

int fib(int n){
    if(n==0 || n==1) return 1;
    return (fib(n-1)%mod+fib(n-2)%mod)%mod;
}

int main() {
    int n;
    scanf("%d",&n);
    printf("%d\n",fib(n))
    return 0;
}
```

There is a problem in this program. If the value of n is greater than 50 then this program will start taking huge computation time. Can you help us to rewrite the program so that we can determine the 100000th Fibonacci number efficiently without waiting huge amount of time? If yes, then write the efficient program. Please note that we are very busy person so we do not want to wait more than 2 seconds to execute the program.

[4]

- (b) Write a function, which will takes a string of alphabets and print the words(separated by space) which contain the equal number of vowels and consonants. [4]

Sample Input	Sample Output
Enjoy the Semester Exam	Exam
Data Structure	Data

- (c) Determine the output of the following program: [6]

```
#include <stdio.h>
#define ctrl 3
#define sum(x,y) x+y
#define times(x,y) x*y
#define mod(x,y) 2*x+y
#define LOG(w,x,y,z) printf("%d %d %d %d\n", w, x, y, z)

#ifndef ctrl
int magic = 9;
#define DEBUG(s) printf("%s\n", s)
#else
#line 101
int magic = 4;
#define DEBUG(s)
#endif

void fun(int* a, int* b, int* c) {
    *a = 1 * *c;
    *b = 2 * times(mod(*b,sum(*a,*c)), *a);
    *c = 3 * sum(*a, mod(*b,*c));
    DEBUG("inside fun");
}

int main() {
    int w = ctrl, x = 5, y = magic, z = 6;
    fun(&x, &y, &w);
    LOG(w,x,y,z);
    fun(&x, &y, &z);
    LOG(w,x,y,z);
    printf("%d\n", ...LINE...);
    return 0;
}
```

3. (a) Define array. Point out the advantages and disadvantages to use array. [3]
- (b) Write a program which takes an array of N integers and print the maximum product that can be produced multiplying one or more consecutive numbers from the array. [5]
- (c) Write a program that takes an integer as input and print the pattern as sample cases. [6]

Input1	Output1	Input2	Output2	Input3	Output3
2	* *	4	* * **	6	* * ** *** ****

4. (a) Write a function which will take a 2D array and its shape as parameters. The function will sort the column values in non-ascending order. [4]
- (b) Write a macro which will take three elements as arguments and determine the maximum element. [3]
- (c) Determine the output of the following program: [2+3+2]

```

i. #include <stdio.h>
int main(){
    int num=33;
    printf(" Result: %d\n", num);
    return 0;
}

ii. #include <stdio.h>
int main(){
    unsigned int num=39;
    unsigned int x = num & 0xAAAAAAAA;
    unsigned int y = num & 0x55555555;
    x>>=1;
    y<<=1;

    printf(" Result: %d\n", x|y);
    return 0;
}

```

```

iii. #include<stdio.h>


//data type size in bytes
//int: 4, long int: 4, double: 8, char: 1
struct structNode{
    int a1:30;
    long int a2;
    int a3:7;
    unsigned int a4:25;
    double d;
};

union unionNode{
    int a;
    char ch;
    long int aL;
    double d;
};

int main(){
    printf("%d %d\n", (int) sizeof(structNode),
                                                    (int) sizeof(unionNode));

    return 0;
}

```


 (a) Suppose you have a linked list, named studentList, where each node contains a student information (id, name, cgpa). Now complete the following function: [1+4+3]

- i. Declare the structure which can hold the student info of studentList.
- ii. void insert(Student **head, Student newStudentInfo, int insertIndex)

This function will insert new student at the insertIndex. If the insertIndex is greater than the studentList size then the newStudentInfo will be inserted at the end of studentList. Moreover, if studentList contains a student whose id is same as the newStudentInfo then your program will just update the student info instead of inserting a new node.

- iii. int delete(Student *head, int sid)

This function deletes a student info from studentList whose id is matched with sid and return 1. This function will return 0 if studentList do not contain a student with sid.

- (b) Write a program to determine whether a given parenthesis sequence is valid. See the sample input and output for clarification: [6]

Sample Input	Sample Output
(){} ()	Valid
(({ }))({)	Invalid
(((((Invalid

- (a) Write a program which will replace the rightmost not set bit(0) with the set bit(1) and the leftmost set bit with not set bit of a given integer. After that print the modified integer. For example, the binary representation of 81 is 1010001. Hence, if we set the rightmost bit and clear the leftmost bit then the modified binary representation will be 0010011 which is 19. Please note that you are not allowed to use an array in your program.
- [3]

- (b) Write a program which will determine the unique numbers contain in a given list of sorted number $A(a_1 a_2 a_3 \dots a_n)$. The first line of input contains $N(1 \leq N \leq 10^7)$ denotes the total number contains in A. The next line contains N space separated decimal numbers, where $1 \leq a_i \leq 10^{20}$. [5]

- (c) Suppose you want to write a program which will take input from user and store that numbers until user gives -1. How can you write this program? You can declare an array with the highest possible size, say 10^7 . But if the user gives -1 after giving just 10 numbers, then 9999990×4 bytes will be wasted. We do not like this type of memory wastage.

Thus, you have to write a program which will declare a 4 sized array and start storing user input. If user gives more than 4 inputs than just double the array size. Your program will repeatedly perform this action everytime it needs more space to store user inputs. [3]

- (d) Find the bug in the following program and rewrite the corrected program:

```
#include<stdio.h>

int factorial(int x) {
    if(x==1)        return 1;
    return x * factorial(x-1);
}

int main(){
    printf("%d\n",factorial(0));
    return 0;
}
```

7. Faculty of Engineering and Technology(FET), University of Dhaka is going to arrange International Conference on Innovation in Engineering and Technology(ICIET) 2018. The accepted paper and poster list have been already published and the author has been notified to complete the registration. The registration process is going on and the registration committee is working hard. However, FET office needs some registration statistics to start the preparation. As the registration committee is very busy, so they need your help to determine these statistics.

Registration committee will give you a text file, `registered_paper_info.txt`, which contains all the registered paper/poster information. This file may contain maximum 101 paper and poster information. Here is a sample snapshot of the file:

```
paperId , paperTitle , authorId , authorName , isStudentPaper , isIEEEMember , type , payment
404," Evolution of student behavior",15," Anik Islam" ,1,0 ,paper ,4000
401,"A DNN approach to generate memes" ,16," Tanveer Hossain" ,0,0 ,poster ,6000
1001,"A study of user data privacy in mobile app" ,20," Tahsin Sayed" ,0,1 ,paper ,7500
```

Write a program which will help to accomplish the following task. Write separate functions for each of the different tasks. [1.5+3.5+4+5]

- (a) Read the file and store the information in an array of structure.
- (b) Print the author id and name who has the highest number of the registered poster.
- (c) Print the list of unique authorID and name.
- (d) Sort the papers/posters information based on the authorID; if two author has the same authorID then sort the papers/posters according to the payment amount. If two papers/posters have the same payment amount then sort according to their paperID(paperID is always unique). After sorting the paper information replace the file contents.

University of Dhaka
Department of Computer Science and Engineering
1st Year 2nd Semester B.Sc. Final Examination 2018
EEE 1202: DIGITAL LOGIC DESIGN

Duration: 3 hours

Credits: 03

Total Marks: 70

(Answer any five of the following questions)

- a) For a single bit sum, half adder adds 2-bits whereas full adder adds 3-bits. So can we use half adder to implement full adder? 3
 If your answer is Yes, design a full adder using half adder for single bit sum. And if your answer is No, state why not possible.
- b) Let the sum of two n-bit numbers $X(X_0X_1X_2 \dots X_{n-1})$, $Y(Y_0Y_1Y_2 \dots Y_{n-1})$ and a carry input C_0 have to be calculated. Determine the generate (G_i) and propagate (P_i) logics for the i-th full adder block of the CLA adder. Find the carry equations for C_3 and C_5 . 4
- c) A special kind of encoding technique of some decimal digits is shown below: 5

Decimal	Code	Grey	Bagan Gur
0 0000	0010	0000	0000
1 0001	0100	0001	0001
2 0010	0001	0011	0010
3 0011	0110	0010	0011
4 0100	1001	0110	0101
5 0101	1100	0111	0100
6 0110	1010	0101	
7 0111	1011	0100	

Show the function table, output equations and the logic(circuit) diagram for the above encoder.

- d) What is the minimum number of bits required to represent 50 objects using binary codes? How many codes will remain unused in this scheme? 2
- a) Implement the function $F(A, B, C, D) = \prod_M(0, 2, 4, 7, 9, 11, 13, 15)$ using 7
 i. 4-to-16 Decoder (without converting to minterms)
 ii. 4-to-1 Multiplexer
 You can use other necessary basic gates if necessary.
- b) Suppose in an experiment you need a 4-to-16 decoder. But in Digital Circuit Lab, there are enough amount of 3-to-8 decoders, 1-to-2 decoders and wires available. No basic gates are available. 3
 Now design (implement) a 4-to-16 decoder for your experiment.
- c) Add the numbers $(115.2)_8$ and $(A3.9)_{12}$ and express the sum in hexadecimal. 4
- a) Design a MOD 6 synchronous counter. Explain the operation of the counter with the help of state transition diagram. 7
- b) A binary counter is being pulsed by a 256-kHz clock signal. The output frequency from the last FF is 2 kHz. 3
 i. Determine the MOD number
 ii. Determine the counting range
- c) Write in detail about the following flip-flop characteristics: propagation delay time, power dissipation time, set-up time. 4
- a) Suppose 3-bit binary data, $[D_2D_1D_0]$ is being given to you in parallel. Now design a Left-Shift Register to collect the data. If the design is not possible, give your opinion on it. 4

- b) Draw a state diagram to recognize the sequence of bits, '01010'. Note that two consecutive sequences might be overlapped. 4
- c) The following K-map is for Boolean function F. Now write a simplified expression in sum-of-products (SOP) form for F'. 6

YZ \ WX	00	01	11	10
00	0	1	1	0
01	1	1	1	1
11	0	0	1	1
10	0	1	1	0

A	B	C	D
1	1	0	0
1	1	0	1

- 5 a) Perform BCD addition on 8505_{10} and 9936_{10} with detail calculation. Sum must be represented in BCD format. 3
- b) Reduce the following Boolean expression to four literal expression using Identities. You need to show the Identity Rule in each step. 4

$$(X' + Y + Z')' + XY'Z' + YZ + XYZ$$

- c) Design a counter which follows the sequence, 7
- $0 \rightarrow 1 \rightarrow 3 \rightarrow 2 \rightarrow 6 \rightarrow 7 \rightarrow 0 \rightarrow 1 \rightarrow 3 \rightarrow 2 \rightarrow 6 \rightarrow 7 \rightarrow 0 \rightarrow 1 \dots$
- You can use any types of flip flop to implement.

- a) Find the simplified product-of-sums (POS) for the following Boolean function F together with the don't-care conditions d: 5

$$F = \sum_m(2, 4, 7, 8, 9, 12, 15) + \sum_d(5, 6, 13)$$

- b) Express the following function in Product of Maxterm (POM) and Sum of Minterm (SOM), 3

$$F(A, B, C, D) = (BD + AC')(AB + C)(BD' + AC')$$

- c) Design a 4-input priority encoder, with its inputs being the binary variables D_3, D_2, D_1 , and D_0 for the decimal digits 3, 2, 1, and 0 respectively; and the output being the binary code $(A_1A_0)_2$ of the appropriate digit. The priority ordering of the digits are as $D_2 < D_0 < D_1 < D_3$, i.e., D_2 has the lowest and D_3 has the highest priority. You need to show the truth table, K-Maps (if needed), and the logic circuit diagram of the system. 6

- a) Subtract 46.5_{10} from 125.5_{10} using 2's complement arithmetic. 1
- b) What is an advantage of encoding a decimal number in BCD rather in straight binary? What is a disadvantage? 3
- c) Convert the number 1011001_2 (binary) to the corresponding gray code equivalent. 5
- d) Draw the circuit diagram for $x = [D + (A + B) \cdot C] \cdot E$ 5

University of Dhaka
Department of Computer Science and Engineering
1st Year 2nd Semester B.Sc.(Hons.) Final Examination, 2018
CHE 1203: Chemistry

Full Marks: 70

Time: 3 Hours

(Answer any Five (5) of the following Questions)

1. a) What is the wavelength of an electromagnetic radiation having a frequency of 2×10^3 Hz? What type of radiation is it? 2+1 = 3
- b) What is the condition imposed on the frequency of the incident photons to cause photoelectric effect in a metal? 2 $\frac{1}{2} \times 10^3$
- c) (i) Calculate the energy emitted when a photon is emitted in a transition from $n_i = 6$ to $n_f = 3$ energy state in a hydrogen atom? [$R_H = 2.18 \times 10^{-18}$ J; $h = 6.63 \times 10^{-34}$ J.s] 2
(ii) In which series of emission spectrum it shows a line? 1
- d) How does the Heisenberg uncertainty principle relate to the dual nature of electron? 1
- e) Show the electron configuration of I⁻ (Z=53) and Cu (Z= 29) 2
- f) Which of the following sets of quantum numbers is permissible? Justify your answer. 3
(i) $n=4, l=1, m=-1, s=+1/2$
(ii) $n=2, l=3, m=-1, s=-1/2$
2. a) Which of the following ionization processes requires more energy, and why? 3
(i) $Mg \rightarrow Mg^+$ (ii) $Mg^+ \rightarrow Mg^{2+}$
- b) Why do boron (B) and silicon (Si) exhibit many similar chemical properties, despite being in different periods and groups in the periodic table? 2
- c) Which of the oxides is more acidic among MgO, Al₂O₃, and SO₃, and why? 2
- d) Match each of the elements on the right with its description on the left: 3
(i) A reactive metal that attacks water Ne
(ii) A dark red liquid Ca
(iii) An inert gas Br₂
- e) Differentiate between electronegativity and electron affinity. 2
- f) Specify which hybrid orbitals are used by the carbon atom in (i) propane, and (ii) CO₂. 2
3. a) The police often use a device called a breathalyzer to test drivers suspected of being drunk. What is the chemical basis of this device? Show appropriate reactions. 1+2
- b) Balance the following redox reaction: Balance the following reaction: $Fe^{2+} + Cr_2O_7^{2-} \rightarrow Fe^{3+} + Cr^{3+}$ (acidic medium). 3
- c) Identify the conjugate acid-base pairs for the following: 2
(i) $NH_3(aq) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$
(ii) $CH_3COOH(aq) + H_2O(l) \rightleftharpoons CH_3COO^-(aq) + H_3O^+(aq)$
- d) Write down Henderson's equation for the pH of a solution containing a weak acid and its conjugate base defining each terms in it. 2
- e) Neither ethanoic acid solution nor sodium ethanoate solution is a buffer solution, but a mixture of the two is a buffer solution. Explain. 2
- f) Arrange the following acids in the order of decreasing acidity: H₂O, H₂S, H₂Se. 2
4. a) Under which set of conditions would a gas be expected to behave most ideally and why? 3
(a) High temperature and high pressure (b) Low temperature and high pressure
- b) Write down van der Waals equation explaining different terms in it. What are the significances of van der Waals constants for a and b ? 3
- c) What do you mean by phase, component and degree of freedom. Write down the mathematical expression for the phase rule. 2
- d) Draw the phase diagram of CO₂ and explain why dry ice does not melt at ambient temperature and pressure. 3
- e) What is SCUBA diving? What would happen if a diver rose to the surface from a depth of 20 ft rather quickly without breathing? Discuss with the help of applicable gas laws. 3

5. a) What do you mean by dynamic equilibrium? 2
- b) What is reaction quotient? How does it indicate the direction of the equilibrium? 1+1
- c) State the principle of Le Chatelier and Brown. Use it to explain why (i) higher pressure and (ii) lower temperature favors higher equilibrium yield in the synthesis of ammonia by the Haber's process. 2+2
- d) Define order and molecularity of a chemical reaction. 2
- e) Write down the rate equation of the first order reaction, $A \rightarrow P$ and derive the integrated form of the rate equation. Mention the salient characteristics of the 1st order reaction. 4
- a) Define *solution*. Define mole fraction and molarity as units of concentration of solutions. 1+2
- b) Name four colligative properties for dilute solutions. 2
- c) With the help of appropriate vapor-pressure-temperature curves, show that the boiling point of a solvent is elevated by a dissolved non-volatile solute. 2
- d) What is reverse osmosis? How can it be used for desalination of sea-water? 2+2
- e) Define electrolytes. How can you differentiate strong electrolytes from weak electrolytes. Give examples. 1+2
- a) What are carbohydrates? How can you classify them based on their reactivity? 2
- b) *D-glucose is an aldose*. Justify. 2
- c) Draw the structures of two amino acids and give their names. What are isoelectric points of an amino acid? 2+1
- d) What are proteins? What are the building blocks in DNA or RNA? 1+1
- e) What are nucleic acids? What are the Chargaff's rules regarding the structure of DNA? 1+2
- f) What are polymers? Name the polymerization process which usually yields large molecular weight polymers? 1+1

University of Dhaka
Department of Computer Science and Engineering
1st Year 2nd Semester Final Examination-2018
MATH 1204: Methods of Integration, Differential Equations, and Series

Duration: 3 hours

Credits: 03

Total Marks: 90

(Answer any five of the following questions)

1. a) Integrate the followings: 7
 - i. $\int \frac{2x+5}{\sqrt{x^2-2x+2}} dx$
 - ii. $\int \frac{2\sin x + 3\cos x}{3\sin x + 4\cos x} dx$
- b) Evaluate the following integrals: 7
 - i. $\int_0^{\pi/2} \ln(1 + \cos x) dx$
 - ii. $\int_1^2 \frac{dx}{x\sqrt{x^2+5x-1}}$
2. a) Find the area of the ellipse $\frac{x^2}{4} + \frac{y^2}{9} = 1$. 5
- b) Find the arc length of the curve $y = x^{\frac{3}{2}}$ from (1, 1) to (2, $2\sqrt{2}$). 5
- c) Find the area of the surface that is generated by revolving the portion of the curve $y = x^3$ between $x = 0$ and $x = 1$ about the x -axis. 4
3. a) Derive Walli's formula for $\int_0^{\pi/2} \sin^n x dx$ and hence evaluate $\int_0^{\pi/2} \sin^6 x dx$ 7
- b) Find the reduction formula for $I_n = \int (\ln x)^n dx$ and hence using this reduction formula evaluate $\int (\ln x)^3 dx$. 7
4. a) Define polar coordinate system. Change the coordinates: (i) $(-2, -2\sqrt{3})$ and $(6, \frac{2\pi}{3})$. 4
- b) Use Simpson's 1/3 rule to evaluate (i) $\int_{-1}^1 e^{-x^2} dx$ (ii) $\int_0^1 \cos(x^2) dx$. 8
- c) Sketch the graph of $r = \frac{2}{1 + 2\sin \theta}$ in polar coordinates 2
5. a) Find the differential equation of all the circles passing through the origin. 4
- b) Use necessary and sufficient condition for exactness to solve the ODE $(2x \cos y + 3x^2 y) dx + (x^3 - x^2 \sin y - y) dy = 0$. 5
- c) Solve the homogeneous ODE $(x^3 + y^2 \sqrt{x^2 + y^2}) dx - xy \sqrt{x^2 + y^2} dy = 0$. 5
6. a) Solve the ODE by Bernoulli's method $\frac{dy}{dx} + y \tan x = y^3 \sec x$. 6
- b) The rate at which radioactive nuclei decay is proportional to the number of such nuclei that are present in a given sample. Half of the original number of the radioactive nuclei have under gone distinguish in a period of 1500 years. What percentage of the original radioactive nuclei will remain after 4500 years? In how many years will only one-tenth of the original number remain? 8
7. a) Define sequence and convergence of a sequence. Determine whether the sequence converges or diverges by examining the limit as $n \rightarrow +\infty$ 8
 - (i) $\left\{ \frac{n}{2n+1} \right\}_{n=1}^{+\infty}$ and (ii) $\left\{ (-1)^{n+1} \frac{1}{n} \right\}_{n=1}^{+\infty}$
- b) State Taylor series with remainder. Expand $f(x) = \cos x$ in powers of $\left(x - \frac{\pi}{2}\right)$ with Taylor's remainder. 6