L-1/T-2/CSE   **Date : 24/07/2013**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
L-1/T-2 B. Sc. Engineering Examinations 2011-2012
Sub : CSE 105 (Structured Programming Language)

Full Marks : 210   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

All the questions in this section are related to C Programming.

1. (a) A C program contains the following array declarations: **(8)**

       char text[80];

Suppose that the following string has been assigned to text

     Programming with C can be a challenging creative activity.

Show the output resulting from the following *printf()* statements.

       (i) printf("%18s", text);   (ii) printf("%.18s", text);

       (iii) printf("%18.7s", text);   (iv) printf("%–18.7s", text);

Use⌴ to show each blank position.

(b) Write an interactive C program that will convert a date, entered in the form mm-dd-yy (example: 4-12-13) into an integer that indicates the number of days beyond January 1, 2000. If the year does not extend beyond 2199 (i.e., if yy <= 99), we can make use of the following relationships: **(12)**

(i) The day of the current year can be determined approximately as

       day = (int) (30.42) * (mm – 1)) + dd

(ii) if mm = = 2 (February), *increase* the value of day by 1.

(iii) if mm > 2 and mm < 8 (March, April, May, June or July), *decrease* the value of day by 1.

(iv) if yy%4 = = 0 and mm > 2 (leap year), *increase* the value of day by 1.

(v) *Increase* the value of day by 1461 for each full 4-year cycle beyond 1-1-2000.

(vi) *Increase* day by 365 for each additional full year beyond the completion of the last full 4-year cycle, then add 1 (for the most recent leap year).

(c) A table contains *n* unique data elements sorted in ascending order. To find a data element, the table is first split into blocks of *m* data elements, and then a linear search is performed on the last data element of each block to find the block containing the target data record. If the number of elements in the selected block is less than *m*, then a linear search is performed on the selected block to find the target data element; otherwise the selected block is further split into blocks of *m* data elements and again a linear search is performed on the last data elements recursively. Write a recursive C function that is to be used to implement the searching of an element from a list of integer data using the stated algorithm. **(10)**

(d) What is escape sequence? What is the purpose of using escape sequence in C programming? **(5)**

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2. (a) Describe the output of the following program: **(15)**

```
#include <stdio.h>
int a = 0, b = 1;
int funct1(int a);
int func2(int b);
main(){
        int count;
        for(count = 1; count <= 5; ++count){
                b += funct1(a + 1) + 1;
                printf("%d ", b);
        }
}
funct1(int a){
        b = funct2(a + 1) + 1;
        return(b);
}
func2(int a){
        return(b + a);
}
```

(b) The flowchart below shows a binary search algorithm to find the index m of the array element $A(m)$, such that the equation "$A(m) = k$" holds, from the array elements $A(1)$, $A(2)$, ... $A(n)$ already sorted in ascending order. In case of "$m = 0$" at the end, there is no element such that the equation "$A(m) = k$" holds. Which statement is to inserted in the process box D in the flowchart? **(10)**
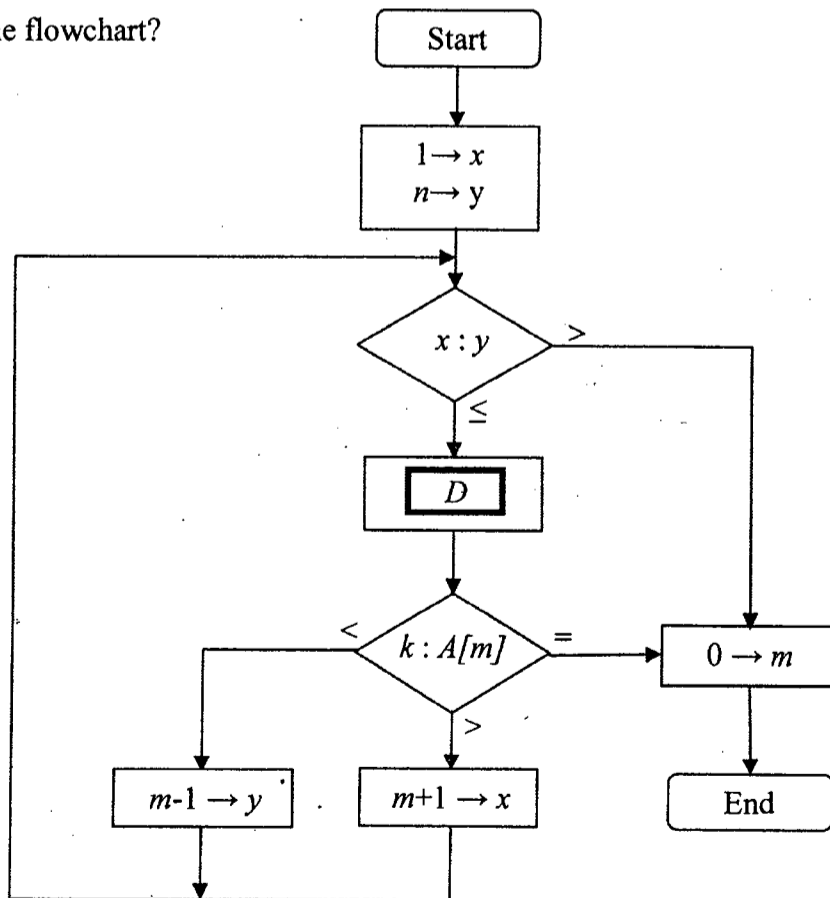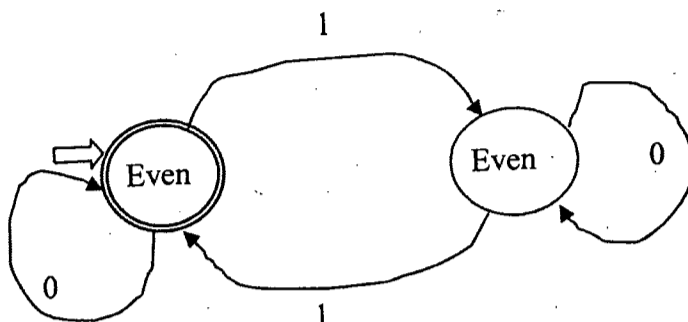

Write an iterative C function for implementing the flowchart stated in the figure.

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Contd ... Q. No. 2

(c) The figure below shows the state transition diagram of an automaton that accepts bit strings with even numbers of 1s. The double circle marked with "Even" represents the accepted state.

(10)

Binary digits, i.e., 1 or 0 are already stored in the array element $A[n]$. Assume that both $A[...]$ and n are declared in the calling function and are propagated to the called function as arguments. Write a C function to determine whether the binary number stored in the array element contains "Even" number of 1s. The algorithm of the function must follow the state transition diagram shown in the figure.

3. (a) A binary search tree can be represented using a 1-D array data structure where the root of the tree is placed in the location indexed by 1 shown in the figure. In such a tree, there is no wastage of memory location for a complete binary search tree but some locations are kept blank if the tree is incomplete. Moreover, non-existence of a child is represented by −1.

(10+10)
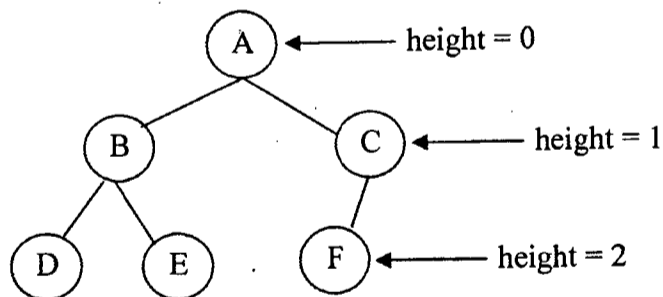
Index→	0	1	2	3	4	5	6	7	8	9	...
A:		A	B	C	D	E	F	−1	−1	−1	...

(i) Write a C function that reads integers from the standard input device and place them in $A[n]$ based on the principle of 1-D array based binary search tree representation. Assume that both $A[...]$ and n are declared globally.

(ii) Write a C function to calculate the height of an element in the tree, when the height of the root is considered as zero (hint: the height of node D as shown in the figure is 2, the height of a non-existence node is −1).

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Contd ... Q. No. 3

(b) Write down some characteristics that are to be followed in writing a good computer program. **(6)**

(c) Explain what happens when the following statement is executed. **(9)**

if (abs(x) < $xmin$)x = (x > 0) ? $xmin$: $-xmin$;

Is this a compound statement? Is a compound statement embedded within this statement?

4. (a) Write a C function to delete an integer element from a sorted array. **(10)**

(b) What is function prototype? Explain with example. Write a C function named "swap" which inter-exchanges the values of x and y and does not need to declare any variable within its body. **(5+7)**

(c) Write a recursive C function to solve the following Legendre Polynomials **(6+7)**

$$P_n = [(n-1)/n]xP_{n-1} - [(n-1)/n]P_{n-2}$$

where $P_0 = 1, P_1 = x, n = 1, 2, \ldots$ and x is any floating point number between -1 and 1. Describe the output of the function for $n = 5$ and $x = 0.5$.

SECTION – B
There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What is doubly linked list? Define the structure of a node in a doubly linked list where each node needs to store two integer variables and one character variable. **(10)**

(b) Suppose you have a doubly linked list. Assume that each node of the list contains an integer variable named 'data'. Also assume that the two pointers are 'next' and 'prev' (apply common sense in using the two pointers). Assume that you have used **typedef** to define the type of the structure used in the linked list as 'DLL'. Now you are given a function named "findNode()" as defined below. Assume that 'pHead' is used to pass the pointer pointing to the start of the doubly linked list. **(20)**

```
DLL * findNode(DLL *pHead, int target)
{
        DLL *pCur;
        /*search the nodes in a linked list*/
        pCur = pHead;
        /* search until the target value is found or the end of the list is reached*/
        while (pCur != NULL && pCur -> data != target)
                pCur = pCur -> next;
        if (pCur != NULL)
                return pCur->next;
        else
                return NULL;
}
```

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Contd ... Q. No. 5(b)

Now you need to write two functions the prototypes of which are given below:

    int deleteNode(DLL *pHead, int target);

    int insertNode(DLL *pHead, int target, int newData);

Both the functions "deleteNode()" and "insertNode()" first need to find the node which has the value target in its 'data' variable. Then "deleteNode()" deletes that node and "insertNode()" inserts a new node after that node. The new node should have 'newData' in its 'data' variable. If there exists no node in the linked list having the value 'target' in its 'data' variable, then "deleleNode()" does not delete anything and returns 0; otherwise it returns 1. If there exists no node in the linked list having the value 'target' in its 'data' variable, then "insertNode()" does not insert anything and returns 0; otherwise it returns 1. Both "deleteNode()" and "insertNode()" **MUST** use the given function "findNode()" to find the node which has the value 'target' in its 'data' variable and need to work with the pointer return by "findNode()". You CAN NOT change the function "findNode()" and hence you need to carefully understand what it really returns at different circumstances.

(c) Now assume that the doubly linked list is arranged in ascending order of the values in the 'data' variable. Now, can you write another function "insertNode1()", such that if "insertNode()" returns 0, then it searches and finds the node that has the **predecessor** value of 'target' in its data field and then inserts the new node after that node. Predecessor of a value is the highest value that is less than it, i.e., in sorted order (ascending), the predecessor of a value will always occupy the previous position of it. **(5)**

6. (a) Write down an appropriate definition of a structure which has a float variable, an integer variable and a character variable. What will be the storage requirement of a variable of this type of structure? What will be the storage requirement if you use a union instead of a structure? **(8)**

(b) Discuss the use of a tagged union. Suppose you need to handle two types of students. One type of student is given marks in percentage (e.g., 90%, 89.9% etc.) and the other type of students are given letter grades (e.g., A, A+ etc.). Use the idea of a tagged union to write a program for such a scenario. Your program will take input of 5 students from a user and put the data in an array. Then it will show the output. **(15)**

(c) Your friend has written the following program which gives no compiler error. However, your teacher says that there is/are problem(s) in the code. Identify the problem and suggest possible corrections. **(6)**

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Contd ... Q. No. 6(c)

```
struct ADate {
        int month;
        int day;
        int year;
};
int main(void)
{
        struct ADate *d;
        d->month = 3;
        d->day = 9;
        d->year = 2014;
        return 0;
}
```

(d) Deduce the storage requirement of the variable 'flag' below. Mention the range of values allowed for f1 and f2. **(6)**

```
struct Flags {
   int     f1:3;
   unsigned int f2:1;
   unsigned int f3:30;
} flag;
```

7. (a) Write a program named 'myCopy' that will copy the content of one file (source file) to another file (destination file). The user may provide upto two file names following the name of the exe file (in this case, 'myCopy.exe'). If two file names are provided, the first file will be used as the source file and the second will be used as the destination file. If one file name is provided, then it will be used as the source file. The program then will have to ask for the destination file from the user. If no file name is provided then the program will ask for both the source file and the destination file. In case of any error in opening either the source or destination files or both, the user must be informed and the program again asks for another file. **(22)**

(b) Suppose you want to open an existing file for both read and write operations. Your friend suggested that you may use either 'r+', 'w+', or 'a+' as the mode for file opening. Do you agree with him? Justify your answer. **(7)**

(c) What could be the problem of the following macro definition? **(6)**

```
#define SQUARE(x) x * x
```

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8. (a) Consider the following code fragment. Assume that x and p are correctly declared as an integer and a pointer to integer respectively. Explain, what does the following loop do? **(3)**

```
...
p = &x;
x = 0;
while (*p = = x) {
        *p = *p + 1;
}
```

(b) Suppose your friend wrote the following function. He needs to swap the values of two variables and calls the swap() function from main() passing two variables (say, a and b). Unfortunately, he realized that the swap() function is not working correctly. Could you explain why it is not working? Can you correct the swap() function to make it work correctly? **(6)**

```
void swap(int x, int y)
{
        int tem;
        temp = x;
        x = y;
        y = temp;
}
```

(c) Consider the following program: **(5)**

```
#include<stdio.h>
int main(void)
{
        char *pChur;
        int * pInt;
        char aChar[8]= {0x78, 0x56, 0x34, 0x12, 0x12, 0x34, 0x56, 0x78};
        printf("%X\n", aChar;/*Output Line #1*/
        pChar = aChar;
        pInt = (int *)aChar;
        printf("%X\n",pChar);/*Output Line #2*/
        printf("%X\n",*pChar);/*Output Line #3*/
        pChar++;
        printf("%X\n",pChar);/*Output Line #4*/
        printf("%X\n",*pChar);/*Output Line #5*/
        printf("%X\n",pInt);/*Output Line #6*/
        printf("%X\n",*pInt);/*Output Line #7*/
        pInt++;
        printf("%X\n",pInt);/*Output Line #8*/
        printf("%X\n",*pInt);/*Output Line #9*/
        return 0;
}
```

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Contd ... Q. No. 8(c)

After executing the program, Output Line #1 gives 22FF24. What will be written in Output Line #2 to Output Line #9?

(d) Explain the following complicated declaration: **(5)**

        char (*(*x())[5])();

(e) The WndProc callback function of a windows program written in C is given below: **(16)**

LRESULT CALLBACK WndProc(HWND hwnd, UNIT msg, WPARAM wParam,
LPARAM lParam)

```
{
    switch(msg)
    {
        case WM_LBUTTONDOWN:
        /*this is the corresponding message for left mouse button click*/
        {
                char param1 [10];
                char param2 [10];
                getUserInput(param1);
                getUserInput(param2);
                MessageBox(hwnd, param1, "The first parameter is:", MB_OK|
                MB_ICONINFORMATION);
                MessageBox(hwnd, param2, "The second parameter is:", MB_OK|
                MB_ICONINFORMATION);
        }
        break;
        case WM_CLOSE:
                DestroyWindow(hwnd);
        break;
        case WM_DESTROY:
                PostQuitMessage(0);
        break;
        default:
                return DefWindowProc(hwnd, msg, wParam, lParam);
    }
    return 0;
}
```

The procedure above uses the following API:

void getUserInput(char *ptr)	It takes input from the user and put it as a string in the memory pointed to by 'ptr'.

Now explain what happens when left mouse button is clicked? Update WndProc() so that when the left mouse button is clicked the summation of the two parameters are shown in a message box. Assume that the users would provide numeric input. For example, if the user provides "123" and "456", a message box would show: "579".

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
L-1/T-2   B. Sc. Engineering Examinations 2011-2012

Sub : HUM 175 (English)

Full Marks : 210   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer Q. No. 1 and any **TWO** from the rest.

1. Read the passage carefully and answer the questions that follow: **(45)**

According to different religious scriptures, we are the descendents of Adam and Eve, all the woes are destined to reach us as we also bore both ... Abel and Cane.

We, teachers are even more unfortunate as eve give birth to thousands; I would like to refer to the humble saying ... teachers give the second birth to their students. Thus our students are our kids/progenies/ off-springs ... our flesh and blood. And when we see one's zeal to kill/harm the other, I come to realize why we were thrown away to the miserable measurable earth from heaven, to live with our sins. A sudden epiphany knocks me down 'as I lay dying' in the pools of blood that is metaphorically mine!

According to the theory of probability, it can be assumed that half of my sons will become Cane while the other half Abel. Our humble visions would have failed to calculate how that tragic scenario would look like, but it is our sole misery ... they don't, as our dark-skinned eyes belong to Bangladesh. And we all live in a nightmare where it seems like, half of our kids are always ready to bury the other half. And, 'wise men' then refers to student politics'.

We keep wondering how good they are at mathematics ... they count the years of political regime to choose which ideology to be homed, they count the seats in the parliament to count back seats in residential halls/hostels, they even count freshly arrived 'cash' at times and then they suddenly forget how to count, they can't count the number of injuries they have inflicted upon their brother body, they forget how to count the number of brothers they have buried. And some 'wisemen' refer to student politics!

Students are the 'future', therefore, we do not mind if they turn out to be politically conscious but it ails if they become politically violent and a series of questions keep haunting ... when would we learn what happens to the poor parents who has raised them so far, God knows with how much care! How would I believe my son could kill and can be killed? If we have satisfactory answers, then, no worries! We should keep living happily ever after with one drop of mustard oil in each of the nostrils; if not, then?

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Contd ... Q. No. 1

If it is all about politics, then we better rectify the culture along with it. As democratic citizens we have every right to demand a better political culture which our political parties home and groom.

At least, I mourn for both, my Abels for their physical death and for my caries for their ideological death ... years of injuries inflicted upon his consistence! May their conscience rest in peace. Amen.

Questions:

(i) Why do you think the passage ends with "Amen"? Is it some kind of prayer? If yes, then what is it about?

(ii) Why do we often find the author referring to his/her students as "off-spring"?

(iii) What was the tone of the passage ... melancholic /sarcastic /allegorical /frustrating? Share your views.

(iv) The author often referred to "wise men"; who do you think they are?

(v) How would you like to define the author's position regarding student politics?

2. (a) Describe the five steps of collection procedure in business letters. **(5)**

(b) As the Credit Manager of Friends Book Corner, Rafin Plaza, Dhaka, you have received a request from the Director of student Affairs of Holy Cross College for the supply of 1200 copies of Fundamental English each session on credit basis. Inventing the necessary details, write a letter either granting the credit or refusing it. In each case, explain and give reasons behind your decision. **(15)**

(c) Write phonetic transcriptions of the following words (any five) **(10)**
yesterday, boot, girl, congratulations, feather, about

3. (a) Why is list of References important? Describe plagiarism. **(5)**

(b) Write a dialogue between two friends on session jam. **(10)**

(c) Write a short essay on any one of the following topics: **(15)**

(i) Virtualization of Friendship (ii) Spot-fixing (iii) Savar Tragedy

4. (a) Transform the following sentences as directed (any five) **(10)**

(i) Spare the rod and spoil the child. (Simple)

(ii) Death or disgrace is in store for you. (Complex)

(iii) Catch me if you can. (Compound)

(iv) I have left no stone unturned. (Compound)

(v) Either give me the thing or refund the money. (Simple)

(vi) I found that the clock had stopped. (Simple)

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Contd ... Q. No. 4

   (b) What do we have in the front matter of a report?   **(5)**

   (c) Write short notes on any three of the following topics: **(15)**

      (i) Glossary (ii) Three Types of Credit Letter (iii) Differences between Tender and Quotation (iv) Phonemes

SECTION – B

There are **FOUR** questions in this Section. Answer Q. No. 5 and any **TWO** from the rest.

5. (a) Explain with reference to the context any two of the following: **(15)**

      (i) "We want to be rescued; and of course we shall be rescued".

      (ii) "People were attracted to him as bees are attracted to cosmos or dahlia stalks".

      (iii) "But the more I read, the more complicated the subject seemed to me and the more conscious I grew of my ignorance".

   (b) Answer any one of the following: **(15)**

      (i) How would you describe the writer's attitude to imperialism in "Shooting an Elephant"?

      (ii) What impression do you form of Ralph who emerges as a leader in "Fire on the Mountain?"

   (c) Answer any three of the following: **(15)**

      (i) Write about the features of the island on which the children were stranded.

      (ii) What was the secret of the astrologer's ability to tell the fortune of his customers?

      (iii) Discuss the significance of the conch shell in "Fire on the Mountain".

      (iv) Why did William Somerset Maugham turn from the ancient philosophers to the modern philosophers?

      (v) What does the writer say about the dead Dravidian coolie?

6. (a) Recast and correct any ten of the following sentences: **(15)**

      (i) He could of had five more workers.

      (ii) This table is more square than that one.

      (iii) It is I who is to make the call.

      (iv) The ocean is too cold for people to go swimming.

      (v) Mr. Josim is a professional banker.

      (vi) Mr. Kabir disliked me asking so many questions.

      (vii) Either of the boys are acceptable to do the errands.

      (viii) Where the house at?

      (ix) He feels badly about the defeat.

      (x) Prier to the winter, we repaired the road.

      (xi) Mona chose Raina and myself for the task.

      (xii) Dina looks like she is a lady in distress.

HUM 175(CSE)

Contd ... Q. No. 6

(b) Give meanings of, and make sentences with, any ten of the following words. **(15)**

Admonish, eulogy, flimsy, garrulous, morsel, oblivion, rancour, tepid, sluggish, surmise, vestige, zealot.

7. Amplify any one of the following ideas: **(30)**

    (i) Knowledge comes but wisdom lingers.

    (ii) Rome was not built in a day.

8. Write a précis of the following passage with a suitable title: **(30)**

Most people would agree that, although our age far surpasses all previous ages in knowledge, there has been no correlative increase in wisdom. But agreement ceases as soon as we attempt to define "wisdom" and consider means of promoting it. It can be asked first what wisdom is and then what can be done to teach it. There are several factors that contribute to wisdom. Of these the first is a sense of proportion; then capacity to take account of all the important factors in a problem and to attach to each its due weight. This has become more difficult than it used to be owing to the extent and complexity of the specialized knowledge required of various kinds of technicians. To take an extreme example, which is in everybody's mind at the present time: you study the composition of the atom from a disinterested desire for knowledge, and incidentally place in the hands of powerful lunatics the means of destroying the human race. In such ways the pursuit of knowledge may become harmful unless it is combined with wisdom; and wisdom in the sense of comprehensive vision is not necessarily present in specialists in the pursuit of knowledge. Comprehensiveness alone, however, is not enough to constitute wisdom. There must be, also, a certain awareness of the ends of human life. This may be illustrated by the study of history. Many eminent historians have done more harm than good because they viewed facts through the distorting medium of their own passions. Hegel has a philosophy of history which did not suffer from any lack of comprehensiveness, since it started from the earliest times and continued into an indefinite future. But the chief lesson of history which he sought to inculcate was that from the year A.D. 400 down to his own time Germany had been the most important nation and the standard-bearer of progress in the world. Perhaps one could stretch the comprehensiveness that constitutes wisdom to include not only intellect but also feeling. It is by no means uncommon to find men whose knowledge is wide but whose feelings are narrow. Such men lack what could be called wisdom. It is not only in public ways, but in private life equally, that wisdom is needed. It is needed in the choice of ends to be pursued and in emancipation from personal prejudice. Even an end which it would be noble to pursue if it were attainable may be pursued unwisely if it is inherently impossible of achievement. Many men in past ages devoted their lives to a search for the philosopher's stone and the elixir of life. No doubt, if they could have found them, they would have conferred great benefits upon mankind, but as it was their lives were wasted.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2   B. Sc. Engineering Examinations 2011-2012

Sub: **MATH 143** (Integral Calculus, Ordinary & Partial Differential Equations & Series Solutions)

Full Marks: 280   Time: 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

Symbols used have their usual meaning.

1.   (a) Workout the following integrals: **(24)**

   (i) $\int \dfrac{x^3}{\left(2+3x^2\right)^{5/2}}\, dx$,   (ii) $\int \sin^2 x \cos^6 x\, dx$

   (b) Obtain the reduction formula for $\int e^{\alpha x} \cos^n x\, dx$.   **(11)**

   (c) Find the value of $\displaystyle\int_0^{\pi} \dfrac{x \tan x}{\sec x + \tan x}\, dx$.   **(11⅔)**

2.   (a) Show that $\beta(m,n) = \dfrac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$.   **(18)**

   (b) Determine the area inside the circle $r = \sin\theta$ and outside the cardioide $r = 1-\cos\theta$.   **(14)**

   (c) Find the perimeter of the loop of the curve $9ay^2 = (x-2a)(x-5a)^2$.   **(14⅔)**

3.   (a) Find the differential equation of all circles of radius a.   **(10⅔)**

   (b) Solve the following: **(3×12=36)**

   (i) $x\cos\left(\dfrac{y}{x}\right)(y\,dx + x\,dy) = y\sin\left(\dfrac{y}{x}\right)(x\,dy - y\,dx)$.

   (ii) $\dfrac{dy}{dx} + \dfrac{x-y-2}{x-2y-3} = 0$.

   (iii) $\left(1+y^2\right)dx = \left(\tan^{-1} y - x\right)dy$.

4.   (a) Find the general solution of the following differential equations:

   (i) $\left(D^2 + 2D + 1\right)y = x\cos x$.   **(14)**

   (ii) $\left(x^4 D^4 + 6x^3 D^3 + 9x^2 D^2 + 3xD + 1\right)y = (1+\log x)^2$.   **(16)**

   (b) Solve $\left[xD^2 + (x-1)D - 1\right]y = x^2$ by the method of factorization of operators.   **(16⅔)**

MATH 143

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. Solve the following:

   (a) $p\cos(x+y)+q\sin(x+y)=z$ **(15)**

   (b) $(p^2+q^2)y-qz=0$ **(14)**

   (c) $p^2+q^2-2px-2qy+1=0$ **(17⅔)**

6. Solve the following higher order PDEs:

   (a) $(3D_x^2+7D_xD_y+2D_y^2)z=e^{x+3y}x^2y^2$ **(17⅔)**

   (b) $(2D_x-5D_y+6)(3D_x+2D_y-3)z=\cos(2x+3y)$ **(15)**

   (c) $(x^2D_x^2-y^2D_y^2+xD_x-yD_y)z=\log x$ **(14)**

7. (a) Show that $J_{\frac{1}{2}}(x)=\sqrt{\dfrac{2}{\pi x}}\left(\dfrac{\sin x}{x}-\cos x\right)$ **(15)**

   (b) Prove that $\dfrac{d}{dx}\left[J_n^2(x)+J_{n+1}^2(x)\right]=2\left\{\dfrac{n}{x}J_n^2(x)-\dfrac{n+1}{x}J_{n+1}^2(x)\right\}$.   **(16⅔)**

   (c) Show that $J_n(x)=\dfrac{1}{\pi}\int_0^\pi\cos(n\phi-x\sin\phi)d\phi$ where n is a positive integer.   **(15)**

8. (a) Show that $P'_{n+1}(x)-P'_{n-1}(x)=(2n+1)P_n(x)$.   **(10)**

   (b) Solve in series the following differential equation by using the method of Fröbenius:

   $x\dfrac{d^2y}{dx^2}+\dfrac{dy}{dx}+xy=0$.   **(36⅔)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2   B. Sc. Engineering Examinations 2011-2012

Sub : **CHEM 113** (Chemistry I)

Full Marks : 210   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) How does heat evolve or absorb during dissolution of solute in a solvent? **(11)**

    (b) Explain the principle underlying the process of steam distillation. **(6)**

    (c) A mixture of an organic compound (M.W. 123) which is immiscible with water has a boiling point of 99 °C at 760 mm pressure. If the vapour pressure of water is 733 mm, calculate the ratio by weight of the two substances in the distillate. **(9)**

    (d) Explain the following terms: (i) Ideal solution, (ii) Salting out effect, (iii) Critical Solution Temperature (CST). **(3×3)**

2. (a) What are colligative properties? What is meant by the relative lowering of vapour pressure? Mention the application of lowering of vapour pressure in determining the molecular weight of a dissolved substance. **(3×3)**

    (b) Thermodynamically prove that the elevation of boiling point of a solvent produced by a dissolved non-volatile substance is proportional to mole fraction and also to molality of the substance in the solution. **(12)**

    (c) Calculate the boiling point of the solution containing 12.5 g of benzoic acid ($C_7H_6O_2$) in 110 g of benzene (C_6H_6). The boiling point of benzene is 80.1 °C and its K_b is 2.53 °C.m^{-1}. **(8)**

    (d) Derive Van't Hoff equation for the osmotic pressure of a dilute solution. **(6)**

3. (a) Derive Gibb's phase rule thermodynamically. Draw the phase diagram of water system and describe its main feature. **(6+6)**

    (b) What is internal energy of a system? How is it related to the enthalpy of the system? **(6+5)**

    (c) What are the factors affecting the enthalpy change of a reaction? **(5)**

    (d) The heat of the reaction of the reaction N_2 (g) + $3H_2$ (g) $\rightleftharpoons$ $2NH_3$ (g) at 27 °C was found to be –21.97 Kcal. What will be the heat of reaction at 100 °C? The molar heat capacities at constant pressure for nitrogen, hydrogen and ammonia are 6.80, 6.77 and 8.86 cal/mol.deg respectively. **(7)**

4. (a) What are photons? What role did Einstein's explanation of the photoelectric effect play in the development of the particle-wave interpretation of the nature of electromagnetic radiation? **(12)**

    (b) What do you mean by Eigen values and Eigen functions? **(8)**

    (c) Group the species that are isoelectronic Be^{2+}, F^-, Fe^{2+}, N^{3-}, He, S^{2-}, Co^{3+}, Ar. **(8)**

    (d) Ionization energy is usually measured in the gaseous state. Why? **(7)**

CHEM 113

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Define order of reaction. Show how you can determine the order of reaction by (i) half-life method and (ii) differential method. **(11)**

(b) Derive an expression for the rate constant of a second order reaction. What are the characteristic features of a second order reaction? **(16)**

(c) The decomposition of a gas follows second order kinetics. It takes 40 minutes for 40% of the gas to be decomposed when the initial concentration is 4×10^{-2} molL^{-1}. Calculate the specific reaction rate. **(8)**

6. (a) Define reversible cell. Give an example and explain how it is reversible. **(11)**

(b) Establish a relation between the emf of a reversible cell and the heat of reaction in the cell. **(14)**

(c) At 25 °C the value of the emf for the reversible cell **(10)**

$$\text{Pb, PbCl}_2 \text{ (s) } | \text{ KCl (aq) } | \text{ AgCl (s), Ag}$$

is 0.4902 volt and $\left(\frac{\partial E}{\partial T}\right)_p = -1.86 \times 10^{-4}$ volt deg^{-1}. Calculate the values of ΔG and ΔH showing the reaction involved in the cell.

7. (a) Define buffer solution and buffer capacity. **(6)**

(b) Establish the condition for maximum buffer capacity. **(12)**

(c) Explain what is meant by the diagonal relationship. List two pairs of elements that show this relationship. **(8)**

(d) State the general periodic trends in size of atomic radii. Arrange the following atoms in order of decreasing atomic radius: **(9)**

$$\text{Na, Al, P, Cl, Mg}$$

8. (a) Discuss the basic features of the VSEPR model. Explain why the magnitude of repulsion decreases in this order: lone pair-lone pair > lone-pair-bond pair >bond pair pair-bond pair. **(13)**

(b) Explain the significance of bond order. Can bond order be used for quantitative comparison of the strength of chemical bonds? Explain why bond order of N_2 is greater than that of N_2^+ but the bond order of O_2 is less than that of O_2^+. **(12)**

(c) Predict whether each of the following molecules has a dipole moment : BrCl; BF$_3$; CH$_2$Cl$_2$. **(6)**

(d) What are the limitations of Bohr's atomic theory? **(4)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2   B. Sc. Engineering Examinations 2011-2012

Sub : **CSE 103** (Discrete Mathematics)

Full Marks: 210   Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Argue whether the following sentences correspond to propositions: (3×3=9)

   (i) Shohag is a liar.

   (ii) I am a liar.

   (iii) There is a cook in a village who cooks food for those who do not cook for themselves.

   (b) Use quantifiers and predicates to express the fact that $\lim_{X \to a} f(X)$ does not exist.   (14)

   (c) Translate each of these statements into logical expressions, using quantifiers, predicates, and logical connectives.   (6×2=12)

   (i) No one is perfect.

   (ii) Not everyone is perfect.

   (iii) All your friends are perfect.

   (iv) One of your friends is perfect.

   (v) Every one is your friend.

   (vi) Not everybody is your friend or someone is not perfect.

2. (a) Prove that $\overline{(A \cup B)} = \overline{A} \cap \overline{B}$.   (10)

   (b) Write a short note on one-to-one, onto, inverse and composition of functions.   (12)

   (c) Prove that the set of real numbers is an uncountable set.   (13)

3. (a) If n is a positive integer, then n cents in change using quartets (25 cents), dimes (10 cents), nickels (5 cents), and pennies (1 cent) possible has at most two dimes, at most one nickel, at most 4 pennies, and cannot have two dimes and a nickel. The amount of change in dimes, nickels and pennies cannot exceed 24 cents. Prove these statements.   (15)

   (b) Write down an algorithm for finding $b^n \bmod m$. Compute $3^{644} \bmod 645$.   (20)

CSE 103

4. (a) A man has 2 sons, 3 daughters, 5 grandsons and 7 granddaughters. If he distributes his money among sons Taka 1 is left, whereas if distributed among daughters Taka 2 is left, if distributed among grandsons then Taka 3 is left, whereas distribution among only granddaughters leaves Taka 4 undistributed. What is the minimum amount of Taka he can have? **(15)**

    (b) Encrypt the word STOP using RSA with $p=43$, $q=59$, $n=43\times59=2537$ and $e=13$ by replacing letters by corresponding positions in the alphabet. **(20)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Prove that every sequence of $n^2 + 1$ distinct real numbers contains a subsequence of length $n + 1$ that is either strictly increasing or strictly decreasing. **(12)**

    (b) Let A be a set with n elements, and let R be a relation on A. If there is a path of length at least one in R from a to b, then there is such a path with length not exceeding n. Moreover, when $a \neq b$, if there is a path of length at least one in R from a to b, then there is such a path with length not exceeding n–1. **(15)**

    (c) Suppose $A = \{a,b,c\}$ and R be a relation on A with $R = \{(a,a), (a,c), (b,b), (c,a), (c,b)\}$. Find the transitive closure of the relation R. Show the steps of your calculation. **(8)**

6. (a) Let c_1 and c_2 be real numbers. Suppose that $r_2 - c_1 r - c_2 = 0$ has two distinct roots r_1 and r_2. Show that the sequence $\{a_n\}$ is a solution of the recurrence relation $a_n = c_1 a_{n-1} + c_2 a_{n-2}$ if and only if $a_n = \alpha_1 r_1^n + \alpha_2 r_2^n$ for $n = 0, 1, 2 ...$, where α_1 and α_2 are constants. **(15)**

    (b) Find a recurrence relation for the number of bit strings of length n that do not contain three consecutive 0s. Also find the solution of the resultant recurrence relation. **(7+8=15)**

    (c) How can you express the number of comparisons used by merge sort using recurrence relation? **(5)**

7. (a) Show that among any $n + 1$ positive integers not exceeding 2n there must be an integer that divides one of the other integers. **(7)**

    (b) Let $A_1, A_2, ..., A_n$ be finite sets. Prove that **(8)**

    $$|A_1 \cup A_2 \cup \cdots \cup A_3| = \sum_{1 \le i \le n}|A_i| - \sum_{1 \le i < j \le n}|A_i \cap A_j|$$
    $$+ \sum_{1 \le i < j < k \le n}|A_i \cap A_j \cap A_k| - \cdots + (-1)^{n+1}|A_1 \cap A_2 \cap \cdots \cap A_n|$$

    (c) Find the number of derangements of n objects. **(10)**

    (d) Prove that there are at most m^h leaves in an m-ary tree of height h. **(10)**

CSE 103

8. (a) At a party there are n hosts and m guests. Each guest shakes hand with each host and each guest also shakes hand with each other guests. How can you find the total number of handshakes using a graph model? **(6)**

(b) Let f is a one-to-one correspondence between the vertex set of graph G and the vertex set of graph H defined as $f(u_1) = v_1, f(u_2) = v_2, f(u_3) = v_4, f(u_4) = v_3, f(u_5) = v_5,$ $f(u_6) = v_7, f(u_7) = v_6, f(u_8) = v_8$. Show whether f is isomorphism or not. **(6)**
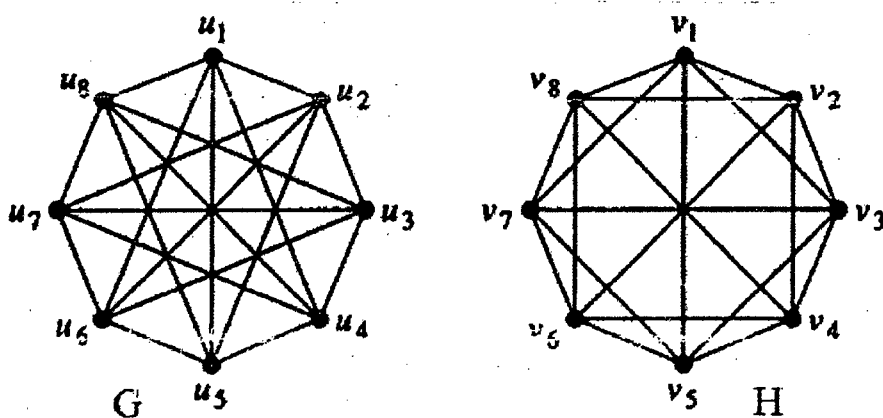
(c) Let G be a connected planar simple graph with e edges and v vertices. Let r be the number of regions in a planar representation of G. Then show that $r = e - v + 2$. **(17)**

(d) How can you search for items in a list efficiently using trees? Describe with an example. **(6)**